Latest Scientific Research on Tortillas

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Tortillas

Tortillas represent a large and growing sector of baked goods and are a popular low-carbohydrate bread replacement among consumers and are available in many types on the global market.

Value, flexibility, and health and wellness innovation spur category growth!

The shift by tortilla manufacturers toward value-added products began several years ago, but the momentum remains apparent in recent sales figures.

Schroeder, 2021

The literature review is a first and "a must" step of not only research and new product development but also process improvement processes.

- A literature review provides context, informs methodology, maximizes innovation, avoids duplicative research, and ensures that professional standards are met.
- Literature reviews take time, are iterative, and should continue throughout the research process.

Maggio et al., 2016

Composite Flours/Tortilla Quality

Composite Flours

Evaluation of non-extruded and extruded pecan (Carya illinoinensis) shell powder as functional ingredient in bread and wheat tortilla

Villasante et al., 2022. Spain, Mexico.

Pecan shell is a source of dietary fiber and phytochemicals and therefore, pecan shell powder could be used as a supplement in the preparation of food products.

The present study evaluated the effect of addition of 5, 10 and 15% pecan shell powder, non-extruded or extruded, in the physical properties of bread and wheat tortillas.

Breads and tortillas produced with the higher substitution level that did not detriment significantly their physical properties (5% in breads and 10% in tortillas) were characterized in terms of chemical composition, total phenolic content, radical scavenging activity and in vitro viability of human-derived liver cancer cells.

Sensory analysis of breads and tortillas supplemented with non-extruded or extruded pecan shell powder showed adequate overall acceptability by consumers. **Results obtained in the present study support that the pecan shell powder can be used as functional ingredient in bakery products especially when pretreated by extrusion.**

Composite Flours

Development, characterization and principal component analysis of fish bone based fortified refined wheat flour tortilla and its organoleptic attributes

Liaqat et al., 2022. Pakistan.

This study was aimed to develop nano-sized-biogenic hydroxyapatite (naturally occurring mineral form of calcium apatite, HAp) from fishbone; followed by calcination at 850°C. The ultrasonic processing method was practiced to reduce the particle size of HAp obtained from the discarded fish bone.

HAp was further used to develop nano-sized-biogenic HAp fortified refined wheat flour tortillas with four formulations at 0%, 0.2%, 0.4%, and 0.6% levels.

The fortification of tortillas with nano-sized-biogenic HAp powders developed from fishbone may play a role to improve bone health.

Composite Flours

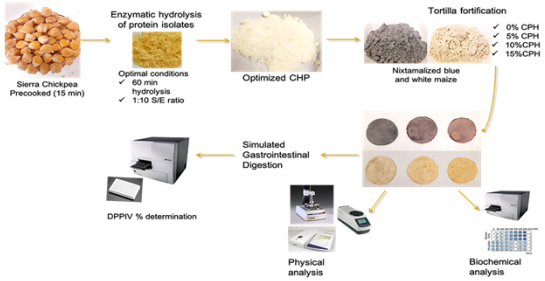
Fortification of Maize Tortilla with an Optimized Chickpea Hydrolysate and Its Effect on DPPIV Inhibition Capacity and Physicochemical Characteristics

Acevedo-Martinez and Gonzalez de Mejia, 2021. USA.

The objective was to compare the effect of adding different levels of an optimized bromelain (proteolytic enzyme) hydrolysate from chickpea isolated protein on DPPIV (Dipeptidyl peptidase) inhibition capacity and physicochemical properties of maize tortilla since chickpea hydrolysates have shown bioactivity towards type 2 diabetes.

White and blue maize tortillas, with no added chickpea hydrolysates were compared with fortified tortillas at the levels of 5%, 10%, and 15%.

Fortification of maize tortilla with chickpea hydrolysate inhibits DPPIV and **can potentially be used in the prevention and management of type 2 diabetes. However, due to observed physicochemical changes of the fortified tortilla, sensory properties and consumer acceptance need to be evaluated.**



Composite Flours

Utilization of the marine microalgae Nannochloropsis sp. and Tetraselmis sp. as innovative ingredients in the formulation of wheat tortillas

Hernández-López et al., 2021. Mexico, Spain.

Powdered biomass of Nannochloropsis sp. and Tetraselmis sp. were used as innovative ingredients in wheat tortillas at flour substitution levels of 0.5–3.0%.

Incorporation of microalgae into the tortilla formulations led to increased protein and fat content. The content of phenolic and carotenoids was also higher in microalgae-enriched tortillas, especially for those enriched in Nannochloropsis sp. at a flour substitution level of 3.0%. Not only the phenolic content but also the antioxidant capacity of the tortillas was higher after microalgae incorporation.

No major differences in physical parameters (besides color) were observed, and the overall acceptance of the microalgae-enriched tortillas assessed after a sensorial analysis was comparable to that of the wheat-only controls.

Moreover, the purchase intention of the products as well as the acceptability index suggested that the tortillas would have a good acceptance.

Composite Flours

Quality and Storage Characteristics of Hot Press Tortilla Prepared from Yam-Wheat Composite Flour

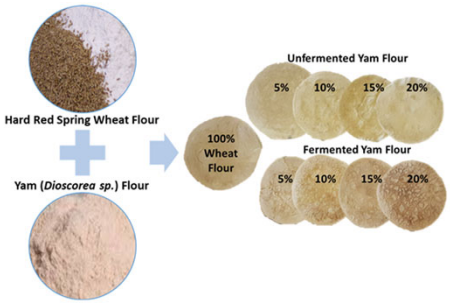
Asiyanbi-Hammed and Simsek, 2020. USA.

Tortillas made from yam (Dioscorea sp.) wheat composite flours were characterized. Refined wheat flour, was substituted with 5, 10, 15%, and 20% of fermented yam flour-brown and unfermented yam flour-white.

