Tortilla Wheat Flour Characteristics and Quality

Dr. M. Hikmet Boyacioglu
Cereal/Grain Scientist
Applications Development Specialist
KPM Analytics
hboyacioglu@kpmanalytics.com

CHOPIN TECHNOLOGIES

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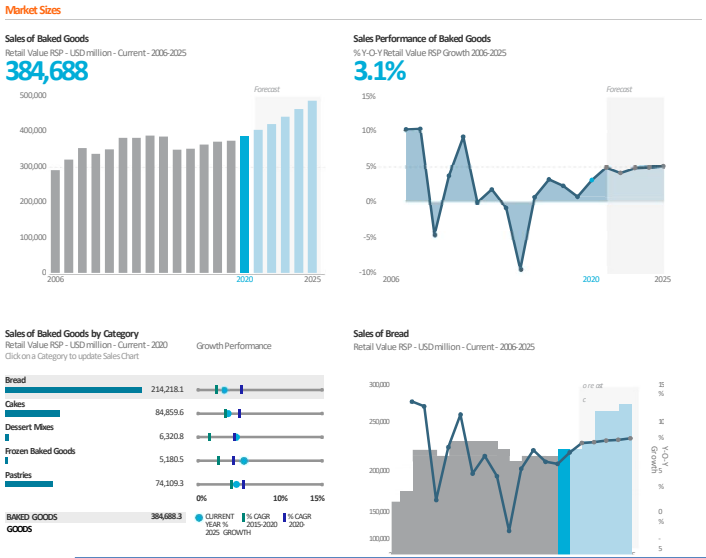
Baked Goods in the World

Passport

BAKED GOODS IN WORLD - DATAGRAPHICS

Datagraphics | Feb 2021

Sales of Baked Goods		
Year	Retail Value RSP USD million	Y-O-Y Growth, %
2020	384,688.30	3.1
2025	485,620.10	



Baked Goods
Bread
Cakes
Dessert Mixes
Frozen Baked Goods
Pastries

Sales of Baked Goods by Category			
Category	Category Value, USD million	Current Year Growth	%CAGR {Forecast} 2020-2025
Bread	214,218.1	2.7	4.8
Flat Bread	31,969.9	5.9	6.7

Euromonitor International, 2021

Industry Challenges

- **There are many different types of tortillas and great variation in manufacturing processes!**

Different types of flours are required for different tortilla processes; hot-press, die-cut, and hand-stretch. Dough preparation and ingredient utilization vary among different operations. Each operation involves a unique dough-forming procedure that then requires specific flour characteristics.

Consequently, tortillas have different properties and end uses.

Bejosano and Alviola, 2015

Wheat flour is the major and most-relevant ingredient used for manufacturing flour tortillas and **the quality of the finished product depends greatly on the quality of the flour.**

Wheat flour requirements are determined by the desired tortilla characteristics, the formula, processing conditions, and equipment.

Industry Challenges

Tortilla flour is considered by milling companies to be a specialty type of flour. It is milled for the tortilla industry as a grade separate from bread, pastry, or all-purpose flours.

Enriched, lightly bleached, hard-wheat flour is generally used for tortillas. It is made from proprietary blends of hard red winter wheat.

Bejosano and Alviola, 2015

Hard Red Winter

Versatile, with excellent milling and baking characteristics for wheat foods like hearth breads, hard rolls, croissants and flat breads.

U.S. WHEAT ASSOCIATES

Tortilla Flour Characteristics

Major Flour Constituents Affecting Tortilla Quality

Protein Quantity & Quality

Most flour tortillas are made using all-purpose flours containing intermediate protein content of around 11%. The milling operations use wheat blends in order to obtain the most suitable flours for this application.
Flours with stronger protein quality are used in hand-stretch and die-cut tortilla operations, while a wider variety of flours is used in hot-press operations.

A strong-protein flour makes tortillas with smaller diameter but with longer shelf stability.
On the other hand, a weak protein-strength flour makes larger-diameter tortillas that have short shelf stability.
Thus, flour with intermediate protein quality would be appropriate.

Tortilla Flour Characteristics

Major Flour Constituents Affecting Tortilla Quality

Protein Quantity & Quality

WHY?

Protein affects;

Size & Shape, Rollability, Appearance (Cracks, Edges, Pillowing, Texture), Stickiness, Less retention of flexibility during storage, Shelf Life!

Flour protein quality appears to have greater impact on tortilla properties than does protein quantity!

Tortilla Flour Characteristics

Major Flour Constituents Affecting Tortilla Quality

Starch

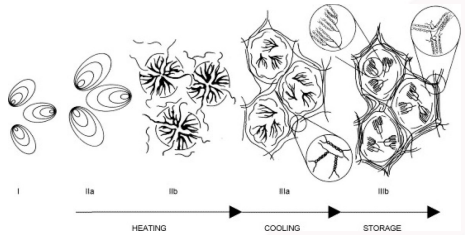
Damaged starch, Retrogradation, Starch particle size, Amylose content

Starch damage in flour affects the properties of tortillas. As starch damage increased, flour tortillas becomes less stretchable, and firmness and rollability increases.
To make a tortilla with acceptable rollability, starch damage should not be too high.

Mao and Flore, 2001

After baking, the starch will tend to partially recrystallize. This phenomenon is called retrogradation and explains why the products become hard (stale).

The faster the starch retrogradation, the faster the tortillas will lose its freshness. As a result, flours with slow retrogradation are favored.



