

INTRODUCTION

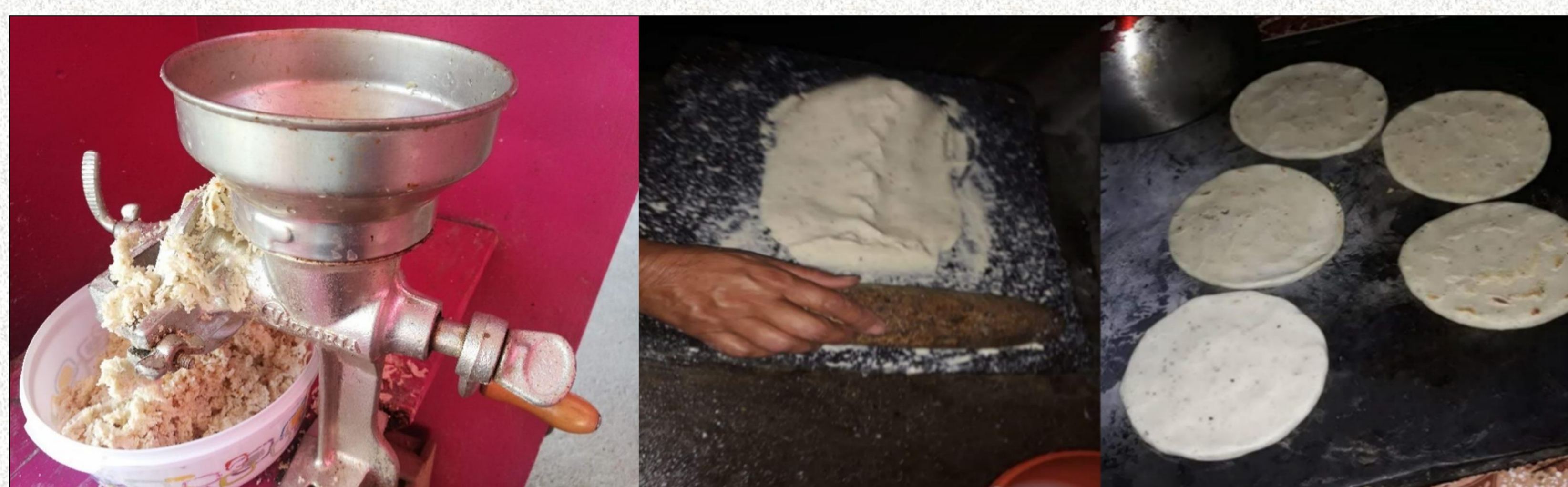
- In Honduras, corn is the most important staple food for the majority of the population. This high-demand crop is susceptible to biological contamination with mycotoxins, which could represent a latent hazard for consumers.
- Mycotoxins are secondary metabolites produced in the differentiation and sporulation phase of toxigenic fungal species and can be in all phenological stages of corn cultivation¹.
- Aflatoxins and fumonisins are the highest incidence in kernels, both mycotoxins are chemically stable and heat-resistant, they can be present in the food of the final consumer².
- Sufferings by high intake of mycotoxins are associated with liver and esophagus cancer, damage to the neural tube during the gestation period, growth children problems, and renal diseases³.
- The maximum limits allowed in corn kernels are 20 ppb for total aflatoxins and 4 ppm for total fumonisins⁴.

OBJECTIVES

- Determine the incidence of aflatoxins and fumonisins in corn kernels, masa, and tortillas from four municipalities in the Lempira department, Honduras.
- Estimate the risk of mycotoxin dietary exposure in the communities under study.



Maize varieties grown in Lempira, Honduras.



Tortilla making traditional process.



Maize varieties grown in Lempira, Honduras.

METHODOLOGY

Samples collected

Producers interviewed were 48, from La Campa, Gracias, Lepaera and San Marcos de Caiquín communities. Information about system of planting, harvesting, post-harvest and making tortillas was obtained. Samples of corn, masa and tortillas were collected from each of the families interviewed.

Toxins quantification

Density, temperature and moisture content of the samples were measured, kernel samples greater than 13% moisture were subjected to an oven drying process. Total aflatoxins and fumonisins were quantitated using fluorometric method and competitive enzyme-linked immunosorbent assays (ELISA) through VICAM "FumoniTest™" and "AflaTest™" immunoaffinity columns. Method 991.31 was used for aflatoxins and 2001.06 for fumonisin, proposed by the AOAC.

