



Corn Masa in the United States

Supply Chain, Market, and Fortification



**Food
Fortification
Initiative**

Enhancing Grains for Healthier Lives

Acknowledgements

This report would not exist without the hard work of Scott Hafemeyer and Fritz Piel. Their investigations on behalf of the Food Fortification Initiative have provided an understanding of the previously unclear structure of the corn masa market in the United States. We would also like to thank Rodrigo Ariceaga for sharing his expertise in this area. Special thanks to Sharon Bustrak, Scott Montgomery, and Jalisa Starling for their contributions.

The Food Fortification Initiative's support of this project was provided as a subcontractor of G2S Corporation. The contract was awarded to G2S to support the Centers for Disease Control and Prevention's National Center on Birth Defects and Developmental Disabilities.

Food Fortification Initiative

The Food Fortification Initiative (FFI) champions effective grain fortification so people have the nutrients they need to be smarter, stronger, and healthier. The only global group that focuses exclusively on the world's most commonly consumed cereal grains (industrially milled wheat flour, maize flour, and rice), FFI helps country leaders plan, implement, and monitor sustainable, country-led fortification programs. FFI also tracks country and global progress in grain fortification. By engaging public, private, and civic stakeholders, FFI's data-driven approach effectuates large-scale change. Established in 2002, FFI is based at Emory University's Rollins School of Public Health.

Executive Summary

Despite mandatory fortification of enriched cereal grains, rates of neural tube defects continue to be seen at disproportionate rates among Hispanic populations in the United States. Due to classification differences related to how corn masa is manufactured, this staple of Hispanic communities was not captured in the enriched cereal grain category. In response to a petition by a coalition of non-profits and masa industry partners, in 2016 the Food and Drug Administration added corn masa flour to the list of foods that may be voluntarily fortified with folic acid. This report concludes that voluntary fortification of corn masa flour has resulted in **approximately 5.8% of corn masa products in the US being fortified with folic acid**. Recent studies have found that there has been no significant change in rates of neural tube defects among Hispanic women following voluntary fortification, an outcome that aligns with the findings of this report. In light of this evidence, FFI will continue its assessment of fortified products that are available to consumers in order to further inform strategies to increase the availability of culturally appropriate fortified foods.

Suggested citation: Food Fortification Initiative. "Corn Masa in the US: Supply Chain, Market, and Fortification". FFI: Atlanta, USA, 2024. Accessed at <https://www.ffinetwork.org/united-states-of-america/?record=231>

Contents

Acknowledgements.....	2
Executive Summary.....	2
Figures, Tables, and Abbreviations.....	4
Part One:	5
Background	5
Part Two:	7
Production and Market	7
Methods.....	7
Manufacturing Process	10
Dry Corn Milling (Non-masa Products)	10
Corn Masa Milling	11
Supply Chain.....	12
Corn Masa Flour Producers.....	12
Dry Masa Product Manufacturers.....	14
Wet Masa Product Manufacturers.....	14
Import/Export	15
Consumption of Masa Products.....	16
Segmentation	16
Distribution.....	17
Current State of Fortification	18
References	21

Figures, Tables, and Abbreviations

Figures

Figure 1 - Hispanic Population in the US.....	6
Figure 2 - Corn Masa Supply Chain	9
Figure 3 - Dry Corn Milling	10
Figure 4 - Corn Kernel Components	11
Figure 5 - Corn Masa Manufacturing	12
Figure 6 - Map of CMF Producers	13
Figure 7 - Corn Masa Tortilla Chips.....	15
Figure 8 - Fortified CMF Bags	19
Figure 9 - Fortified Corn Masa.....	20

Tables

Table 1 - Dry Masa (CMF) Manufacturers	14
Table 2 - Dry Masa Product Manufacturers	14
Table 3 - Wet Masa Product Manufacturers	15
Table 4 - Imports	16
Table 5 - Exports.....	16
Table 6 - Masa Product Segmentation	17
Table 7 - Masa Distribution Channels.....	17
Table 8 - Masa Product Retailers.....	17

Terms and Abbreviations

- **CAGR:** compounded annual growth rate
- **CMF:** corn masa flour
- **Enrichment:** the adding back in of nutrients lost during the processing of a food
- **Extrusion:** pushing a substance through a die opening to form it into shapes
- **FDA:** the United States’ Food and Drug Administration
- **Fortification:** the addition of nutrients to foods to increase their health benefits
- **IRI:** Information Resources, Inc
- **Maize:** another, more broadly used, word for corn
- **Masa:** a dough made from corn soaked in a lime and water solution
- **MT:** metric tons
- **Nixtamalization:** the process of washing corn that has been soaked in an alkaline solution to remove the majority of the pericarp layer of the corn kernel
- **NTD:** neural tube defect
- **TIA:** Tortilla Industry Association
- **Tortilleria:** a small-scale producer of tortillas
- **UPC:** Universal product code
- **WHO:** the United Nation’s World Health Organization



Part One: Background

Neural tube defects (NTDs) are birth defects of the brain and spine that affect between 214,000 and 322,000 pregnancies globally each year (1). The neural tube fails to close during these pregnancies, resulting in outcomes such as anencephaly or spina bifida (2). Approximately 50% – 70% of NTDs are folic acid sensitive, meaning they may be preventable with sufficient folic acid intake before and during pregnancy (3).

Beginning in 1998, the Food and Drug Administration (FDA) of the United States (US) mandated that any enriched cereal grain products must contain between 0.43 and 1.4 mg/lb of folic acid as a public health measure to reduce the risk of NTDs (4). This move resulted in a 35% reduction in NTDs nationwide, and a 72% reduction in severe upper lesion level spina bifida cases (5,6). Despite these efforts, Hispanic women in the US continue to experience higher rates of NTDs than any other subpopulation (5). The US Office of Management and Budget defines “Hispanic or Latino” as “a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race” (7). This is the definition used by the US Census Bureau and all other federal agencies. Individuals taking the Census or surveys can choose to self-identify as part of these broadly defined categories. While there are other terms, such as Latine, that parts of the community advocate as more neutral, many studies use Census data and the previously mentioned terms and as such this report does as well (8).

Differences in grain consumption patterns between Hispanic populations and other groups may be partially responsible for the disparity in NTD rates (9). Certain Hispanic cultures, in particular Mexican and Central American cultures, may consume more corn masa-based foods as compared to enriched wheat flour products, and corn masa products did not fall under the 1998 FDA standard regarding enriched cereal grains (10). In an effort to address this gap, in 2012 a coalition of non-profits and corn masa producers petitioned the FDA to allow voluntary fortification of corn masa flour (CMF) with folic acid (11). The FDA approved the petition, allowing the addition of up to 0.7 mg/lb of folic acid (12). No lower limit was established. Recent studies show no significant impact on NTD rates among Hispanic women in the intervening years (3,13). Surveys of corn masa products in stores suggest there has not been widespread uptake of folic acid fortification of CMF (14,15), and the Center for Science in the Public Interest found that only 14% of CMF products sampled

contained folic acid (2). Therefore, while there have been no significant changes in NTD rates in the target population, it appears there has also been no significant change in the amount of fortified masa.