During storage, moisture contents of composite flour tortillas increased while the refined wheat flour tortilla decreased.

Tortilla from fermented yam flour-brown-composite flour exhibited greater strength compared to unfermented yam flour-white-composite tortillas, while unfermented yam flour-white-composite flour tortillas had good extensibility and rollability properties.

The properties and composition type and ratios of flour blends affected tortilla quality during the storage period. **The substitution of refined wheat flour with 15% or 20% unfermented yam flour-white would be more suitable for making tortilla with improved properties compared to that of fermented yam flour-brown.**



Composite Flours

Tortilla added with Moringa oleífera flour: Physicochemical, texture properties and antioxidant capacity

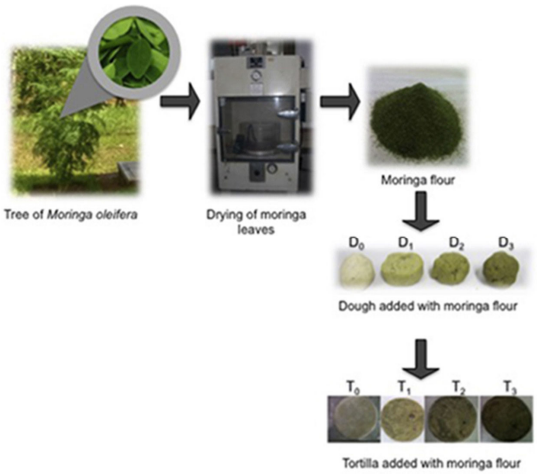
Páramo-Calderón et al., 2019. Mexico.

Moringa oleifera is the most widely cultivated specie of the Moringaceae family, is commonly known as “moringa” and various parts of moringa plant and their active constituents are known to possess diverse biological activities.

Tortillas were prepared using corn dough with Moringa flour at different proportions (1, 2 and 3%). Tortillas with higher proportions of moringa flour showed higher protein content, while the lipid content increased up to 50%. Phenolic content and antioxidant activity increased with the addition moringa flour.

Tortillas added with moringa flour obtained were less luminous and greener. The texture tests showed that the tortillas added with moringa flour showed a lower cohesiveness compared to the control tortilla, while the adhesiveness values showed no significant differences.

Therefore, the addition of moringa flour could be a good alternative to prepare a food with better nutritional characteristics.



Composite Flours

Effect of pre-cooked yellow pea flour incorporation on wheat tortilla quality parameters

Kloepfer and Smith, 2018. USA.

The pulse flours have the potential to increase tortilla markets by enhancing the nutritional value of tortillas.

In this study, tortillas were made by substituting wheat flour with pre-cooked pea flour at a rate of 75.66, 83.83, and 92.00 g in 200 g batches (flour basis).

It was found that all treatments and controls had similar decreasing trends in rollability scores over the storage time. Conversely, tortilla toughness values increased over time, where wheat had overall greater values throughout storage and a more rapid initial increase in toughness values. Tortilla extensibility for the pea flour treatments increased for the first 6 days of storage and decreased for the remainder. Wheat tortilla extensibility decreased throughout storage.

Addition of pea flour to tortilla formulations can be accomplished without sacrificing quality and storage stability.

Composite Flours

Rheology, acceptability and texture of wheat flour tortillas supplemented with soybean residue

Montemayor-Mora et al., 2018. Mexico.

Dry soybean (Glycine max) residue, SBR is a byproduct rich in dietary fiber and protein with high levels of essential amino acids.

The effects due to the substitution of refined wheat flour with 5% or 10% soybean residue in dough rheology determined by Mixolab and hot-press tortilla texture, dimensions, color, protein and dietary fiber contents were studied.

Substitution of 10% soybean residue improved flour in terms of gluten strength and sedimentation without significantly affecting dough hardness, cohesiveness, adhesiveness, and extensibility. The dimensions, color and sensory acceptance of the supplemented tortillas were not affected by the addition of the soybean residue. The 10% soybean residue tortillas contained more insoluble dietary fiber, protein content in vitro protein digestibility, and protein digestibility corrected amino acid score.

Results indicated that wheat flour tortillas with 10% soybean residue an excellent alternative to regular counterparts owing to their higher dietary fiber and protein quantity and quality.

Composite Flours

Development of Gluten Free Tortilla with Orange Sweet Potato

Rou, 2018. Malaysia.

Gluten-free tortilla with mushroom flavor is a selection of food for the patients who suffered from celiac disease, as gluten-free is a new healthy trend nowadays.

The objective of this study was to develop a gluten-free tortilla with additional nutritional value compared to commercial wheat flour tortilla.

In conclusion, the developed formulation could be potentially applied as a nutritional gluten-free product.

Wheat, Corn, Flour Quality/Tortilla Quality

Wheat, Corn, Flour Quality

High protein and gliadin content improves tortilla quality of a weak gluten wheat

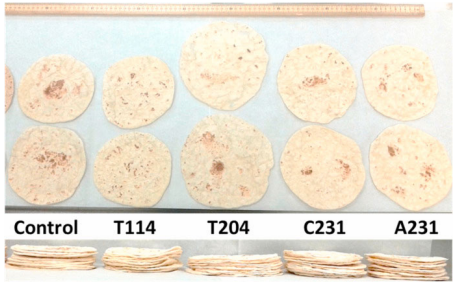
Dizlek et al., 2022. Turkey, USA.

Flatbreads, like tortillas, are specialty breads that require extensible dough to reduce shrinking and sufficient protein content (10–12%) to maintain flexibility in storage.

This study compared wheat varieties bred for differing properties (high protein content, ruminant grazing quality, specialty breads) to identify potential desirable traits for tortillas and other flatbreads.