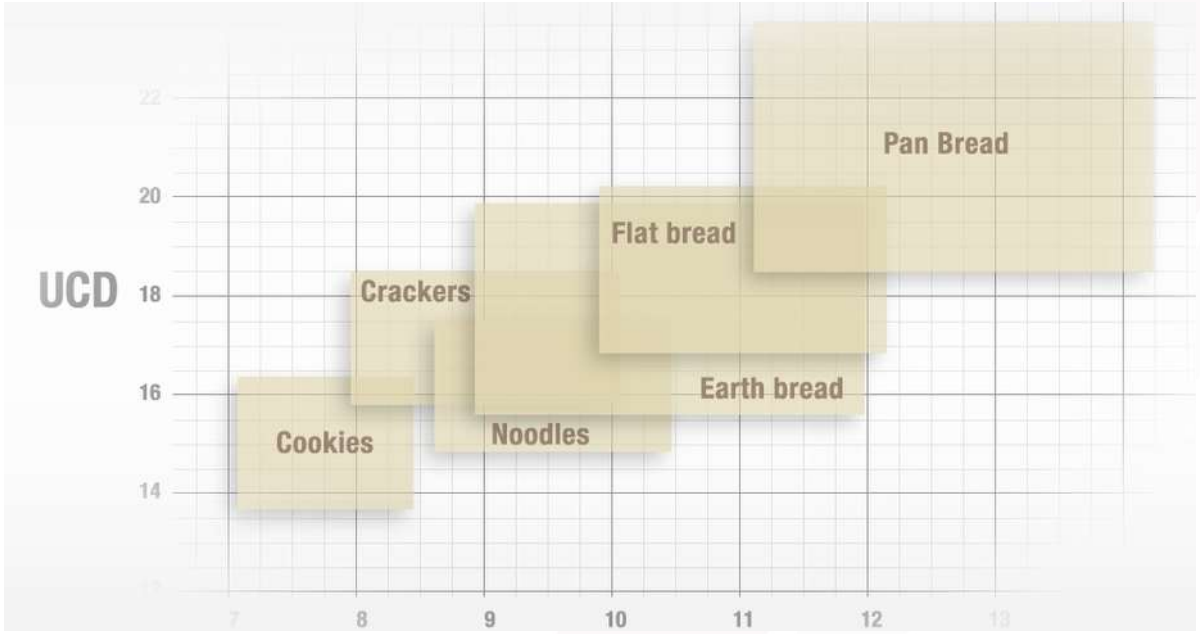
Wang et al 2015

Tortilla Flour Characteristics

Major Flour Constituents Affecting Tortilla Quality

Starch
Damaged starch

For any product, there is an optimum level of starch damage!



Tortilla Flour Characteristics

Major Flour Constituents Affecting Tortilla Quality

Starch

Damaged starch, Retrogradation, Starch particle size, Amylose content

Flours with larger starch granules, were found to produce better tortilla texture.

Flour amylose content greatly affected tortilla textural characteristics. **Mao and Flore, 2001**

Guo et al 2003

WHY?

Starch affects;

Rollability, Appearance (Cracks, Texture), Stickiness, Shelf Life!

Tortilla Flour Characteristics

Physical Dough Properties/Dough Rheology

Water Absorption

This is the quantity of water that can be added to the flour to give it the necessary plasticity (firmness, extensibility, elasticity).

The addition of lower or higher levels of water than the optimum results in tough or slack doughs, respectively, that cause problems downstream.

Tortillas require less water compared to bread doughs.

The amount of water that any flour can absorb increases with high levels of protein, damaged starch (particle size) or pentosans.

WHY?

Water absorption affects;

Size & Shape, Appearance (Pillowing), Stickiness (Overhydration), Shelf Life!

Tortilla Flour Characteristics

Physical Dough Properties/Dough Rheology

Mixing Time

Appropriate dough for tortillas is the result of many factors and is the most important parameter to control in tortilla operations.

The under-and overmixing modify dough texture, gluten development, and tortilla quality.

The goal is to generate optimally developed doughs that will process adequately and generate the best-quality
tortillas.

WHY?

Mixing time affects;

Size & Shape, Appearance, Stickiness, Shelf Life!

Tortilla Flour Characteristics

Physical Dough Properties/Dough Rheology

Dough Consistency

Dough consistency depends on the amount of water added and the ability of the flour to absorb it.

This consistency changes during mixing, reflecting the formation of the gluten network. For any given level of hydration, the consistency of the dough represents its firmness, its hardness.

This depends, at the moment, on the quantity and quality of the proteins, the starch damage, and the pentosans.

Tortilla Flour Characteristics

Physical Dough Properties/Dough Rheology

Extensibility

Extensibility is the capacity of the dough to be stretched without breaking.

For a given consistency, it depends mainly on the quality of the protein network.

Dough that is not very extensible will not spread during pressing; conversely, dough that is too extensible will not hold shape well enough.

WHY?

Extensibility affects;

Size & Shape, Appearance!

Tortilla Flour Characteristics

Physical Dough Properties/Dough Rheology

Elasticity

Elasticity is the tendency of the dough to return to its initial position after its shape is dist
such as by pressing.

It takes a certain level of elasticity for the dough to be machinable. If the elasticity is too low, the dough won't hold shape; if it is too high, the dough will tend to retract, which impacts the appearance of the finished product.

WHY?

Elasticity affects;

Size & Shape, Appearance!