Corn masa is used in many food products. It is important to note that a key difference between masa and other corn products is the use of lime or other alkaline materials during processing (16). This addition increases the bioavailability of certain nutrients and impacts the flavor profile (16,17). The most commonly consumed corn masa products are tortillas, whether made at home, in a restaurant, or mass produced at a factory (18). Masa and corn tortillas are also used in other products such as (19):

- Corn chips – masa that is pushed through a die to form it into shapes prior to baking and/or frying. Fritos fall into this category.
- Enchiladas – tortillas filled with meat, cheese, and/or vegetables, covered in sauce, and baked.
- Pupusas – thick, stuffed, fried tortillas.
- Tamales – masa stuffed with a filling, wrapped, and steamed. Fillings and wrappings vary between restaurants and regions.
- Taco shells – tortillas fried into a hard, U-shaped shell.
- Tortilla chips – tortillas that are cut into smaller pieces and baked and/or fried. Doritos and Takis are examples of tortilla chips.
- Tostadas – tortillas fried flat and used as a base (rather than a wrap) for toppings.

Corn masa flour fortification is of particular public health interest in part due to the steady increase of the US Hispanic population (Figure 1). The US Census Bureau predicts that by 2025, Hispanic individuals will make up 20% of the US population. Part of this growth will continue to come from immigration, where about one third of immigrants are Hispanic (20). Addressing NTD disparities among Hispanic or Latino individuals will only become a more pressing public health challenge as time goes on. As such, this report analyzes the US corn masa industry, current fortification coverage, and remaining gaps to build strategies that increase the proportion of corn masa that is fortified with folic acid.

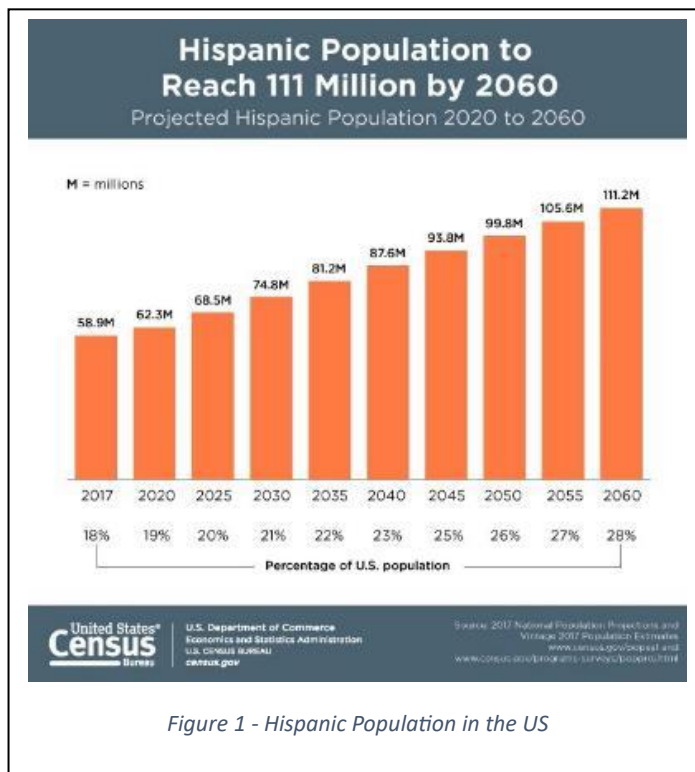



Figure 1 - Hispanic Population in the US



Part Two:

Production and Market

Methods

The information presented in this report was gathered from trade conventions, interviews with masa industry professionals, educational sessions, web-based searches, in-store surveys, journal articles, equipment and ingredient vendors, market research firms, and public interest groups.

Interviews provided both qualitative and quantitative data and were an extremely important part of this research due to the complexity and opacity of the corn masa industry. Interviewees included past and present masa industry senior executives, as well as individuals in positions with titles such as:

- Quality, food safety, research and development director
- Sales and/or marketing director
- Technical and/or operations manager
- Strategic business development professional
- Process engineer
- Equipment and ingredient manufacturing representative
- Consumer relations representative
- Food science professor
- Public health consultant

Some sources requested anonymity and as such may be referred to simply by their position or association with the corn masa industry.

Research into the corn masa market is at times made more difficult by unclear food labels. Videos available on YouTube show how Fritos and Doritos are made, referring to the dough used to produce these popular snack products as “masa” (21). However, as opposed to corn masa flour packaging, the labels for Fritos and other chip products do not list masa or lime as an ingredient, only corn. Frito-Lay consumer relations was contacted to ask if lime, wood ash, or other alkaline materials were added to the corn while soaking prior to being

processed into Fritos or Doritos. Their reply was, “Processing aids are not part of our ingredient information, so we are unable to provide the detail you are seeking.” However, in the corn milling industry, corn masa exclusively refers to products where the corn has been soaked in lime or other alkaline solutions prior to further processing (22). It is therefore likely Frito-Lay does use corn masa for some of its snack products. This is an example of an assumption the research team made in order to describe the corn masa market in the US.

There were other challenges to finding pertinent data. On the company level, the US Department of Commerce assigns NAICS (North American Industry Classification System) codes to manufacturers, which can be used to obtain industry data. However, many masa industry product manufacturers are conglomerates and therefore fall under multiple codes, making it difficult to accurately separate out what portions of their data are or are not useful for the analysis. At the product level, Information Resource Inc. (IRI) gathers scanned UPC (Universal Product Code) data from various retailers to collate and publish tortilla industry data. However, less than one third of all tortilla sales are through chain retailers, creating an incomplete picture of the market. Similarly, a large portion of tortillas are used in other products like burritos, wraps, and frozen entrees, and therefore are not recorded as a tortilla sale. Corn masa tortillas and products made on-site at Mexican restaurants and grocery stores are not assigned UPC codes, making these volumes unobtainable. For these reasons, the multiple sources previously mentioned were used to obtain what masa industry data were available. These were then cross-referenced with other sources to the extent possible and reviewed by subject matter experts within the industry for verification. All relevant findings were analyzed and used to create a model of the current corn masa industry supply chain.

This supply chain model (Figure 2) also includes calculations based on extrapolations of the data collected. Annual volumes, processing capacities, industry standard yields, and capacity utilizations were used to estimate the amount of corn processed into masa. Product segmentation percentages and median compounded annual growth rates were applied to consumption volumes to obtain estimates of volumes over time. Market share percentages were calculated within each supply chain element. The percentage of masa fortified with folic acid was calculated by dividing the amount of finished masa products known to be fortified by the total annual corn masa volume. As mentioned, due to scarce data the calculations required assumptions, which were based on market intelligence, industry knowledge, and historical data.

This report structure is based on the supply chain model. The following sections detail the corn masa manufacturing process, producers of corn masa flour and other masa products, import/export trends, consumption patterns, and the current state of fortification.