Flour with weak protein matrix but high protein content produced best tortillas. Best tortilla flour had highest ratio of monomeric: polymeric gluten proteins.

The relatively high gliadin concentration imparted dough extensibility and the high protein content allowed for flexibility throughout storage, though the same flour was previously found to produce poor bread quality. **Best tortilla flour in a variety rated poor for bread quality.**



Wheat, Corn, Flour Quality

Effect of wheat quality traits and glutenin composition on tortilla quality from the USDA Southern Regional Performance Nursery

Zhang et al., 2021. USA.

This study investigated the kernel and flour quality traits, dough rheological properties, and tortilla quality parameters, and glutenin composition of 131 wheat lines from 1995 to 2007 in SRPN.

A wide variation of wheat and flour tortilla quality traits was found among these wheat lines. **Increased protein content and dough strength significantly decreased tortilla diameter, but improved tortilla shelf life. Medium protein content and dough strength were ideal to produce good quality tortillas.** The 1RS translocation, and Glu-B1 and Glu-D1 loci significantly affected tortilla quality, and manipulation of HMW-GS composition or the 1RS translocation is the effective approach for improving tortilla quality.

Four wheat lines, viz. TAM 302, HBG0358, CO99W192, and CO99534 showed premium tortilla quality, which **could be important parental lines in a tortilla wheat breeding program.**

Wheat, Corn, Flour Quality

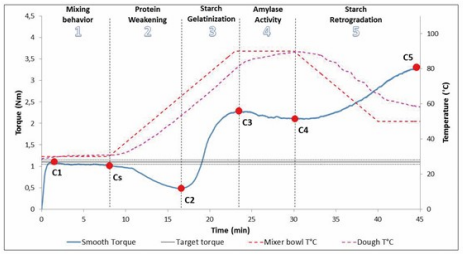
Evaluation of the quality of nixtamalized maize flours for tortilla production with a new Mixolab protocol

Espinosa-Ramírez et al., 2020. Mexico, Spain.

In the present study, a Mixolab protocol was set up for the analysis of nixtamalized maize flours, NMF and to predict mixing conditions in tortilla making. The validity of the procedure was tested with 10 commercial samples.

Mixolab curves permitted to characterize the nixtamalized maize flours dough development time, mixing stability, starch gelatinization, starch gel stability, and retrogradation. This analysis was efficient to discern among the quality of different samples. Good correlations among the Mixolab parameters and the tortilla moisture and texture confirmed the validity of the method.

The optimized Mixolab test proved to be a useful tool to evaluate the quality of nixtamalized maize flours and the new Mixolab protocol could be used to predict relevant process parameters for tortilla production.



Wheat, Corn, Flour Quality

Quality Parameters of Masa and Tortillas Produced from Blue Maize (Zea mays sp. mays) Landraces

Chimimba et al., 2019. France, USA.

https://en.wikipedia.org

There is increasing interest in the production of landrace blue maize varieties for the production of traditional foods and for specialty (non-commodity) products. Most varieties have soft (floury) endosperm and their suitability for thermo-alkaline processing is not known.

They examined the physical and functional properties of eight floury varieties with those of three dent and one flint variety for masa and tortilla production.

The results showed variation among varieties in the kernel, masa, tortilla hardness, as well as in extensibility of the tortillas.

Southwestern blue floury maize varieties are suitable for nixtamalized tortilla production. Variation between varieties was observed for quality parameters. **Floury varieties require shorter cooking time, but it is recommended that nixtamalization parameters be optimized.**

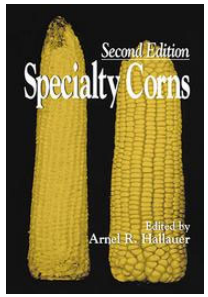
Fatty acids and starch properties of high-oil maize hybrids during nixtamalization and tortilla-making process

Preciado-Ortíz et al., 2018. Mexico.

The objective of this work was to evaluate changes in the fatty acids profile and starch properties during nixtamalization and tortilla-making processes of high-oil maize (HOM) hybrids. (A normal maize grain has 3.5–5.1% oil content, maize hybrids with higher than 6% of this component are known as “high-oil maize”).

HOM grains had more linoleic acid than normal maize, and it decreased significantly from raw maize to tortilla, probably due to saponification and by its participation in the amylose-lipid complexes formation. Tortillas from HOM showed similar retrogradation degree after 48 h of storage as revealed by thermal analysis, and this was reflected in the texture as reflected by the tensile strength and elongation values.

High-oil maize hybrids can be used for nixtamalization and tortilla preparation, but the higher oil content could not give an advantage for reducing tortilla staling.



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Processing/Tortilla Quality

Processing

Understanding the functionality and manufacturing of nixtamalized maize products

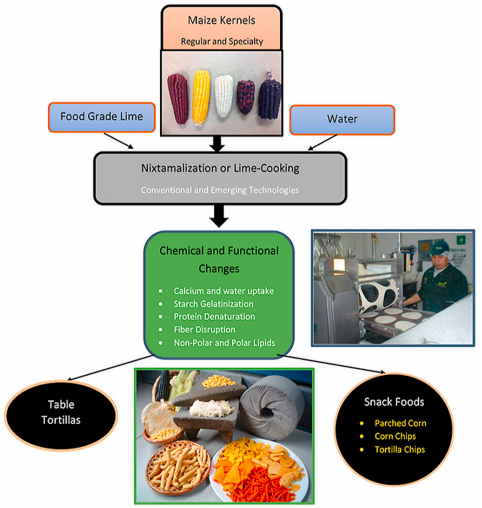
Serna-Saldivar, 2021. Mexico.