The rheological properties of dough determine its behavior during dividing, rounding and molding, as well as the quality of the finished products!

Tortilla Flour Characteristics

Tortilla Quality

The ultimate measure for determining the baking performance of flours for tortillas is the baking test.

- Good quality tortillas are symmetrical, uniform and opaque with toasted spots!
- They should also be soft, flexible without cracking when folded, and puffed!
- Good quality wheat flour tortillas usually have large diameters (17-18 cm) and more than two weeks of shelf stability!

de Barros, 2009

Good-quality tortillas have been defined as tortillas that are symmetrical, uniform, opaque, toast-marked, puffed, soft, flexible without cracking, and having a long shelf life.

Brooker, 2015

Diameter, thickness, weight, specific volume, moisture, rollability, flexibility, appearance (crack/break, blisters), pillowing, color, opacity, firmness, …!

Major Flour Constituents Affecting Tortilla Quality

Measuring moisture and protein levels by near-infrared analysis (NIR)

The **Infraneo** is a near-infrared (**NIR**) analyzer that works on both whole and powdered grains. It uses transmittance and monochromator technology. Simple, reliable, and precise, it can rapidly measure many parameters, such as moisture and protein content, that affect the **absorption of water**, as well as the **stickiness**, the **consistency**, the **flexibility** and the **appearance**.

The **Spectralab** is an infrared analyzer that operates based on reflectance. With a wider measurement spectrum, it also determines **moisture** and **protein**.

Major Flour Constituents Affecting Tortilla Quality

Measuring amylase enzyme activity

Amylab FN measures the amylase enzyme activity of flours, based on the Hagberg falling number principle, the global reference method in the cereal industry.
It boats innovative technology (induction heating, aluminum tube) allowing it to be simpler and safer to use than conventional devices.
The Amylab FN can also be used in a rapid test mode, called the Testogram, which allows it to provide a result in 90 seconds, regardless of the sample.

Amylase enzyme activity impacts the flexibility of tortillas.

Major Flour Constituents Affecting Tortilla Quality

Measuring starch damage

The **SDmatic** allows for simple, fast, safe analysis of starch damage.

Based on the measurement of iodine absorption, it works on 1 gram of flour and provides results in only 10 minutes.
The reliability of the SDmatic has been confirmed in international collaborative studies. It is a standardized method recognized by AACC, ICC, ISO, CEN Afnor, Gost, etc.

Starch damage affects water absorption, stickiness, consistency, flexibility and retrogradation.

Major Flour Constituents Affecting Tortilla Quality

Measuring flour functionality

The **SRC-CHOPIN** is a means of measuring hydration based on the increased swelling capacity of the various flour polymers when they are in contact with particular solvents.

It performs 4 measurements in one automated test:

- ✓ Water absorption (Solvent: distilled water)
- ✓ Glutenins (Solvent: Lactic Acid)
- ✓ Damaged starch (Solvent: Sodium carbonate)
- ✓ Pentosans (Solvent: Sucrose)

The SRC-CHOPIN is a method recognized by the AACC.

It allows one to measure water absorption and factors influencing the stickiness and consistency of dough.

Major Flour Constituents Affecting Tortilla Quality

Measuring dough tenacity, extensibility, elasticity and baking strength.

The **Alveolab** has been an internationally recognized method (AACC, ICC, ISO, CEN, Afnor, Gost, and others) for many years; it measures the characteristics of dough during the swelling of a bubble.
Completely adaptable, the Alveolab directly measures:

- **Tenacity**, firmness (the resistance of the dough to deformation, its consistency)
- **Extensibility** (the ability to stretch the gluten network)
- **Elasticity** (the tendency of the dough to return to its original position after stress)
- **Strength**, force (the work required to deform the dough).

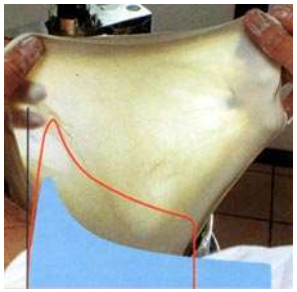
The Alveolab allows one to work with both constant hydration and adapted hydration.
It measures water absorption and characteristics of the dough such as extensibility, elasticity, and consistency which also impact the flexibility and appearance of tortillas.

How KPM Analytics Can Help You to Measure These Characteristics

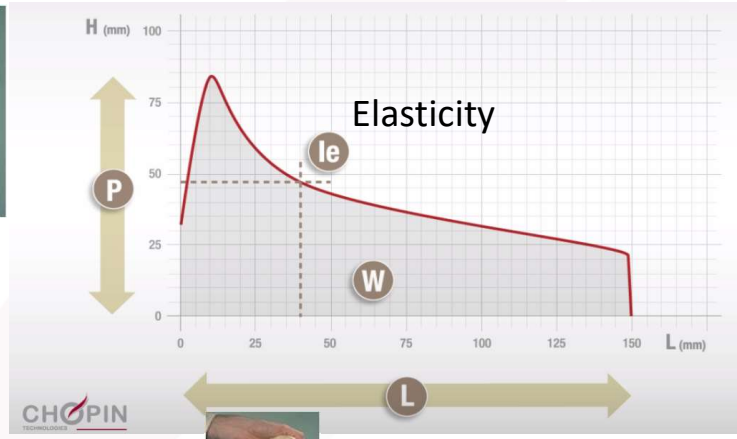
Major Flour Constituents Affecting Tortilla Quality

Measuring dough tenacity, extensibility, elasticity and baking strength.