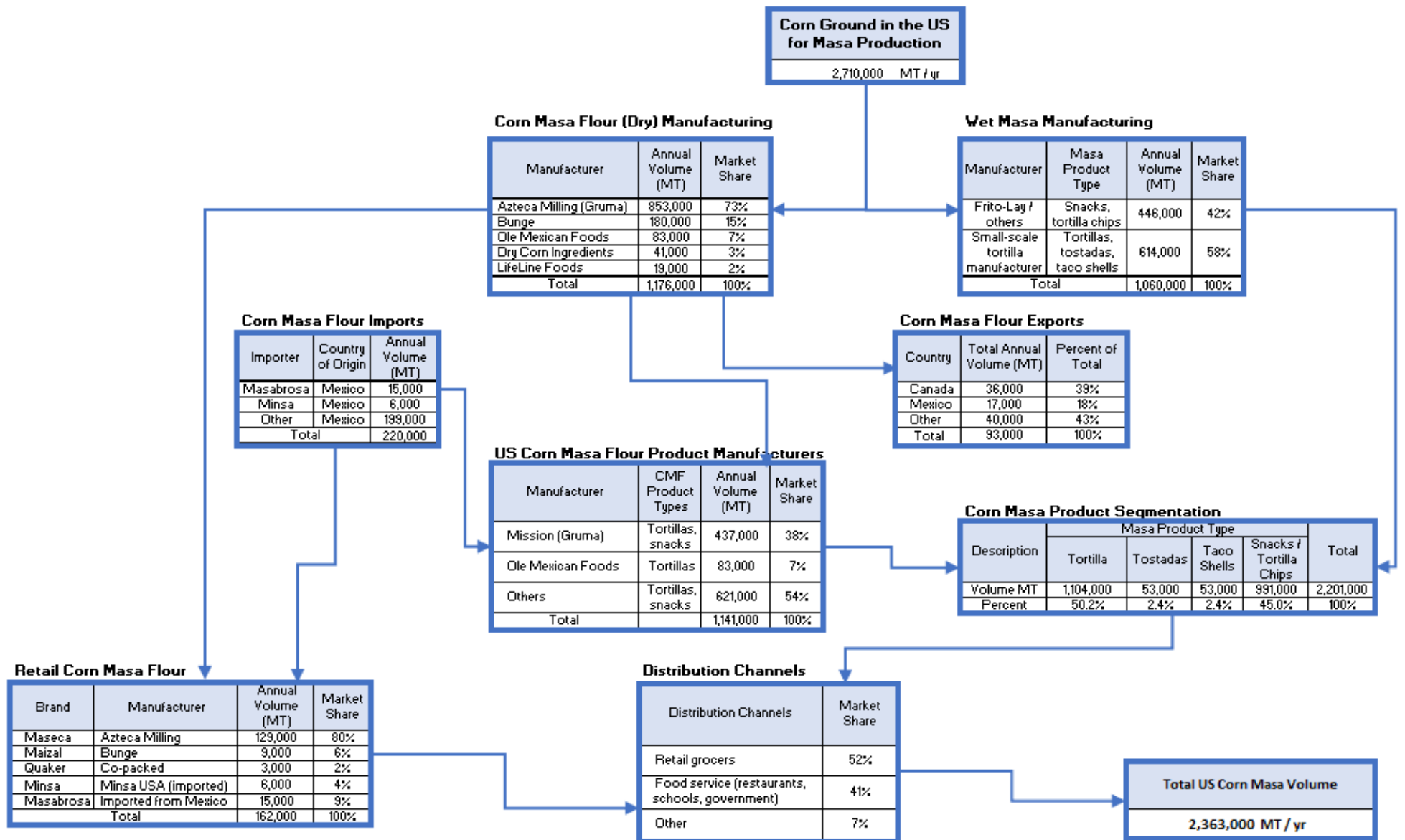


Figure 2 - Corn Masa Supply Chain

MT: metric tons

Manufacturing Process

Dry Corn Milling (Non-masa Products)

Unlike corn masa, other milled corn products (specifically enriched corn grits and corn meal) were included in the 1998 FDA rule on enriched grain products (4). Breakfast cereals such as Corn Flakes are also permitted to have folic acid as a food additive (23). The main difference between corn masa and other corn products is the manufacturing process.

The modern dry corn milling process used in the US to make flaking grits (used for Corn Flakes), corn grits (used to make snacks such as Cheetos), brewers' grits (used to make beer), corn meal (used for breading, coatings, and to make Funyuns), and corn flour (used for baking) is depicted below in Figure 3. These products are made by adding hot water to whole kernels of corn that have been cleaned and then holding them in a tank for a brief period to soften the pericarp (hull). A machine scours the kernels to remove the pericarp, bran, germ, and tip cap from the endosperm (Figure 4) in a process referred to as degermination. The endosperm is then dried, cooled, ground by roller mills, and sifted to produce the various granulations of flaking grits, corn grits, brewers' grits, corn meal, and corn flour. The pericarp, bran, germ, tip cap, and fine endosperm are by-products that become animal feed after being dried and cooled. Some mills use a technology referred to as the Beal degermination process to separate the various components of the corn kernel that enables the germ to be recovered and processed into corn oil.