This paper reviews the functionality of ingredients, physicochemical changes incurred during processing and the current state of nixtamalized processes for table tortillas and snacks produced from regular and specialty maize types.

The most promising specialty genotypes are quality protein, high-oil, blue, Cuzco/Cacahuacintle and nutritionally enhanced types.

In terms of novel nixtamalization procedures, extrusion, ohmic, microwave and infrared represent promising alternatives for production of new whole-grain nixtamalized products with the usage of less energy, water and plant space. The main advantage of these green technologies is the lack of wastewaters or the necessity to treat the high-alkaline effluents of the traditional and regular processes.

The future of nixtamalization is bright because the plant breeding of high producing nutritionally enhanced genotypes plus the alternatives of new processing technologies is the ground for development of innovative products.



Processing

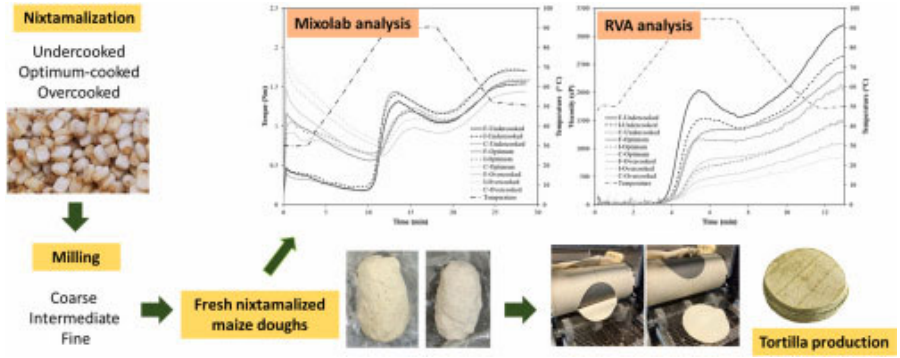
Assessment of the quality of fresh nixtamalized maize doughs with different degrees of cooking and milling: A comparison of Mixolab and RVA analyses

Espinosa-Ramírez et al., 2021. Mexico.

In the present study, we used the Mixolab to analyze fresh nixtamalized maize doughs produced with three degrees of cooking (undercooked, adequate cooked and overcooked) and milled to produce coarse, intermediate and fine doughs.

The results obtained in the present study validated that it is possible to analyze fresh nixtamalized doughs using the Mixolab 2 and predict the degree of starch pre-gelatinization and starch damage produced during different cooking and milling conditions and Mixolab may be useful to predict the quality of tortillas.

The Mixolab results obtained for the nixtamalized maize doughs that were used to produce tortillas, showed significant correlations with their quality features.



Processing

Relaxation tests and textural properties of nixtamalized corn masa and their relationships with tortilla texture

Topete-Betancourt et al., 2020. Mexico.

Texture is one of the most important quality factors of tortillas: they should be soft, extensible, and easily rollable without cracking and good tortilla texture is strongly correlated with an appropriate masa texture.

The relationships among the viscoelastic and textural properties of corn masa **obtained using several nixtamalization processes** and the texture of tortilla were studied.

An important observation was that the degree of gelatinization of the nixtamalized corn flour strongly influenced all of the rheological and textural properties of masa, as well as the textural characteristics of tortillas. Therefore, special attention must be paid to this aspect to understand their effects on nixtamalized corn-based products.

The results suggest that relaxation parameters showed better results than texture profile analysis for predicting masa and tortilla quality including the texture of both fresh and stored tortillas.

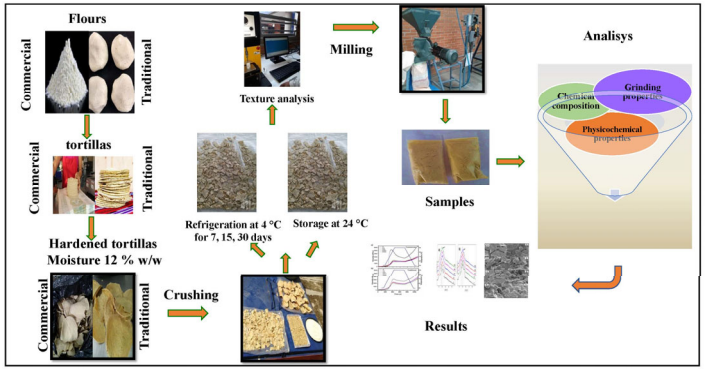
Processing

Physicochemical Properties and Resistant Starch Content of Corn Tortilla Flours Refrigerated at Different Storage Times

Rojas-Molina et al., 2020. Mexico.

The objective of this work was to evaluate, the physicochemical properties and resistant starch content of flours. These were obtained from nixtamalized corn tortillas made with traditional and industrial (commercial) methods, stored at 4°C for 7, 15, and 30 days.

Storage at 4°C increased the friability (crumbly) of tortillas. The commercial corn tortilla flours showed higher water absorption index and water solubility index values than the traditional corn tortilla flours. On the other hand, the traditional corn tortilla flours exhibited higher resistant starch content values than commercial corn tortilla flours as well as peak viscosity.



Processing

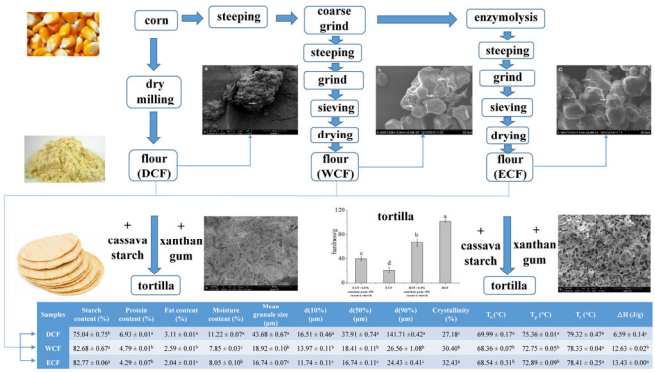
The Properties and Tortilla Making of Corn Flour from Enzymatic Wet-Milling

Liu et al., 2019. China.