Exposure risk

It was calculated from the daily corn intake and average levels of fumonisin and aflatoxin contamination found in samples evaluated tortillas. Also, the body weight (bw) was considered 60 kg for an adult. The risk of exposure was estimated by municipality, considering different amounts of daily corn intake.

RESULTS AND DISCUSSION

- Samples contaminated by aflatoxins were 65%, with levels between 1.28 to 32.05 for kernels, 1.15 to 12.61 for masa, and 1.01 to 5.98 µg/kg for tortillas.
- Samples contaminated by aflatoxins were 100%, with levels between 0.82 to 28.04 for kernels, 0.66 to 14.36 for masa, and 0.63 to 12.04 mg / kg for tortillas.
- The reduction of aflatoxins was 83% and fumonisins 52% due to the processing of kernel to tortilla.
- Postharvest grain management and the nixtamalization process affect the incidence of mycotoxins in corn-based products⁵.
- Per capita consumption of tortillas calculated was 490 g/day, it was estimated that the dietary exposure is high in the communities. The levels were 0.003 to 0.073 µg/kg bw/day for aflatoxins and from 6.16 to 151.98 µg/kg bw/day for fumonisins.
- Daily intake limit for aflatoxins is 0.001 µg/kg and for fumonisins is 2 µg/kg⁶.

Table 1. Aflatoxins incidence (µg/kg), by products and municipality.

Products	Municipality			
	Gracias	La Campa	Lepaera	San Marcos de Caiquín
Corn kernels	8.34 ± 4.31 ^A	4.36 ± 3.60 ^A	6.88 ± 8.29 ^A	9.04 ± 7.67 ^A
Masa	4.66 ± 2.95 ^B	3.41 ± 1.75 ^B	3.08 ± 2.00 ^B	5.28 ± 4.18 ^B
Tortilla	3.34 ± 1.78 ^B	1.87 ± 0.98 ^B	1.51 ± 1.87 ^B	3.92 ± 3.61 ^B
Pr > F	< 0.0001	0.003	0.001	< 0.0001

Table 2. Fumonisin incidence (mg/kg), by products and municipality.

Products	Municipality			
	Gracias	La Campa	Lepaera	San Marcos de Caiquín
Corn kernels	5.66 ± 7.71 ^A	6.20 ± 9.42 ^A	9.48 ± 11.99 ^A	3.59 ± 4.37 ^A
Masa	1.88 ± 2.54 ^B	1.45 ± 3.22 ^B	3.07 ± 4.29 ^B	1.17 ± 1.41 ^B
Tortilla	1.08 ± 1.62 ^B	1.02 ± 1.59 ^B	1.51 ± 1.87 ^B	0.62 ± 0.76 ^B
Pr > F	0.000	0.032	0.003	0.0002