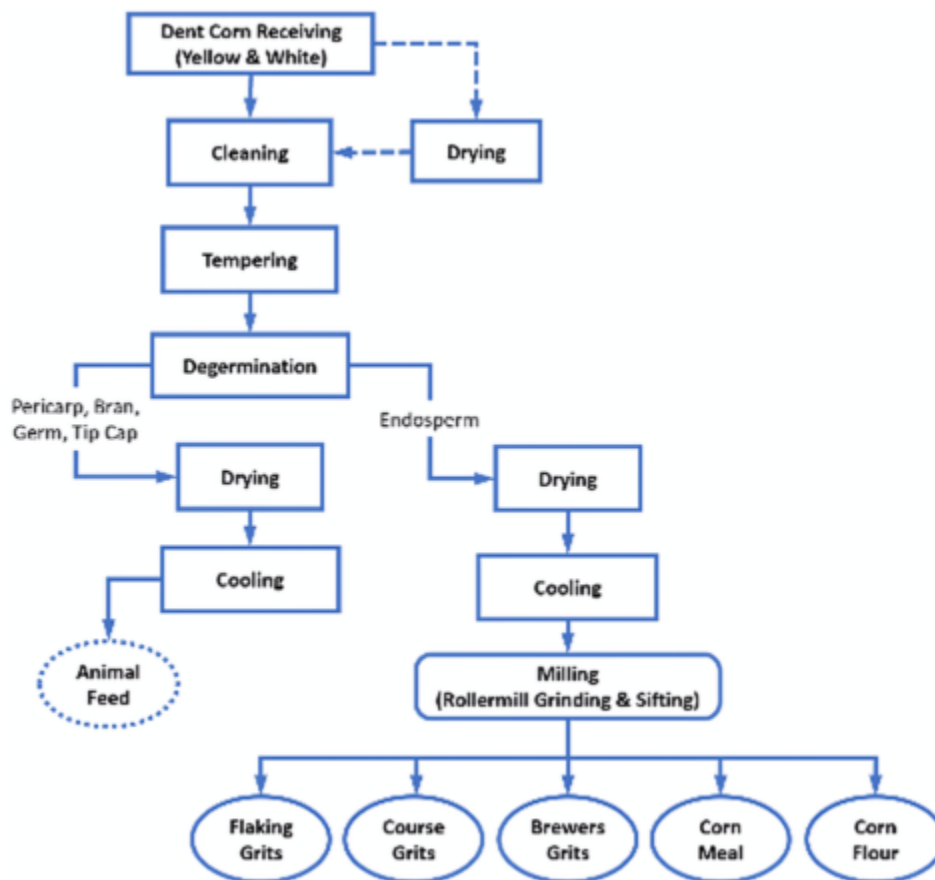


Figure 3 - Dry Corn Milling

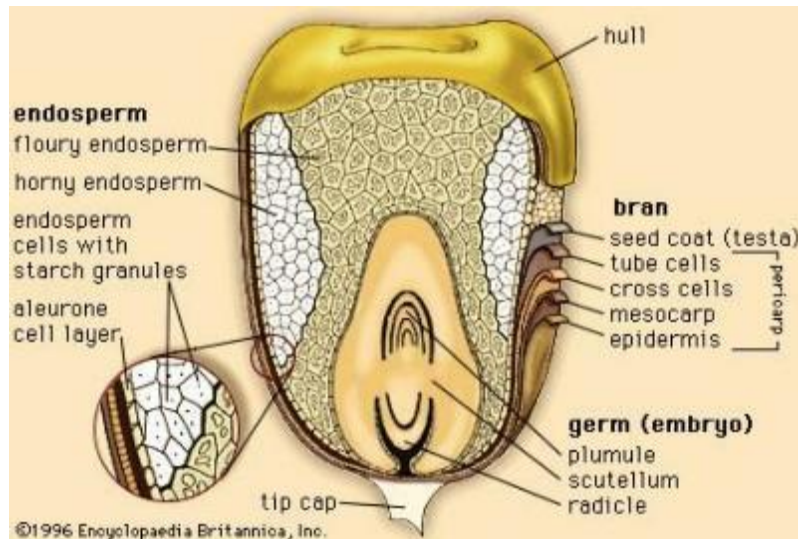


Figure 4 - Corn Kernel Components

Corn Masa Milling

A key difference between these dry corn milled products and corn masa products is nixtamalization. While both processes may be done at the same mill, the nixtamalization method requires some different materials and equipment. To make masa, corn is soaked in a warm solution of lime and water before being washed to remove the pericarp (24). The resulting substance is called nixtamal, which is then ground to produce corn masa. Less of the corn kernel is removed in this process than the dry corn milling process, and some nutrients become more bioavailable (17). From the grinding stage, the masa goes through either a wet or dry manufacturing process (Figure 5). Wet masa is immediately either extruded or sheeted and cut to form the shape of tortillas or chips which are then baked and/or fried to make the finished masa product. Approximately 47% of corn masa in the US is manufactured using this method (25).

The other 53% of corn masa is made into corn masa flour (CMF) using the dry manufacturing process, which dries, mills, and sifts the masa into different granulations after the wet stone grinding stage. The CMF leaves the plant in retail bags ranging in size from 24 oz to 50 lb, or in bulk via totes (2,000 lb bags), trucks, or rail cars for further processing. Masa products manufactured from CMF are made by adding water to reconstitute the masa flour into dough, then processing it similarly to the traditional wet method to create the finished product (26).

Fortification of corn masa flour is done at the stage where other additives are blended into the flour after it is milled and sifted (Figure 5). Currently, no wet masa is being fortified. However, Dr. Michael Dunn, a Food Science researcher who spent many years studying methods of fortifying corn masa, stated that adding folic acid to the nixtamal prior to wet stone grinding would be an ideal point to fortify wet masa (27).

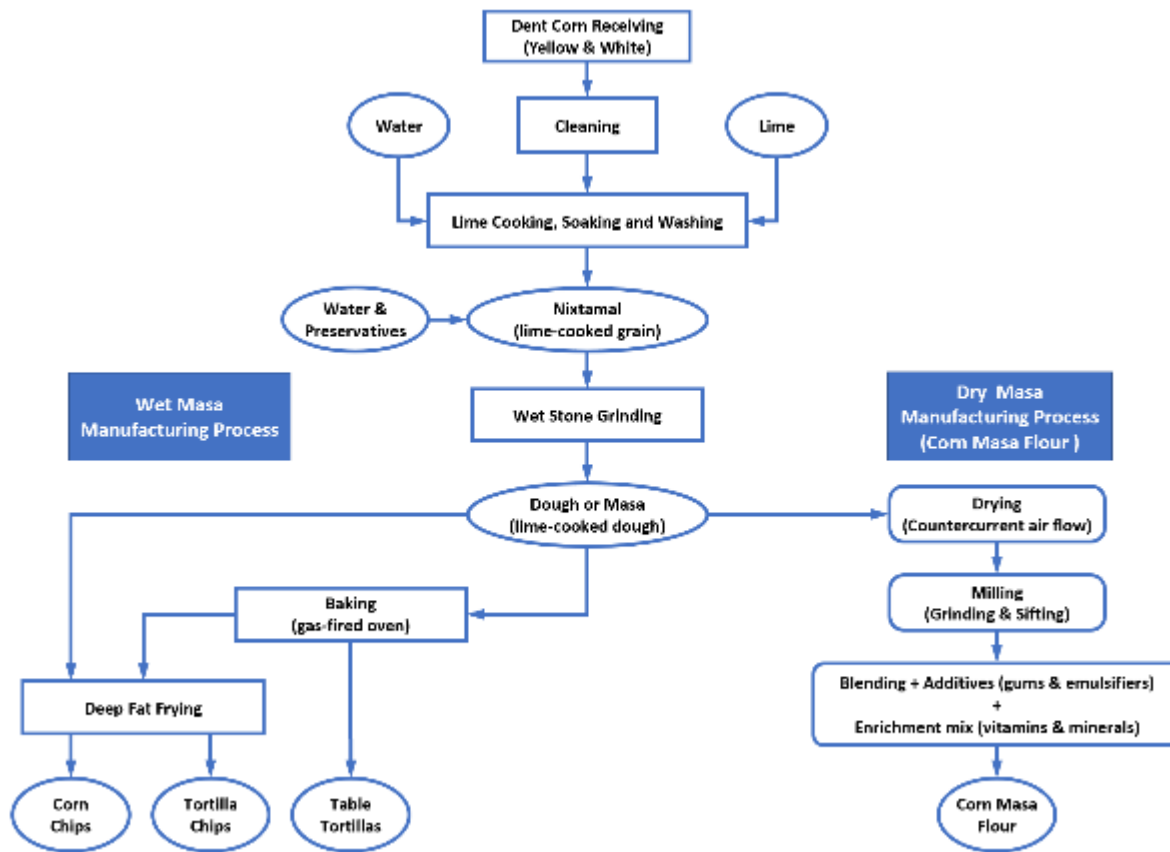


Figure 5 - Corn Masa Manufacturing

Supply Chain

As mentioned in the previous section, corn masa can be classified as either dry (CMF) or wet based on the processing method. Dry corn masa is either sold as flour or products made from flour. A masa industry market analysis conducted in 2017-2018 reported dry masa market segmentation as 46% tortillas, 40% snacks, 12% retail bags of flour, and 2% specialty products (e.g., gluten free masa pasta) (18). For the purposes of this report, the 2% specialty category was combined with the snack category, resulting in the dry masa market segmentation of 46% tortillas, 42% snacks, and 12% retail bags of flour. The assumption was made that the distribution of market shares of dry masa products was also representative of wet masa products. However, wet masa is not used to make corn masa flour, so the 12% dry masa market share attributed to retail bags of flour was split evenly between the tortilla and snack segments. This resulted in our assumption that the wet masa market is 46% + 6% = 52% tortillas and 42% + 6% = 48% snacks. These assumptions were validated by a masa industry subject matter expert who stated that the wet corn masa market is approximately half tortillas and half snacks (18).