Corn flour was prepared by wet-milling with the treatment of neutral protease and the gelatinization, thermal, and rheological properties were analyzed.

Tortilla was prepared with enzyme treated corn flour and additives (xanthan gum and cassava starch) and the properties were analyzed. Compared with dry-milling corn flour and wet-milling corn flour, the enzyme treated corn flour had less average particle size, higher peak viscosity and higher final viscosity, respectively.

The gel structure of tortillas made of enzyme treated corn flour was homogeneous in distribution of pores. **The gelatinization, thermal and rheological properties of corn flour were improved by addition of neutral protease. The addition of xanthan gum and cassava starch helped to make the tortilla with porous structure and good sensory quality.**



Processing

The in vitro digestibility of starch fractions in maize tortilla can be rendered healthier by treating the nixtamalized masa with commercial baking yeast

Vernon-Cartera et al., 2018. Mexico.

The aim of this study was (i) to explore the effect of adding baking yeast with amylolytic activity to masa obtained from nixtamalized maize flour on viscoelasticity, total sugars and apparent amylose content; and (ii) to produce tortillas from the yeast-treated masa, evaluating their hardness and in vitro starch digestibility, when freshly made and after four days of storage.

Baking yeast treatment of maize masa reduced sugars and apparent amylose content.

Tortillas made with treated masa exhibited reduced contents of rapidly digestible starch and increased content of resistant starch.

Baking yeast treatment led to tortillas with reduced hardness. Hardness of the yeast-treated tortillas was significantly lower and remained practically without change during storage, while the untreated tortillas hardened significantly.

Treatment with baking yeast induces beneficial health and textural effects in tortillas.

Staling/Shelf Life/Tortilla Quality

Nutritional/Sustainability/Consumer Acceptability/Tortilla Quality

Cricket (Acheta domesticus) protein hydrolysates' impact on the physicochemical, structural and sensory properties of tortillas and tortilla chips

Calzada, et al., 2021. USA.

Consumer interest towards consumption of more sustainable protein sources has led way towards the adoption of insect protein for human food applications. Research shows that insect proteins utilized as food ingredients are more promising to be accepted by Westerners. In this study, cricket protein hydrolysates, CPH were produced using Alcalase, AL and Flavourzyme, FL proteases. The physicochemical and structural properties, as well as the sensory acceptability of corn tortillas formulated with 20% (w/w) CPH were evaluated.

CPH-tortillas contained all essential amino acids, including 40% of the daily lysine requirement. AL-CPH and FL-CPH had different impacts on elastic modulus of raw corn masa (dough), and hardness and extensibility values of tortillas. **Sensory evaluation results showed acceptability towards tortillas chips formulated with 20% CPH.**

Enzymatic hydrolysis of cricket protein can create peptides with functional characteristics and sensory acceptability for their use as ingredients in food formulation.

Staling/Shelf Life

Obtaining and encapsulation of a hydrolysate with antifungal potential from the fermentation of sub-products of tortilla corn with lactic acid bacteria

Mares-Mares et al., 2021. Mexico.

The objective of the present work as to obtain and microencapsulate a hydrolysate fermented using lactic acid bacteria (for increase antifungal activity) from tortilla corn sub-products.

Hydrolysate fermented with Lactobacillus rhamnosus showed the highest inhibition percentages against the mold tested, therefore it considered as the most viable alternative for obtaining a hydrolysate ingredient for tortilla corn self-conservation. Finally, the hydrolyzed fermented with lactobacillus rhamnosus was mixed with maltodextrin to be microencapsulated by spray drying.

In conclusion, lactic acid bacteria can functionalize hydrolysate tortilla corn sub-products, through the production of antifungal compound and the microencapsulation process preserves antifungal activity to increase shelf life.

Staling/Shelf Life

Amylose lipid complexes formation as an alternative to reduce amylopectin retrogradation and staling of stored tortillas

Mariscal-Moreno et al., 2019. Mexico, USA.

The impact of addition of palmitic acid, PA on the amylose-lipid complexes formation and their influence on amylopectin retrogradation were studied.

Tortillas prepared with 0.0%, 1.0% and 1.5% (w/w) of palmitic acid were stored for 0, 7, and 14 days at 4°C.

Tortillas with 1.0% and 1.5% of palmitic acid were softer than tortillas without palmitic acid during storage time; this change can be associated with reduction in starch retrogradation. Texture evaluation suggests that retrogradation reduction, influences directly tortilla texture.

Addition of palmitic acid to masa during tortilla-making process may be an alternative strategy to reduce starch retrogradation and tortilla staling.

Staling/Shelf Life

A novel, simple, economic, and effective method for retarding maize tortilla staling

Alvarez-Ramirez et al., 2018. Mexico.

Staling of maize tortillas is a major drawback affecting their manufacture, commercialization, and consumption.

In this work, a novel, simple, economic and effective method is proposed, based on adding completely gelatinized nixtamalized maize flour, GMF dispersion to the basic masa formulation recipe in substitution of 50, 100 and 150 g kg−1 of water.

Masa added with GMF showed increased water retention capacity, reduced freezable water content, and improved flow and dynamic rheological properties and produced tortillas with decreased firmness. All the above indicators were more pronounced the higher was the GMF content.

This work showed that GMF can play the role of a self-hydrocolloid anti-staling agent by retarding the retrogradation of maize starch and deterring the loss of water and rheological properties of masa and the increase in undesirable sensory characteristics of tortilla such as increased firmness.