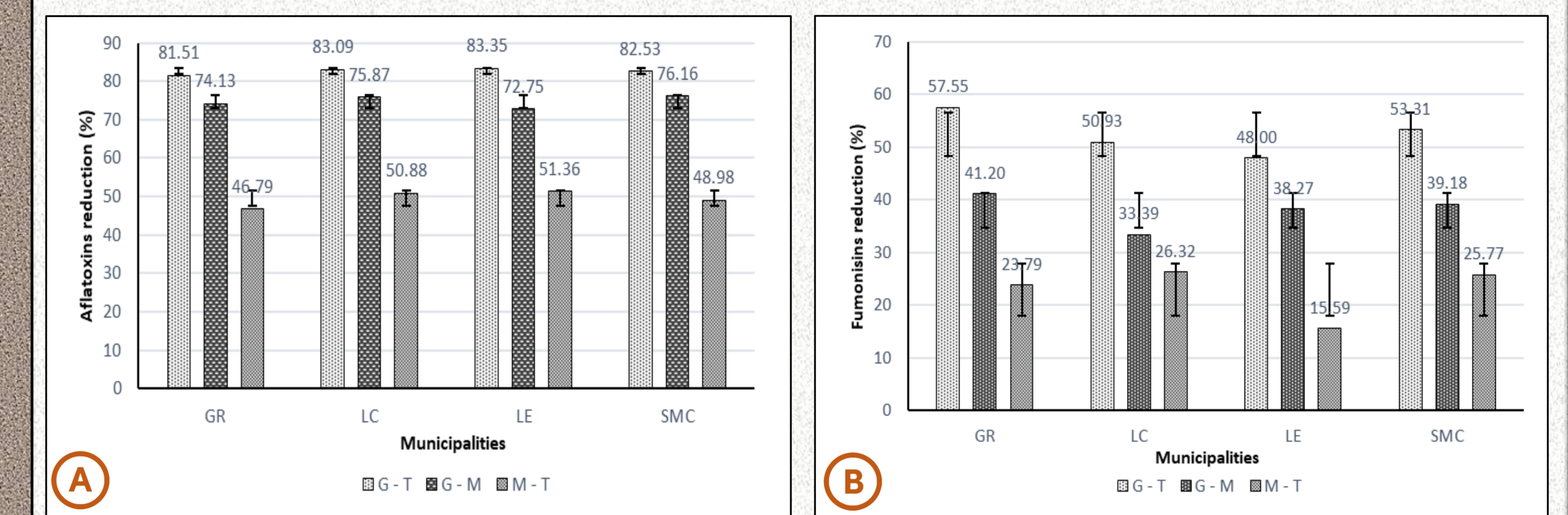


Figure A and B. Aflatoxins and fumonisin reduction (%) after grains were processed into tortilla (G-T), grain to masa (G-M) and masa to tortillas (M-T).

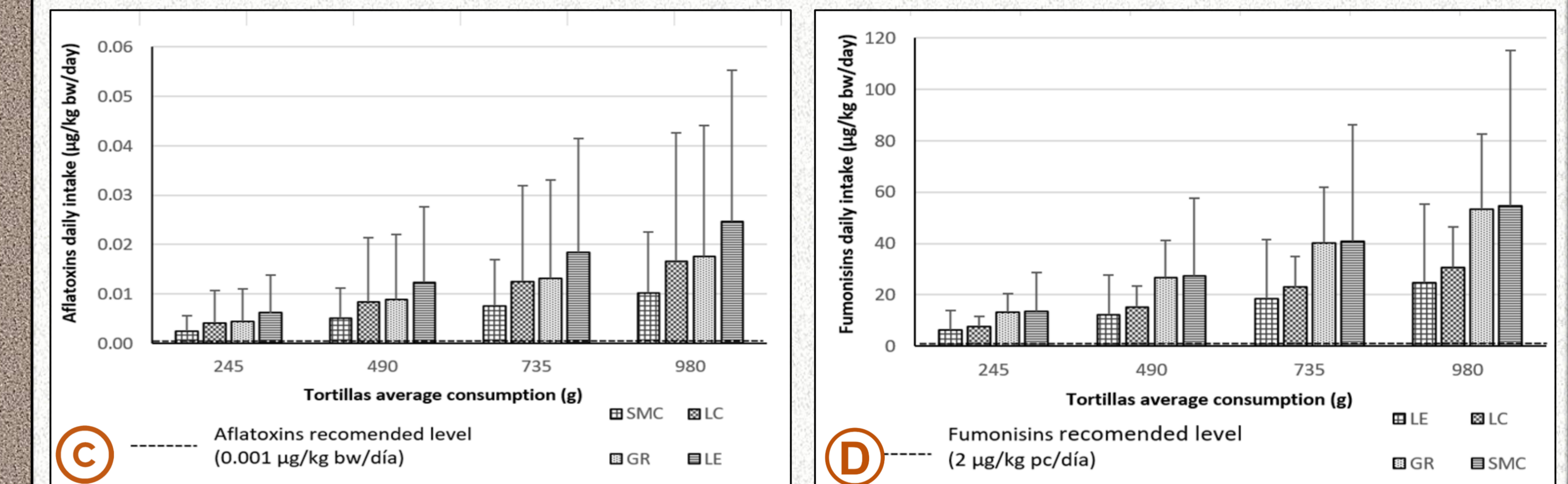


Figure C and D. Exposure risk by aflatoxins and fumonisins daily intake (µg/kg bw/day) for maize tortillas in the four communities.

CONCLUSIONS

- In the municipalities of Gracias, La Campa, San Marcos de Caiquín and Lepaera, there was a higher incidence of fumonisins than aflatoxins. Masa and tortilla samples had a considerable reduction of aflatoxins, and a lower percentage of fumonisins, when compared to kernels.
- Traditional chemical and thermal processes of nixtamalization reduced the levels of aflatoxin and fumonisin contamination in masa and tortillas. This reduction was influenced by the amount of calcium hydroxide and washing steps of the nixtamal. It is important to create programs to disseminate awareness of preventive and corrective measures associated with the corn production chain.
- Regulatory actions are required to establish permissible levels of contamination and intake of aflatoxins and fumonisins, considering the country context and the high demand for consumption of corn products.

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