Corn Masa Flour Producers

Forty-five US mills are listed in the Dry Corn Milling section of the 2022 Grain & Milling Annual Directory (28). However, only eight of these mills list corn masa flour as one of their products (28). Azteca Milling, which is owned by Gruma, has the most masa manufacturing facilities (n=6). Three are in Texas (Amarillo, Edinburg, and

Plainview) and one each is located in Madera, California; Evansville, Indiana; and Henderson, Kentucky. Lifeline Foods operates a facility in St. Joseph, Missouri, and Dry Corn Ingredients (owned by Cargill) operates a masa mill in Indianapolis, Indiana. The Grain and Milling Annual Directory does not appear to be comprehensive, as there are companies known to produce CMF that are not listed as such. For example, Bunge Milling operates dry corn facilities in Worthington, Indiana; Red Oak, Iowa; and Muleshoe, Texas, all of which are thought to produce corn masa (29). Other corn masa flour producers such as Ole Mexican Foods, one of the largest tortilla manufacturers (La Banderita brand), mill CMF that is immediately used to make their products at facilities co-located on the same parcel of land where they manufacture their CMF (18). While the map below (Figure 6) may not be exhaustive, it does capture all major corn masa millers in the country.



Figure 6 - Map of CMF Producers

Published capacities for dry corn mills include the volume of corn ground for all dry corn products at a given facility, both masa and non-masa products, making those volumes unusable for this analysis. As such, the annual volume of CMF in the United States was obtained through market intelligence provided by Rodrigo Ariceaga, who conducted the previously mentioned 2017-2018 corn masa market analysis (18). At that time, the total annual CMF production by Azteca Milling, Bunge Milling, and LifeLine Foods was estimated to be 838,000 metric tons (MT). Dry Corn Ingredients and Ole Mexican Foods added another 96,000 MT for a total annual CMF production of 934,000 MT (25). To estimate current volumes, compounded annual growth rates cross referenced from several sources were applied to the 2017-2018 values provided.

The three primary CMF market segments of tortillas, snacks, and retail bags of flour have median compounded annual growth rates (CAGRs) of 7% (19), 2.2% (30), and 4% respectively (18). Applying these rates to the 2017-18 base year volumes provides the current estimated annual CMF production of 1,176,000 MT (Table 1). The top three producers are Azteca Milling at 853,000 MT/year with 73% market share, Bunge Milling at 180,000

MT/year or 15% market share, and Ole Mexican Foods at 83,000 MT/year or 7% market share. Dry Corn Ingredients produces CMF for snacks, and as such is assumed to have grown at a 2.2% CAGR to 41,000 MT and 3% market share (30). LifeLine Foods has run at a maximum capacity of 19,000 MT since 2018 (30). As LifeLine has not been able to increase its market share due to those capacity limitations, this report assumes that Bunge Milling absorbed LifeLine’s growth due to its acquisition of two mills in 2018 (29).

Manufacturer	Annual CMF Volume (MT)	Market Share
Azteca Milling (Gruma)	853,000	73%
Bunge Milling	180,000	15%
Ole Mexican Foods	83,000	7%
Dry Corn Ingredients (Cargill)	41,000	3%
LifeLine Foods	19,000	2%
Total	1,176,000	100%

Table 1 - Dry Masa (CMF) Manufacturers

Dry Masa Product Manufacturers

Many manufacturers use CMF to make masa products (Table 2). From 2017 to 2018, Mission Foods (a subsidiary of Gruma) used 345,000 MT of CMF manufactured by Azteca Milling (also owned by Gruma) to make the Mission and Calidad brands of chips and the Mission and Guerrero brands of tortillas. That volume of internally supplied CMF to Mission grew to 437,000 MT in 2022 after applying the 7% CAGR to the tortilla segment and 2.2% CAGR to the snack segment. Azteca also supplies their own Maseca brand of CMF to other product manufacturers like La Mexicana Tortilla Factory in Renton, Washington, for use in the products they make (31).

As mentioned previously, Ole Mexican Foods makes masa products from the 83,000 MT of CMF they manufacture annually. Many companies use the remaining 54% or 621,000 MT of the total 1,141,000 MT of CMF available in the US to make tortilla or snack masa products. For example, Bite Brands has facilities in Atlanta, Georgia; Syracuse, New York; and Parkersburg, West Virginia, that use CMF to produce several house brands and co-pack private label masa products (32).

Manufacturer	CMF Product Types	Annual CMF Volume (MT)	Market Share
Mission (Gruma)	Tortillas, snacks	437,000	38%
Ole Mexican Foods	Tortillas, snacks	83,000	7%
Others	Tortillas, snacks	621,000	54%
Total		1,141,000	100%

Table 2 - Dry Masa Product Manufacturers

Wet Masa Product Manufacturers

The 2017-2018 market analysis found that around half of the corn masa products in the US were made from CMF and the other half were made from the more traditional wet masa manufacturing process (18). Applying these percentages to the supply chain model numbers in Figure 2 (page 9) suggests that 838,000 MT of wet masa were manufactured in 2018. Applying the median CAGRs of 7% for tortillas and 2.2% for snacks to the 2017-18 base results in the current annual US wet masa manufacturing output of 1,060,000 MT.

Due to the significant spread between the two CAGRs, from 2018 to 2023 the market share of wet masa tortillas and snacks became 58% and 42% respectively (Table 3). The Frito-Lay Doritos, Tostitos, and Santitas brands dominate the wet masa snack segment with an estimated 69% share of the tortilla chip market (33). Smaller producers who make and market their own brands of tortilla chips together comprise the remainder of the annual 446,000 MT (25). The other 614,000 MT of wet masa products are largely made in numerous small tortillerias located throughout the US, with concentrations in cities such as Los Angeles, California; Chicago, Illinois; and New York City, New York. Additionally, there are small tortilla factories like Manuel’s Tortilla Factory in Odessa, Texas, that produce tortillas exclusively for institutional use (34).

Manufacturer	Masa Product Type	Annual Volume (MT)	Market Share
Frito-Lay / others	Snacks / tortilla chips	446,000	42%
Small-scale tortilla manufacturers	Tortillas, tostadas, taco shells	614,000	58%
Total		1,060,000	100%

Table 3 - Wet Masa Product Manufacturers



Figure 7 - Corn Masa Tortilla Chips

Import/Export

The vast majority (94%) of maize flour imported to the US comes from Mexico. A query of the United States International Trade Commission database reported slightly over 220,000 MT of maize flour (assumed to be CMF) was imported from Mexico in 2022 (35). In 2018, industry sources reported that Masabrosa had exported over 12,000 MT of retail bags of CMF into the US (Table 4). At a median retail bag CAGR of 4%, that

volume has grown to 15,000 MT. Bunge retained the Minsa brand of retail CMF (bought in 2018) until 2020, when the rights to the label ended under the provisions of the purchase agreement (29). Upon regaining their rights to the brand, Minsa USA began exporting bags of CMF from Mexico to the US. Sources within the industry report it has taken time for the label to regain its previous market share, which is assumed to now be equal to the volume of 6,000 MT it had in 2018 at the time of the Bunge acquisition (29). Trade data show over 90% of imports come through two US cities: San Diego, California, and Laredo, Texas, at 73% and 19% respectively (25,35). One website suggests that Gruma, Minsa, and Hari Masa are three of the biggest Mexican exporters of corn flour (36). They each have production facilities in Nuevo Leon, Mexico, less than 4 hours from Laredo, TX (37,38). Minsa has distribution centers in Mexicali and Tijuana, Baja California, Mexico, both within two hours of San Diego, CA (39). It is thought that at least Minsa has products available in bulk, but all three companies list bags ranging in sizes of 1-22kg (40-42). It is therefore thought the balance of the CMF imports to the US is in large bags and totes.