Flour Strength



Tenacity



Elasticity

Extensibility

How KPM Analytics Can Help You to Measure These Characteristics

Major Flour Constituents Affecting Tortilla Quality

Measuring the characteristics of dough during mixing, as well as the quality of starch and protein.

The **Mixolab 2** is the only internationally standardized device (AACC, ICC, ISO, CEN, Afnor, Gost, etc.) that can perform a complete analysis of dough that is subjected to temperature increase.
It measures **dough hydration**, **mixing behavior** (consistency, development time, stability, and so on).
It is the only device that allows you to observe the changes in the dough at the beginning of heating as well as during **gelatinization** and starch **retrogradation**.

By working on representative doughs, the Mixolab 2 allows one to get as close as possible to the actual conditions of use of the flours.

How KPM Analytics Can Help You to Measure These Characteristics

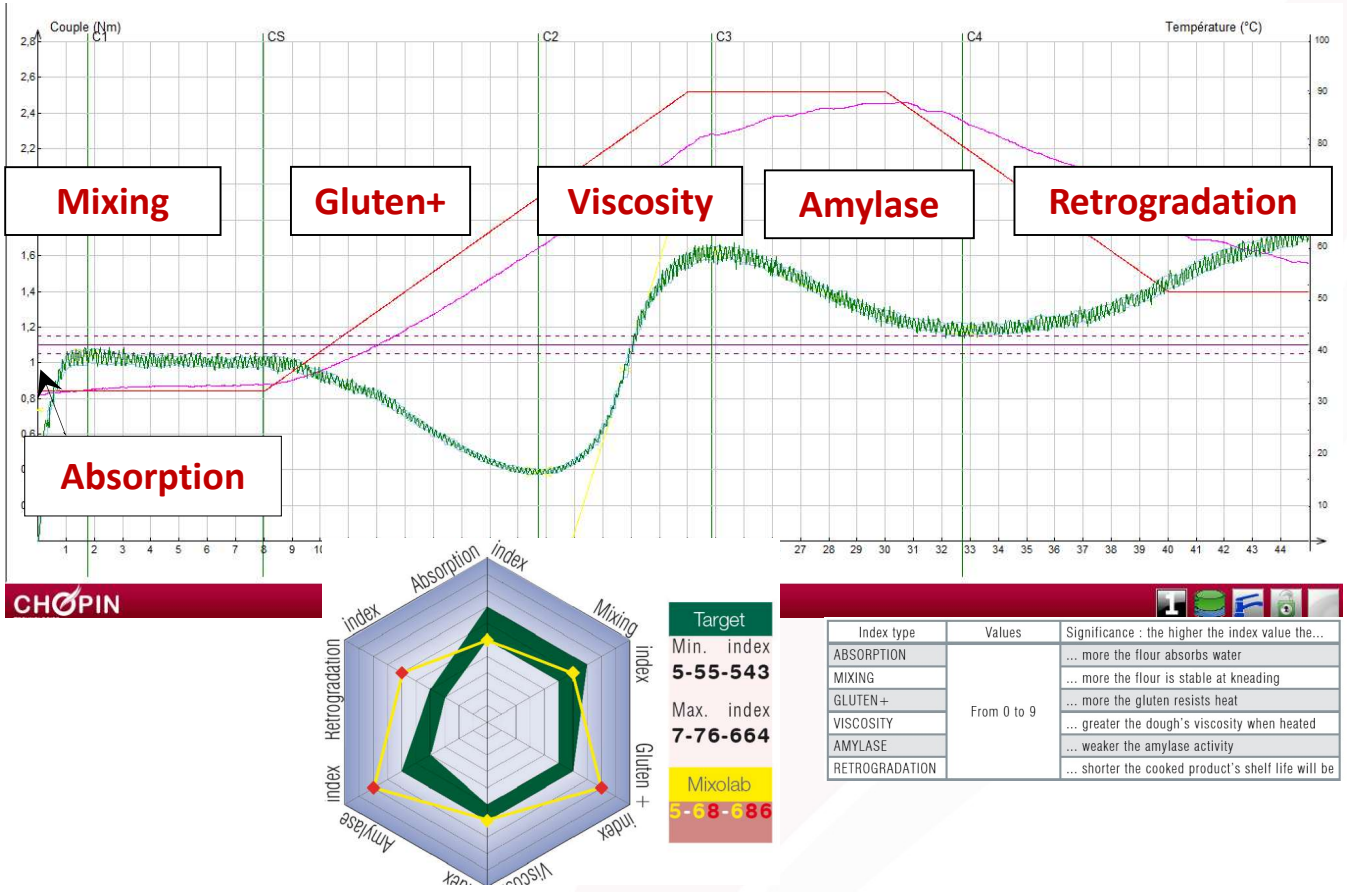
Major Flour Constituents Affecting Tortilla Quality

Measuring the characteristics of dough during mixing, as well as the quality of starch and protein.

Standard Mixolab Curve

How KPM Analytics Can Help You to Measure These Characteristics

Mixolab Profiler



Index type	Values	Significance : the higher the index value the...
ABSORPTION	From 0 to 9	... more the flour absorbs water
MIXING		... more the flour is stable at kneading
GLUTEN+		... more the gluten resists heat
VISCOSITY		... greater the dough's viscosity when heated
AMYLASE		... weaker the amylase activity
RETROGRADATION		... shorter the cooked product's shelf life will be

How KPM Analytics Can Help You to Measure These Characteristics

Major Flour Constituents Affecting Tortilla Quality

Measuring the characteristics of dough during mixing, as well as the quality of starch and protein.