Nutritional/Sustainability/Consumer Acceptability/Tortilla Quality

Use of online questionnaires to identify emotions elicited by different types of corn tortilla in consumers of different gender and age groups

Santiago-Cruz et al., 2021. Mexico, USA.

The objective of the study was to identify the emotions that are usually elicited by four types of corn tortillas available in the Mexican market (homemade, from tortilla store, from supermarket, and plastic bagged).

An internet survey was conducted with 378 Mexican consumers. Gender and age factors were used to identify differences on emotions elicited by the four tortilla types. Emotions such as happy, pleasant, mild, good nature, enthusiastic, free, warm, loving, joyful, adventurous, secure, and nostalgic were associated with homemade corn tortillas. Also, emotions such as good, active, and calm were associated with tortilla from tortilla store. Supermarket corn tortilla and plastic bagged corn tortilla elicited negative emotions such as wild, aggressive, disgusted, guilty, worried, and bored. **Differences were found among age groups suggesting generational effects rather that gender effects on elicited emotions in consumers.**

Findings from this study highlight the emotions elicited by the consumption of different types of corn tortillas in people of different gender and age that may be related to the purchase intention of consumers of this product.

Nutritional/Sustainability/Consumer Acceptability/Tortilla Quality

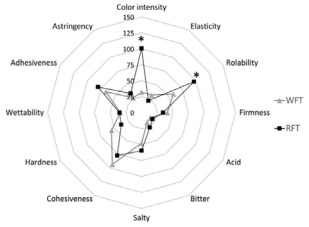
Brosimum alicastrum Sw. (Ramón): An Alternative to Improve the Nutritional Properties and Functional Potential of the Wheat Flour Tortilla

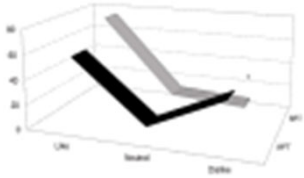
Subiria-Cueto et al., 2019. Mexico.

The wheat flour tortilla, WFT is a Mexican food product widely consumed in the world, despite lacking fiber and micronutrients. Ramón seed flour, RSF is an underutilized natural resource rich in fiber, minerals and bioactive compounds that can be used to improve properties of starchy foods, such as Wheat Flour Tortilla.

Results indicated that Ramon Flour Tortilla (25% RSF) had higher dietary fiber and mineral content than Wheat Flour Tortilla. Two sensory attributes were significantly different between Ramon Flour Tortilla and Wheat Flour Tortilla, color intensity and rollability. RFT was soft and it was accepted by the consumer. Phenolic compounds and antioxidant capacity were higher in Ramon Flour Tortilla than Wheat Flour Tortilla.

These results show that Ramon Seed Flour can be used as an ingredient to improve nutritional and antioxidant properties of traditional foods, such as the Wheat Flour Tortilla.





Food Safety/Tortilla Quality

KPM Analytics

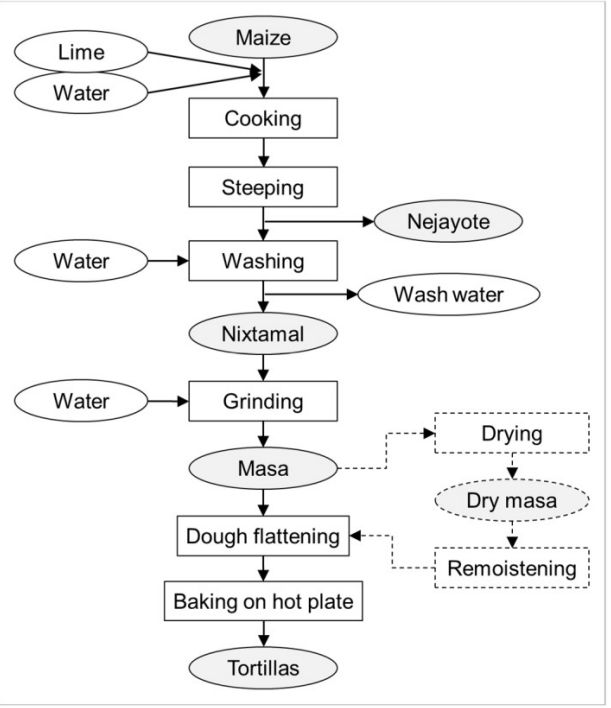
Mycotoxins during the Processes of Nixtamalization and Tortilla Production

Schaarschmidt and Fauhl-Hassek, 2019. Germany.

This article summarizes the current knowledge on mycotoxin changes during the nixtamalization of maize and tortilla production. **Upon nixtamalization, mycotoxins can be affected in different ways**. On the one hand, the toxins can be physically removed during steeping and washing. On the other hand, mycotoxins might be degraded, modified, or released/bound in the matrix by high pH and/or high temperature.

This also applies to the subsequent baking of tortillas. Many studies have shown reduced mycotoxin levels in alkali-cooked maize and in tortillas. Most of the available data relate to aflatoxins and fumonisins.

However, some studies have indicated the potential formation of toxicologically relevant modified forms and matrix-associated fumonisins. More data are required to assess the influence of alkaline cooking regarding such modified forms, as well as mycotoxins other than aflatoxins/fumonisins.