Importers Name	Country of Origin	Total Annual Volume (MT)
Masabrosa	Mexico	15,000
Minsa	Mexico	6,000
Other	Mexico	199,000
Total		220,000

Table 4 - Imports

The US also exports corn flour (Table 5). A query of the US International Trade Commission database reported 93,000 MT of maize flour, which would be 8% of the total US CMF production, was exported to countries around the world in 2021 (35). Canada and Mexico receive 57% of US corn flour exports at 39% and 18% respectively, with the remaining 43% distributed to 55 other countries.

Country of Origin	Total Annual Volume (MT)	Pct of Total
Canada	36,000	39%
Mexico	17,000	18%
Other	40,000	43%
Total	93,000	100%

Table 5 - Exports

Consumption of Masa Products

Segmentation

Using the results of the 2017-2018 market analysis and CAGRs to bring volumes up to date, this analysis extrapolated current market segmentation of corn masa products. This provides an estimated annual volume (including CMF imports, less CMF exports) of 1,303,000 MT of corn masa flour, split into 162,000 MT of retail bag CMF, 545,000 MT of CMF used for snacks, and 596,000 MT of CMF used for tortillas. Wet masa totals 1,060,000 MT annually, with 446,000 MT used for snacks and 614,000 MT for tortillas.

The CMF and wet masa product volumes were combined to view and evaluate the entire masa market. The resulting volumes of the three primary masa market segments are:

- 162,000 MT for retail bags of CMF
- 991,000 MT for snacks
- 1,210,000 MT for tortillas

A study conducted by a market research firm found that tamales, enchiladas, and pupusas represent a tiny proportion of the tortilla segment and for the purposes of this report were included in the larger tortilla

category rather than their own segments (19). A 2021 analysis conducted by the Tortilla Industry Association (TIA) found sales of corn tortilla products to be 91.3% table tortillas, 4.3% tostadas, and 4.3% taco shells (43). These percentages were applied to the annual corn tortilla volume of 1,210,000 MT to provide a refined corn masa product segmentation of 1,104,000 MT of table tortillas, 53,000 MT of tostadas, and 53,000 MT of taco shells (Table 6). Excluding CMF sold as CMF, 45% of masa products by volume are considered snacks/tortilla chips.

Description	Masa Product Type				Total
	Tortilla	Tostadas	Taco Shells	Snacks / Tortilla Chips	
Volume MT	1,104,000	53,000	53,000	991,000	2,201,000
Pct	50.2%	2.4%	2.4%	45.0%	100%

Table 6 - Masa Product Segmentation

Distribution

A 2021 TIA report showed 52% of masa products were purchased by retailers, 20% by restaurants, 21% by schools and government institutions, and 7% by other outlets (43). The restaurant, school, and government channels were combined for this report and collectively called the “food service” channel, totaling 41% of the corn masa market. It is assumed all masa products reach the consumer via one of these channels and therefore the percentages were applied for all products represented in the supply chain model (Table 7).

Distribution Channels	Market Share
Retail grocers	52%
Food service (restaurants, schools, government)	41%
Other	7%

Table 7 - Masa Distribution Channels

The distribution channel percentages from TIA were based on data provided by IRI, a data analytics and market research company. They categorize sales of tortilla products as frozen tortilla, refrigerated tortilla, perimeter (those found on the perimeter of a grocery store) tortilla, tortilla chip, and taco kit (44). IRI obtains its data via UPC scans at supermarkets, drugstores, mass market retailers, convenience stores, military commissaries, wholesale clubs, and dollar retail chains. See Table 8 for a list of retailers.

Category	Description	Market Share
Grocery	Kroger, Southwestern Grocery, Albertsons	42.5%
Walmart	Walmart	22.6%
Drug	CVS, Rite Aid, Walgreens	4.2%
Club	BJ, Sams club	4.1%
Mass	Kmart Target	6.1%
Dollar	Dollar General, Family Dollar	3.0%
Military	Commissarys	0.6%
Amazon	Amazon	0.1%
CONVENIENCE	7/11, circle K, etc	16.8%
Total		100.0%

Table 8 - Masa Product Retailers

Notably missing from the list provided by IRI is the significant number of Mexican restaurants and grocery stores which use and sell masa products. This is an important characteristic of the masa market. TIA reports there are approximately 58,000 Mexican restaurants and 28,000 Mexican grocery stores that make and/or sell masa products (43). 47,000 of the Mexican restaurants are independent, stand-alone, or chains of less than 50 stores (45). The other 11,000 are large chain stores such as Taco Bell and Chipotle. Approximately 24,000 Mexican grocery stores are considered solvent, multiple location grocers with an estimated 17% making their own tortillas (either corn or wheat) on-site (43). The remaining 4,000 are thought to be very small or unstable. It was not possible to ascertain the percentage of market share of corn masa purchased via these outlets. However, the amount of corn masa they use is likely present in all three segments listed in Table 7.

Current State of Fortification

The FDA's voluntary folic acid fortification recommendation specifies that folic acid in corn masa flour cannot exceed 0.7 mg/lb (1.54 ppm, or parts per million) and does not provide a minimum standard (12). The World Health Organization (WHO) recommends that when a target population consumes on average between 75-149 grams per capita per day (g/c/d) of maize flour, that flour be fortified at 2.6 ppm of folic acid (46). This decreases to 1.3 ppm when flour is consumed at 150-300 g/c/d. The average consumption of CMF by Hispanic populations in the US is unknown. However, for comparison, the average availability of maize flour is 283 g/c/d in Mexico, 230 g/c/d in Guatemala, 223 g/c/d in El Salvador, and 208 g/c/d in Honduras (47).

Multiple surveys suggest that retail CMF is the only corn masa product being fortified, although not all producers do so (14,15). In-store surveys and internet searches of masa products found not one label of a corn tortilla, tostada, taco shell, or corn snack fortified with folic acid. As for CMF, in-store surveys conducted in Minnesota, Georgia, Texas, and Arizona throughout the duration of the research for this report consistently found the 4 lb bag of Maseca CMF to be fortified with folic acid at 15% of the Daily Value (DV), or 0.6 ppm (Figure 8). A source familiar with the Maseca brand stated that 90% of all Maseca retail CMF is fortified with folic acid (48). Applying a 90% fortification percentage to the 129,000 MT of Maseca CMF indicates that 116,000 MT is fortified with folic acid annually. It is worthwhile to note that Gruma has stated that it is planning to fortify all "core corn tortillas" by the end of 2024 (2).

A survey conducted at a Walmart store in Casa Grande, Arizona, in April 2023 found the 4 lb CMF bag of Great Value (the Walmart brand) and a 4 lb bag of Masabrosa (imported from Mexico) also fortified at 15% of the DV. Gruma had funded, and Walmart participated in, the petition for the FDA to allow voluntary fortification of CMF with folic acid. Based on this cooperation, the fact that Walmart does not make its own products, and Azteca's standing ability to fortify CMF, it is likely that Azteca Milling is co-packing the 4 lb bag of Great Value brand that is fortified. However, it is unknown how consistently Great Value is fortifying, as the Instant Corn Masa Flour found online is unfortified (49). Therefore, the following calculations do not count Walmart as fortifying its CMF.