"The Mixolab profiler showed that a good flour for hot-press tortillas had a relatively lower absorption and short dough mix time compared with a bread flour and should have a significantly higher gluten compared with an all-purpose flour.

Compared with bread flour, the tortilla flour had higher retrogradation and viscosity values.

The Mixolab profiler proved to be a good preliminary test to evaluate flours for hot-press tortillas.

This instrument showed that the best performing flours had a relatively lower absorption and short dough mix time compared with bread flour and a high gluten profile within the category of all-purpose flours."

Posner et al 2014

How KPM Analytics Can Help You to Measure These Characteristics

Solutions / Key Point	NIR	AMYLAB FN	SDMATIC	SRC-CHOPIN	ALVEOLAB	MIXOLAB 2
water absorption	X		X	X	X	X
Stickiness	(X)		X	X		
Dough consistency	(X)		(X)	(X)	X	X
Extensibility					X	
Elasticity					X	
Flexibility	X	X	X		X	X
Appearance	X				X	
Retrogradation			(X)			X

X: direct measurement. (X): indirect measurement

EyePro System

Product Inspection

CONFIDENTIAL

EXAMPLES **Tortilla, Flat Bread, Pizza Crust**

PRODUCTS

Corn/Flour Tortilla, Flat Bread, Pizza Crust

LINE CONFIGURATIONS

Line Width: 900-2300mm

Throughput: up to 1500pcs/min

SYSTEM MODULES

Top Side Inspection (Color & 3D)

Bottom Side Inspection (Color)

Automatic Learning

Real Time Statistics

Data Collection & Reporting

Pneumatic Rejection System

Hygienic Stainless Steel Frame

MEASUREMENT CAPABILITIES

2D/Shape (diameter, roundness)

3D/Height (peak, mean, slope)

Bake Color (Lab & BCU)

Topping/Toast Marks Conformity

Rim Conformity

DEFECT DETECTION CAPABILITIES

Misshapen products

Edge Defects (bites, straight edge)

Out of spec (e.g. small, too dark …)

Spots (light, dark, foreign mat.)

Topping defects (e.g. voids)

Holes

EyePro System products are leading the effort for incorporating vision technology in the baking and snack food industry.

SHAPE/2D CONTROL

LENGTH / WIDTH

DIAMETER / AREA

ASPECT / EDGES

BITES / TAGS

HOLES BURNT SPOTS

OVERLAPPING PRODUCTS

ROUNDNESS

FULL COLOR ANALYSIS

CIE-LAB OR BCU

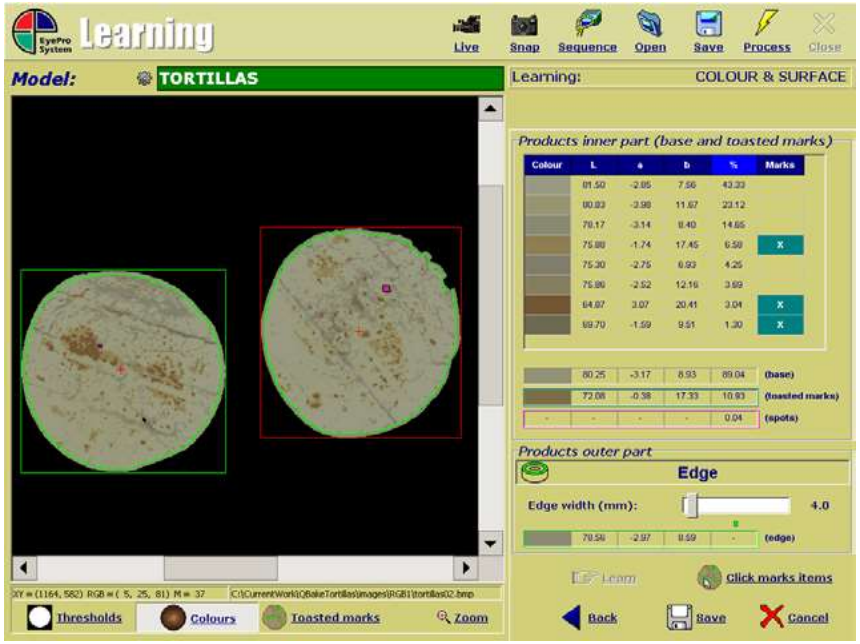
BAKE COLOR INTENSITY (MEAN/EDGE/CENTRE)

TOPPING (COLOR/DISTRIBUTION)

BURNS / RESIDUES

SPOTS / HOLES

SURFACE DEFECTS (TEXTURE)