CONCLUSION

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- **This literature review was limited with the last 4 years (2018-2022) and peer-reviewed articles.**
- **The literature review is an integral part of any kind of research process. It provides foundation of knowledge on topic; identify areas of prior scholarship to prevent duplication; identify inconstancies: gaps in research, conflicts in previous studies, open questions left from other research; identify need for additional research (justifying your research) and place your own research within the context of existing literature making a case for why further study is needed.**
- **The future of tortilla industry is bright because the plant breeding of high producing nutritionally enhanced both wheat and corn genotypes, novel ingredients, new processing technologies as well as enhanced production equipment and quality testing instruments!**

KPM Analytics Introduction

KPM ANALYTICS

Global Leader in Analytical Instrumentation

KPM Analytics enables food producers to effectively manage product quality and protect the value of their brands

Our Brands

AMS Alliance | BRUINS INSTRUMENTS | CHOPIN TECHNOLOGIES | EyePro System | PROCESS SENSORS CORPORATION | Sensortech Systems | SIGHTLINE | Unity Scientific

Industries

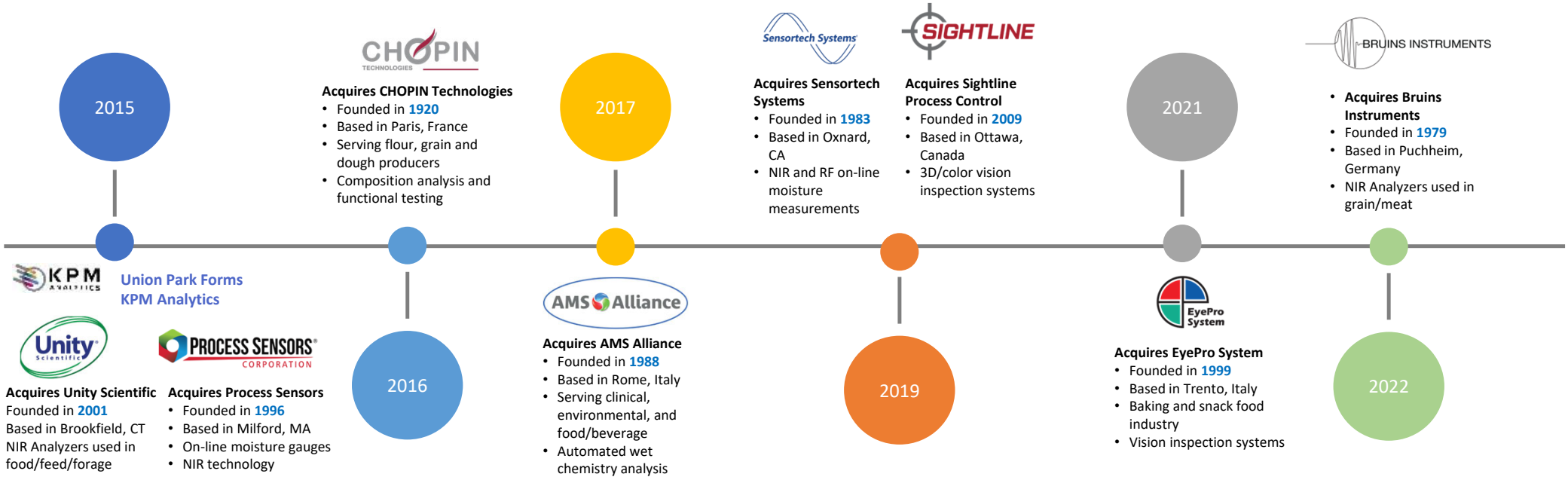
Impacting Quality Across the Entire Value Chain

KPM Analytics provides critical insight and analysis for companies to achieve the highest quality standards at every step of their process

Our solutions provide rapid, precise, and repeatable data that directly impacts business results

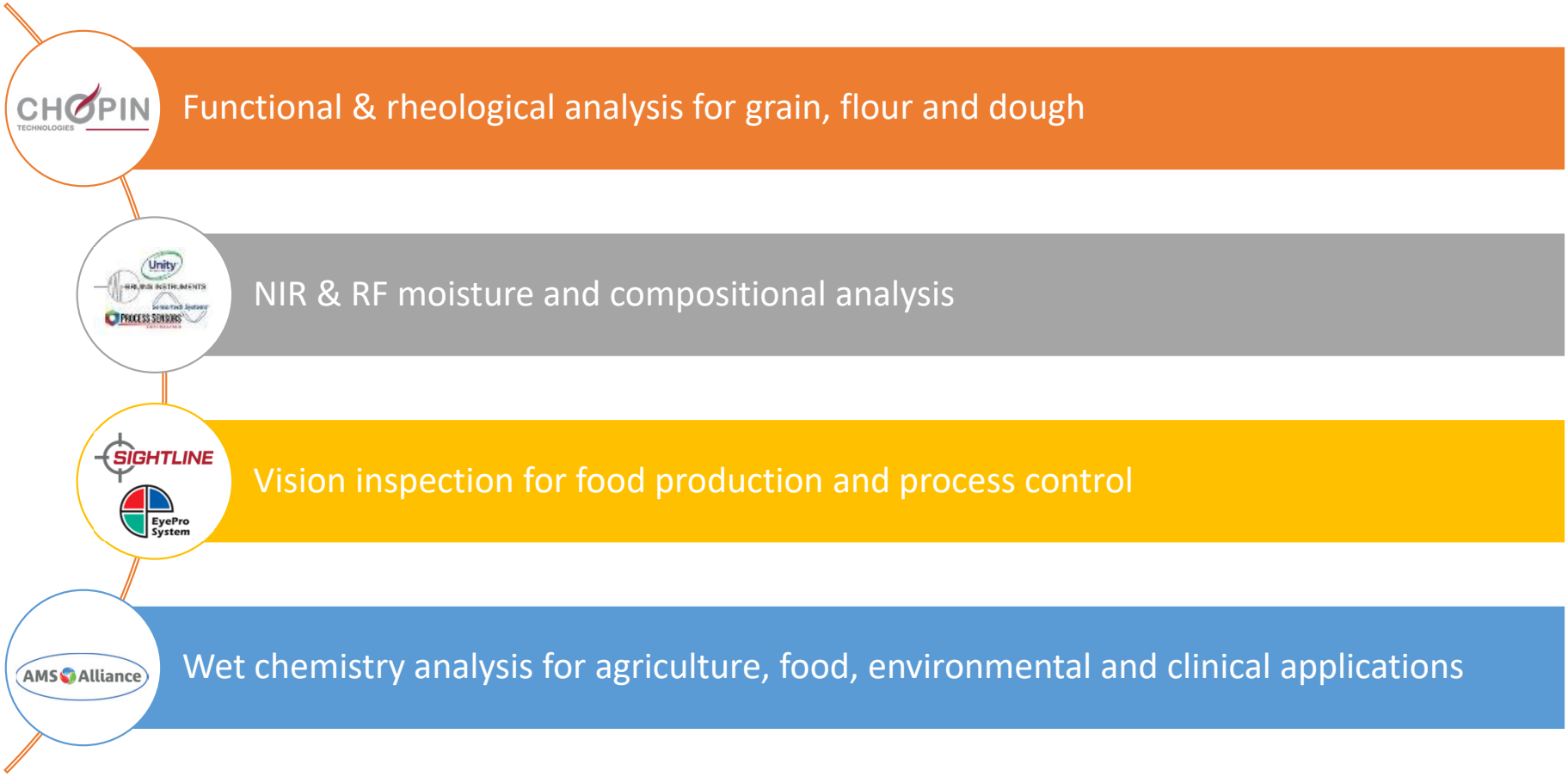
We help food producers reduce waste and costs, increase energy efficiency, improve quality, and protect their brands