Multiple retail bags of 4 lb fortified Minsa CMF were obtained at the Tortilla Industry Association convention in Austin, Texas, in May of 2023. Imported 4 lb Masabrosa bags also contain folic acid. Masabrosa imports 15,000 MT of retail CMF annually and Minsa imports 6,000 MT. Adding these two volumes to the 116,000 MT fortified by Maseca results in 137,000 MT of retail CMF being fortified with folic acid annually. Dividing this volume by the total annual retail CMF volume of 162,000 MT results in **85% of all retail corn masa flour being fortified**. The Quaker Oats brand, Maisel (Bunge brand), and multiple other retail brands of CMF were found to be unfortified.



Figure 8 - Fortified CMF Bags

The total annual volume of masa available in the US (2,363,000 MT) was calculated by adding the annual 162,000 MT of retail CMF to the annual 2,201,000 MT of the other corn masa product segments. The 137,000 MT of retail CMF that is fortified with folic acid annually was then divided by the total annual corn masa volume of 2,363,000 MT. This calculation indicates that an estimated **5.8% of all corn masa products in the US are fortified with folic acid** (Figure 9).

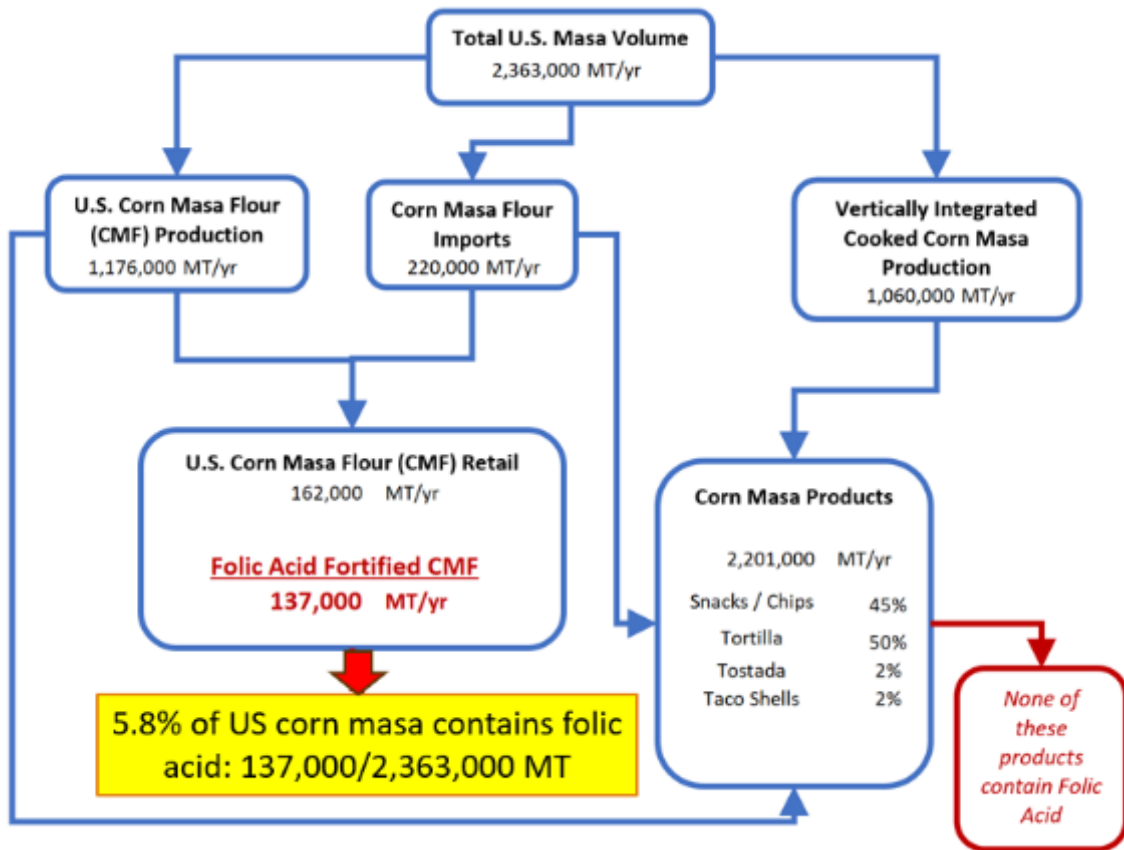


Figure 9 - Fortified Corn Masa



References

1. Kancherla V. Neural tube defects: a review of global prevalence, causes, and primary prevention. *Childs Nerv Syst.* 2023 Jul 1;39(7):1703–10.
2. Moraga Franco C, Greenthal E. Failure to Fortify [Internet]. Center for Science in the Public Interest; 2023 Feb. Available from: <https://www.cspinet.org/resource/failure-fortify>
3. Khalid SI, Thomson K, Hunter BM, Garcia RM, Bowman R, Lam S. The impact of voluntary folate fortification of corn masa flour on US pregnancies complicated by neural tube defects. *Childs Nerv Syst.* 2023 Apr 26;1–7.
4. Food and Drug Administration. Food Standards: Amendment of Standards of Identity For Enriched Grain Products to Require Addition of Folic Acid [Internet]. 1996. Available from: <https://www.govinfo.gov/content/pkg/FR-1996-03-05/pdf/96-5014.pdf>
5. Williams J, Mai CT, Mulinare J, Isenburg J, Flood TJ, Ethen M, et al. Updated Estimates of Neural Tube Defects Prevented by Mandatory Folic Acid Fortification — United States, 1995–2011. *Morb Mortal Wkly Rep.* 2015 Jan 16;64(1):1–5.
6. Mai CT, Evans J, Alverson CJ, Yue X, Flood T, Arnold K, et al. Changes in Spina Bifida Lesion Level after Folic Acid Fortification in the US. *J Pediatr.* 2022 Oct;249:59-66.e1.