Software Features

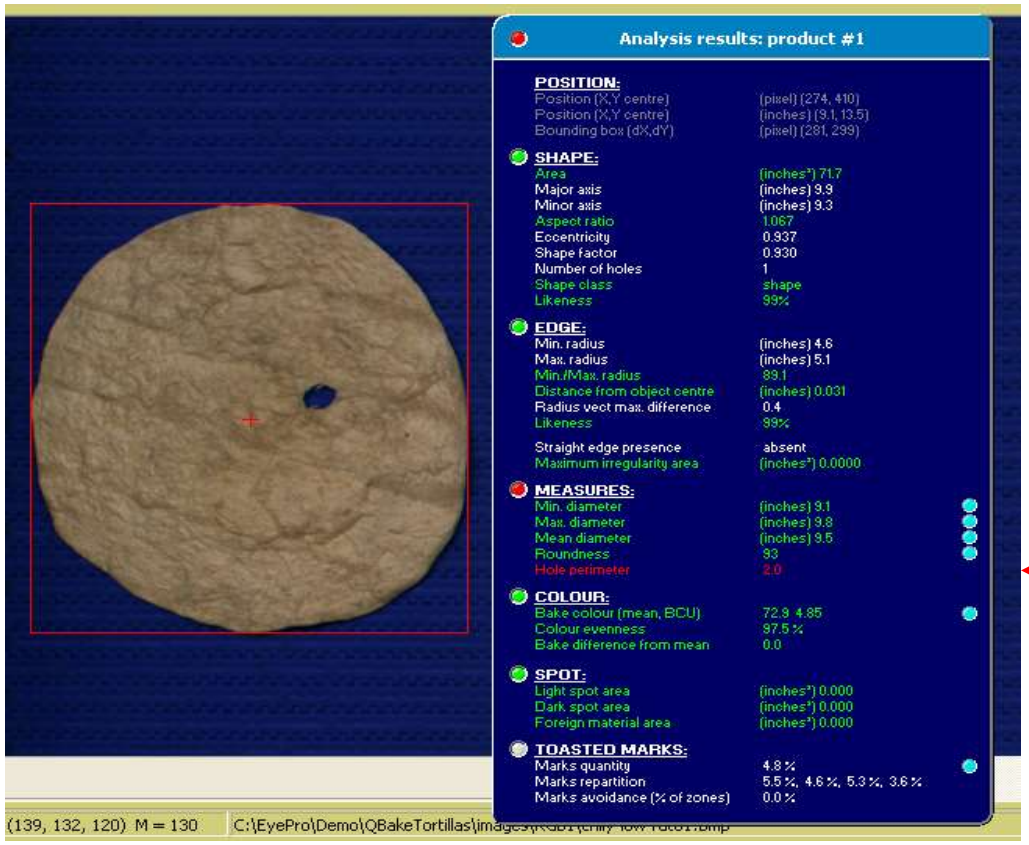
POSITION ON THE BELT

CONFORMITY OF THE SHAPE

PRESENCE OF DEFECTS ON THE EDGE

MEASURES (DIAMETER)