Timeline and Growth of KPM Analytics

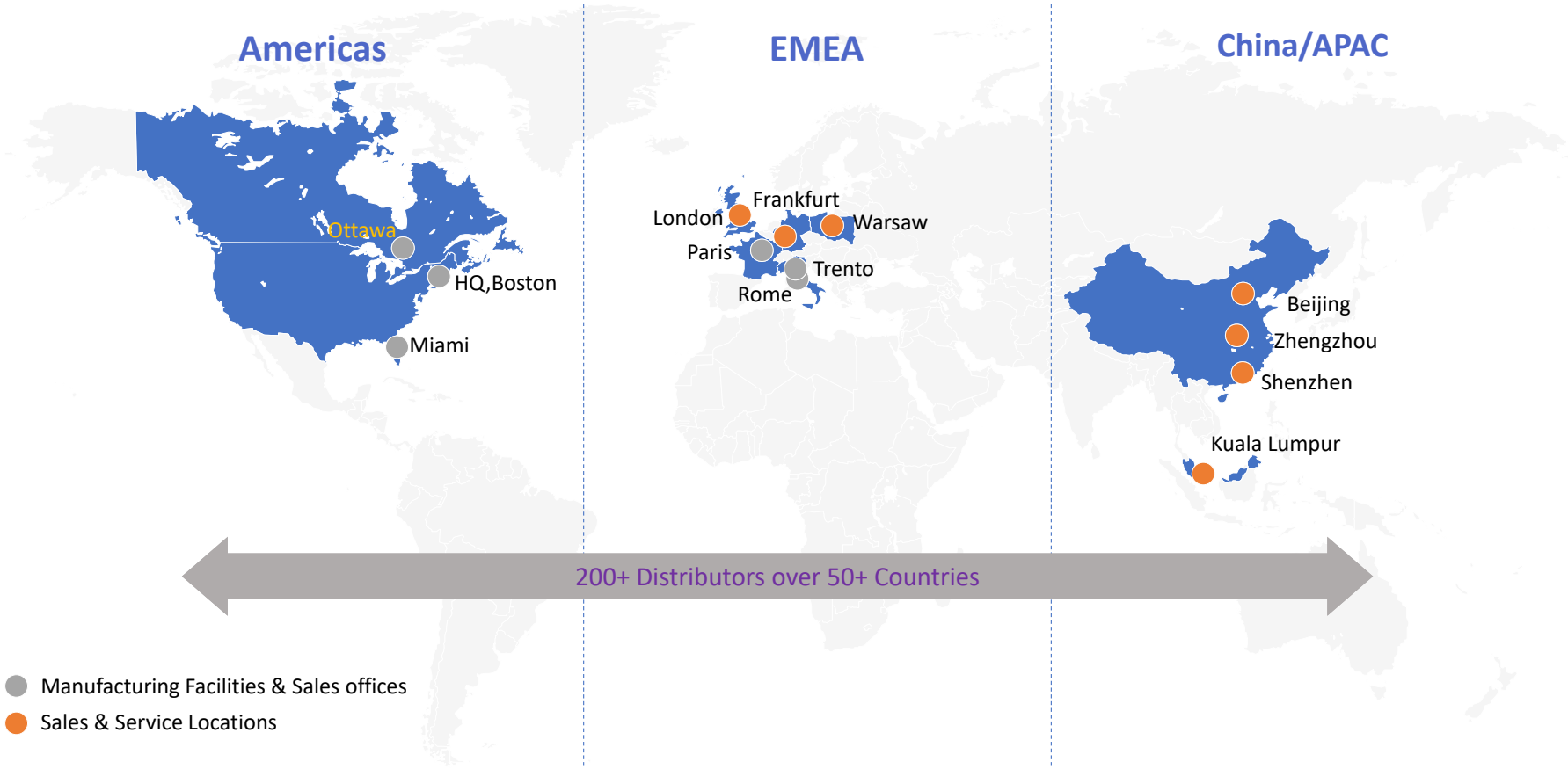


KPM Analytics brands have long and successful histories servicing customers worldwide

Broad Range of Products and Technologies



Extensive Global Sales and Service Network



Thank you!

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