7. Bureau UC. Census.gov. [cited 2023 Jul 24]. About the Hispanic Population and its Origin. Available from: <https://www.census.gov/topics/population/hispanic-origin/about.html>
8. LATV. LATV. [cited 2023 Jul 24]. LATINE Vs. LATINX: What They Mean, Why They Matter. Available from: <https://latv.com/latine-vs-latinx>
9. Flores AL, Cordero AM, Dunn M, Sniezek JE, Arce MA, Crider KS, et al. Adding folic acid to corn Masa flour: Partnering to improve pregnancy outcomes and reduce health disparities. *Prev Med.* 2018 Jan;106:26–30.
10. Hamner HC, Tinker SC, Flores AL, Mulinare J, Weakland AP, Dowling NF. Modelling fortification of corn masa flour with folic acid and the potential impact on Mexican-American women with lower acculturation. *Public Health Nutr.* 2013 May;16(5):912–21.
11. March of Dimes. Coalition Petitions FDA to Fortify Corn Masa Flour With Folic Acid [Internet]. [cited 2023 Jun 13]. Available from: <https://www.marchofdimes.org/about/news/coalition-petitions-fda-to-fortify-corn-masa-flour-folic-acid>
12. Food and Drug Administration. Food Additives Permitted for Direct Addition to Food for Human Consumption; Folic Acid [Internet]. 2016 [cited 2023 Jun 14]. Available from: <https://www.federalregister.gov/documents/2016/04/15/2016-08792/food-additives-permitted-for-direct-addition-to-food-for-human-consumption-folic-acid>
13. Wang A, Rose CE, Qi YP, Williams JL, Pfeiffer CM, Crider KS. Impact of Voluntary Folic Acid Fortification of Corn Masa Flour on RBC Folate Concentrations in the U.S. (NHANES 2011–2018). *Nutrients.* 2021 Apr 16;13(4):1325.
14. Redpath B, Kancherla V, Oakley GP. Availability of Corn Masa Flour and Tortillas Fortified With Folic Acid in Atlanta After National Regulations Allowing Voluntary Fortification. *JAMA.* 2018 Oct 16;320(15):1600–1.
15. Kancherla V, Averbach H, Oakley Jr GP. Nation-wide failure of voluntary folic acid fortification of corn masa flour and tortillas with folic acid. *Birth Defects Res.* 2019;111(11):672–5.
16. Giles D. Heat and Control. 2021 [cited 2023 Jul 5]. A Guide to Processing Corn Products from Raw Corn to Masa to Formed Products. Available from: <https://www.heatandcontrol.com/blog/guide-to-processing-corn-products-from-raw-corn-to-masa-to-formed-products>
17. United States Department of Agriculture. Food Buying Guide for Child Nutrition Programs [Internet]. USDA Food and Nutrition Service; 2022 [cited 2023 Jun 20]. Available from: <https://www.fns.usda.gov/tn/food-buying-guide-for-child-nutrition-programs>
18. Ariceaga R. Masa industry expert. 2023.
19. Skyquest. United States Corn Masa Project. 2022.
20. Budiman A. Key findings about U.S. immigrants [Internet]. Pew Research Center. [cited 2023 Aug 18]. Available from: <https://www.pewresearch.org/short-reads/2020/08/20/key-findings-about-u-s-immigrants/>
21. Frito Lay Fritos - by Curiosity Quest [Internet]. 2016 [cited 2023 Jul 5]. Available from: <https://www.youtube.com/watch?v=xJDKrMgBhUg>
22. Piel F. Former masa plant manager. 2023.
23. 21 CFR 172.345 -- Folic acid (folacin). [Internet]. [cited 2023 Jul 6]. Available from: <https://www.ecfr.gov/current/title-21/chapter-I/subchapter-B/part-172/subpart-D/section-172.345>

24. Burton KE, Steele FM, Jefferies LK, Pike OA, Dunn M. Effect of Micronutrient Fortification on Nutritional and Other Properties of Nixtamal Tortillas. *Cereal Chem.* 2008;85(1):70–5.
25. Food Fortification Initiative. FFI Calculation. 2023.
26. Serna-Saldivar SO, Rooney LW. Chapter 13 - Industrial Production of Maize Tortillas and Snacks. In: Rooney LW, Serna-Saldivar SO, editors. *Tortillas* [Internet]. AACC International Press; 2015 [cited 2023 Jul 10]. p. 247–81. Available from: <https://www.sciencedirect.com/science/article/pii/B978189112788550013X>
27. Dunn M. Wet masa fortification [Internet]. 2023. Available from: <https://ndfs.byu.edu/directory/michael-dunn>
28. World Grain. World-Grain.com. 2022 [cited 2023 Jun 28]. *Grain & Milling Annual*. Available from: <https://www.world-grain.com/directories/1801-grain-milling-annual>
29. FoodIngredientsFirst. [foodingredientsfirst.com/](https://www.foodingredientsfirst.com/). [cited 2023 Jun 27]. Bunge acquires Grupo Minsa’s US corn milling business, following ADM takeover approach. Available from: <https://fif.cnsmedia.com/a/R2wIlblxMLQ=>
30. Senior masa industry executive. Corn masa market. 2023.
31. Killam A. La Mexicana Tortillas. 2023.
32. Bite Brands [Internet]. [cited 2023 Jul 10]. Potato Chip Co-Packing and Private Label Manufacturing. Available from: <https://www.bitebrands.com/capabilities>
33. Finkel E. Snack Food & Wholesale Bakery. 2022 [cited 2023 Jul 10]. State of the Industry 2022: Tortilla chips continue to crunch | Snack Food & Wholesale Bakery. Available from: <https://www.snackandbakery.com/articles/99118-state-of-the-industry-2022-tortilla-chips-continue-to-crunch>
34. Owner, Manuel’s Tortilla Factory. Manuel’s Tortillas. 2023.
35. United States International Trade Commission. USITC DataWeb. [cited 2023 Jun 26]. DataWeb. Available from: <https://dataweb.usitc.gov/>
36. B2b Postavki. TOP 26+ Corn flour suppliers from MX Mexico [2023] [Internet]. 2023 [cited 2023 Jul 25]. Available from: <https://b2b-postavki.ru/suppliers/corn-flour-mexico.html>
37. GRUMA. GRUMA - GIMSA [Internet]. n.d. [cited 2023 Jul 25]. Available from: <https://www.gruma.com/en/our-brands/companies/gimsa.aspx>
38. hariMASA. hariMASA - Nosotros [Internet]. n.d. [cited 2023 Jul 25]. Available from: <http://www.harimasa.com/aboutUS.php>
39. Minsa. MINSA - GET TO KNOW US [Internet]. Minsa. 2021 [cited 2023 Jul 25]. Available from: <https://minsasusa.com/>
40. Diaz Foods. Diaz Foods. 2017 [cited 2023 Jul 25]. Meet Minsa, the Manufacturer of Authentic Mexican Corn Masa. Available from: <https://www.diazfoods.com/news-about-diazfoods/2017/8/1/meet-minsa-the-manufacturer-of-authentic-mexican-corn-masa>
41. hariMASA. hariMASA - Productos [Internet]. n.d. [cited 2023 Jul 25]. Available from: <http://www.harimasa.com/products.php>
42. GRUMA. GRUMA - Maseca [Internet]. n.d. [cited 2023 Jul 25]. Available from: <https://www.gruma.com/en/our-brands/locate-a-brand/maseca.aspx>

43. Tortilla Industry Association. International Baking Industry Exposition. 2022 Sep; Las Vegas, NV.
44. IRI. About Us | IRI [Internet]. [cited 2023 Jun 28]. Available from: <https://www.iriworldwide.com/en-us/company/about-us>
45. elrestaurante.com [Internet]. 2015 [cited 2023 Jun 28]. Independent Mexican Restaurants: Strong, Growing, Facing Challenges. Available from: <https://elrestaurante.com/api/content/ed7a3a1c-888b-11e5-985b-22000b078648/>
46. WHO. WHO Guideline: Fortification of Maize Flour and Corn Meal with Vitamins and Minerals [Internet]. Geneva: World Health Organization; 2016 [cited 2023 Jul 27]. (WHO Guidelines Approved by the Guidelines Review Committee). Available from: <http://www.ncbi.nlm.nih.gov/books/NBK402401/>
47. Food and Agriculture Organization of the United Nations. FAOSTAT [Internet]. [cited 2023 Jun 26]. Available from: <https://www.fao.org/faostat/en/#data/SCL>
48. Anonymous. Anonymous source - Maseca. 2023.
49. Walmart. Walmart.com. [cited 2023 Jun 30]. Great Value Instant Corn Masa Flour, 60 oz. Available from: <https://www.walmart.com/ip/Great-Value-Instant-Corn-Masa-Flour-60-oz/379902967>