Software Features

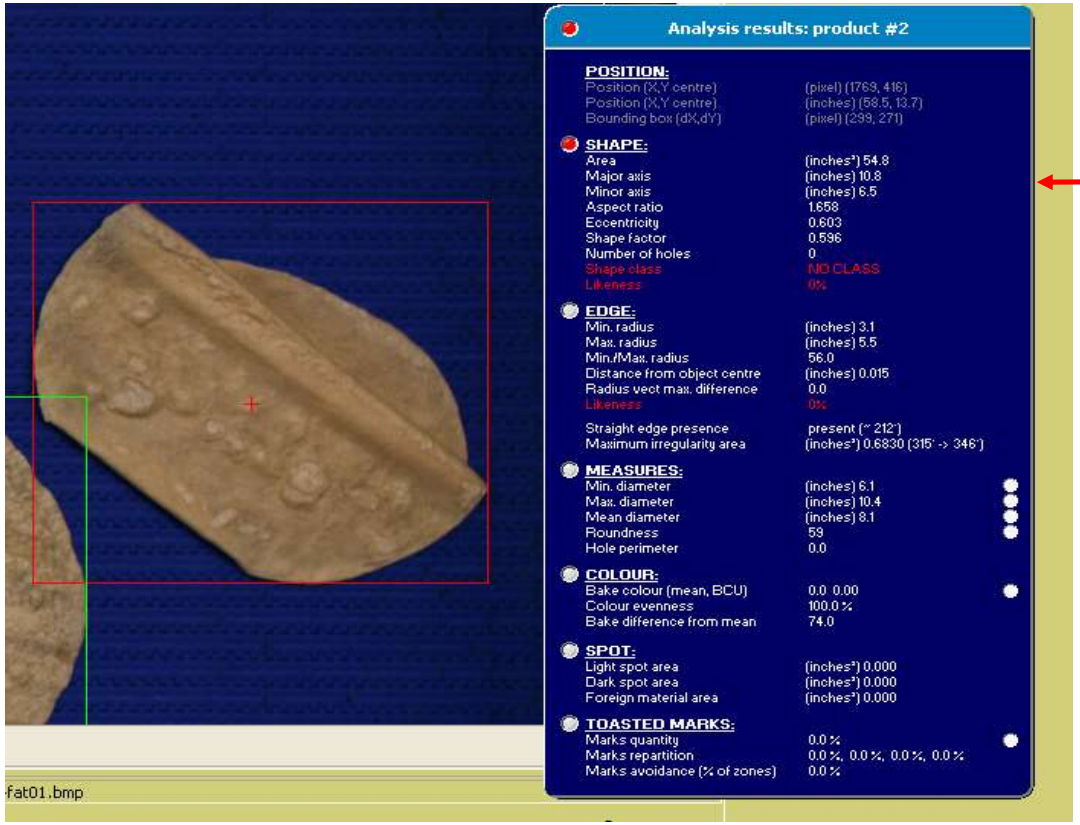


HOLE DEFECT

EyePro System

CONFIDENTIAL

Software Features



MISSHAPEN PRODUCT

Vision Technology used to automatically adjust process equipment

Example on Tortilla applications

Automatic Process Control

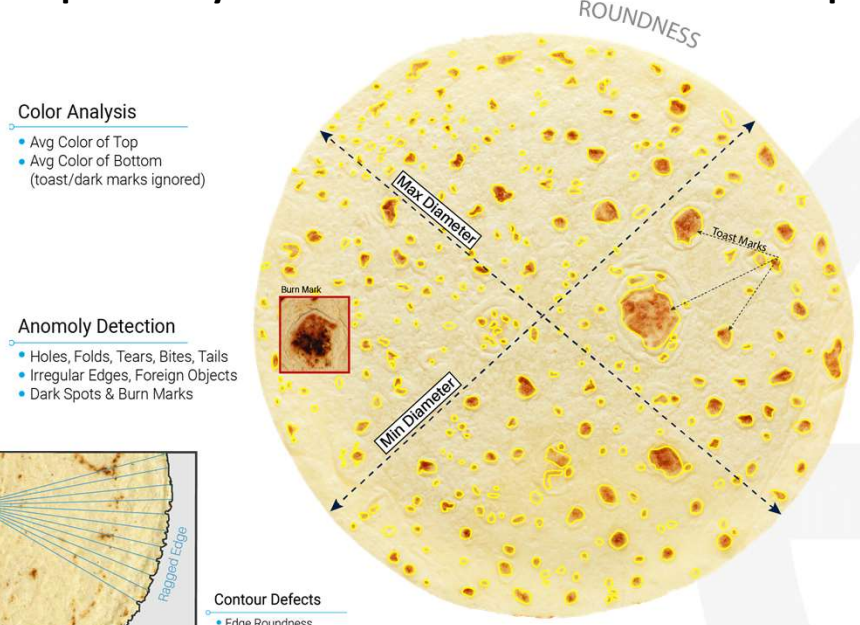
Flour tortilla

- Vision System measures product diameters and automatically adjust the press settings
- Improved product size consistency
- Waste reduction

Vision Inspection Systems

Tortilla Measurements

Sightline Process Control products are specialized, 3D color vision technologies used in inspection systems and automation solutions for process control.

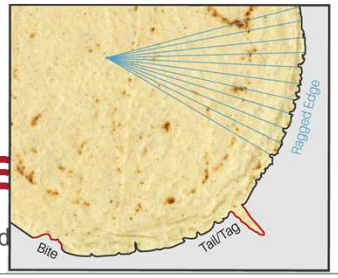


Color Analysis
- Avg Color of Top
- Avg Color of Bottom (toast/dark marks ignored)

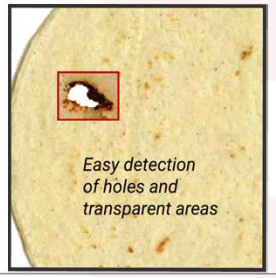
Anomoly Detection
- Holes, Folds, Tears, Bites, Tails
- Irregular Edges, Foreign Objects
- Dark Spots & Burn Marks

Toast Marks
- Color Analysis
- Total Number
- Area/Coverage

2D Geometry
- Min, Max, Avg Diameter
- Roundness/Shape Verification
- Area Measurements



Contour Defects
- Edge Roundness
- Blowout Detection
- Bites, Tails, Folds
- Curling



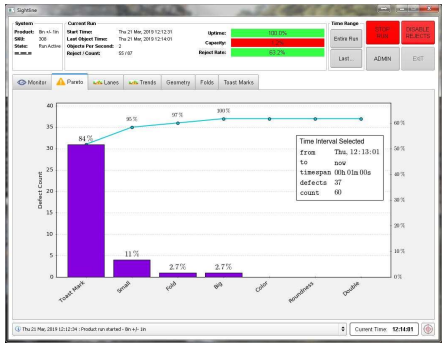
SIGHTLINE a KPM ANALYTICS brand

measura Inspection Screen Shots

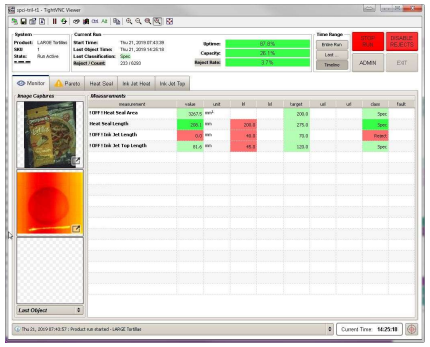
100% INSPECTION SOFTWARE

Ensure Product Quality, Optimize Your Process

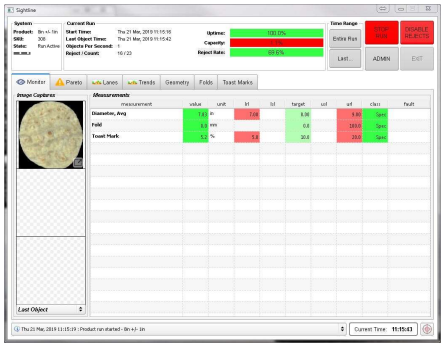
Pareto Chart



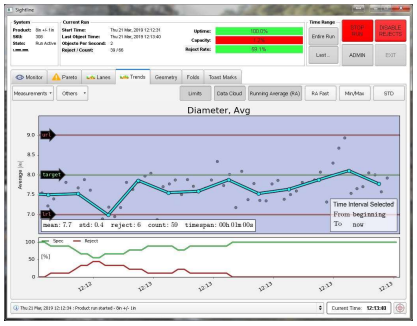
Package Inspection



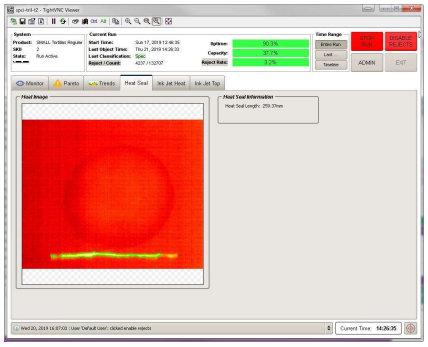
Customizable Summary Screen



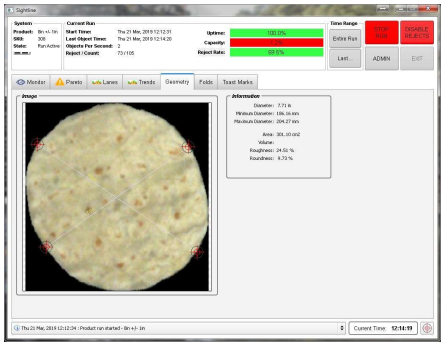
Production Trends



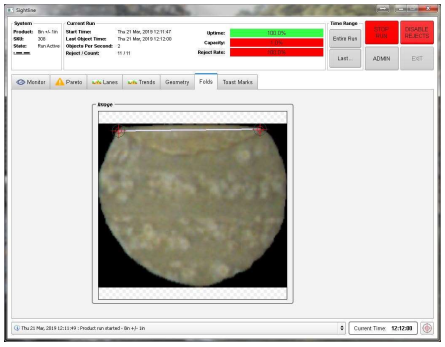
Heat Seal Analysis



2D Measurements



Folds



Automated Product Inspection using 3D Vision

Imaging and analysis solutions for food producers that ensure quality standards, reduce production costs, and increase productivity


Bakery


Meat

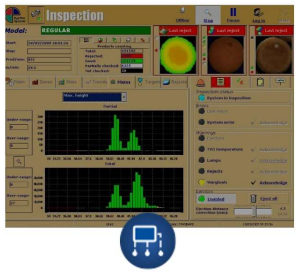

Cheese


Snack Food


Packaged Food

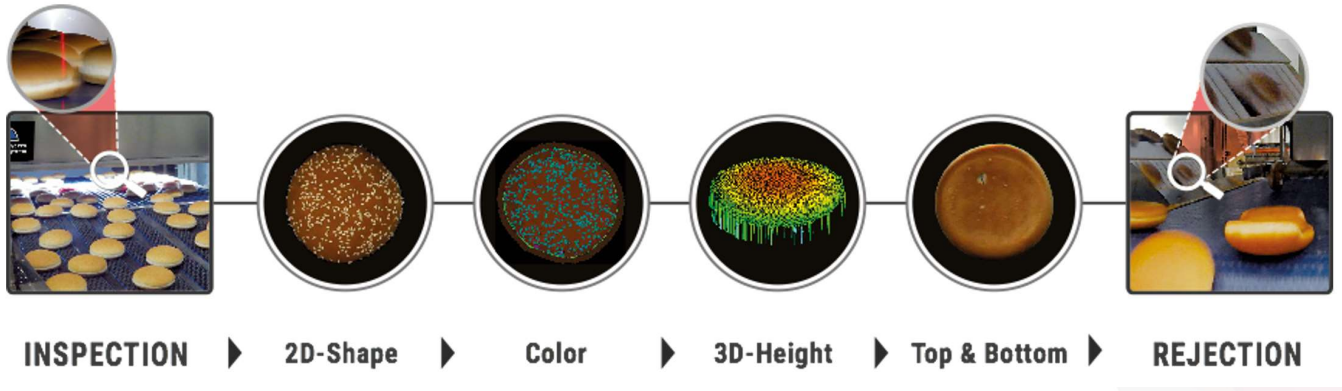

Packaging Crates


PRODUCT INSPECTION



PROCESS CONTROL


PRODUCT HANDLING



CONCLUSION

While the tortilla quality depends on other processing variables and the formulation that the manufacturer uses, since wheat flour is the significant and most relevant ingredient used for manufacturing flour tortillas, its quality dramatically affects the final product quality.

CONCLUSION

The objective methods are reliable, sensitive, and time-saving and replace subjective measurements.

In the baking industry, various objective methods are used to characterize the rheology of wheat flour dough and final products. These objective measurements characterize the rheology of wheat flour dough and tortillas.

There is a need to develop different predictive quality tests for tortillas!


KPM
ANALYTICS

Global Leader in Analytical Instrumentation

- ***KPM Analytics enables companies in agriculture, food, and related industries to effectively manage quality and protect value of their brands***

Summary Highlights

- Established in 2015, HQ in Boston, MA, USA
- 7 strong brands located in four countries
- Long term partnership with blue chip customers in various industries around the world
- Wide product range for R&D, quality control and process optimization
- ~50 patents granted or pending, ~40 trademarks
- Global applications experts with decades of experiences
- Over 15,000 Installs in 100+ countries
- 14 direct sales & service offices globally
- Over 200 sales and service distribution partners worldwide

Industries

Agriculture

Food & Beverage

Feed, Forage & Animal food

Environmental Testing

Clinical Diagnostics

Industrial Manufacturing

KPM Brands

Unity Scientific

CHOPIN TECHNOLOGIES

AMS Alliance

Sensortech Systems

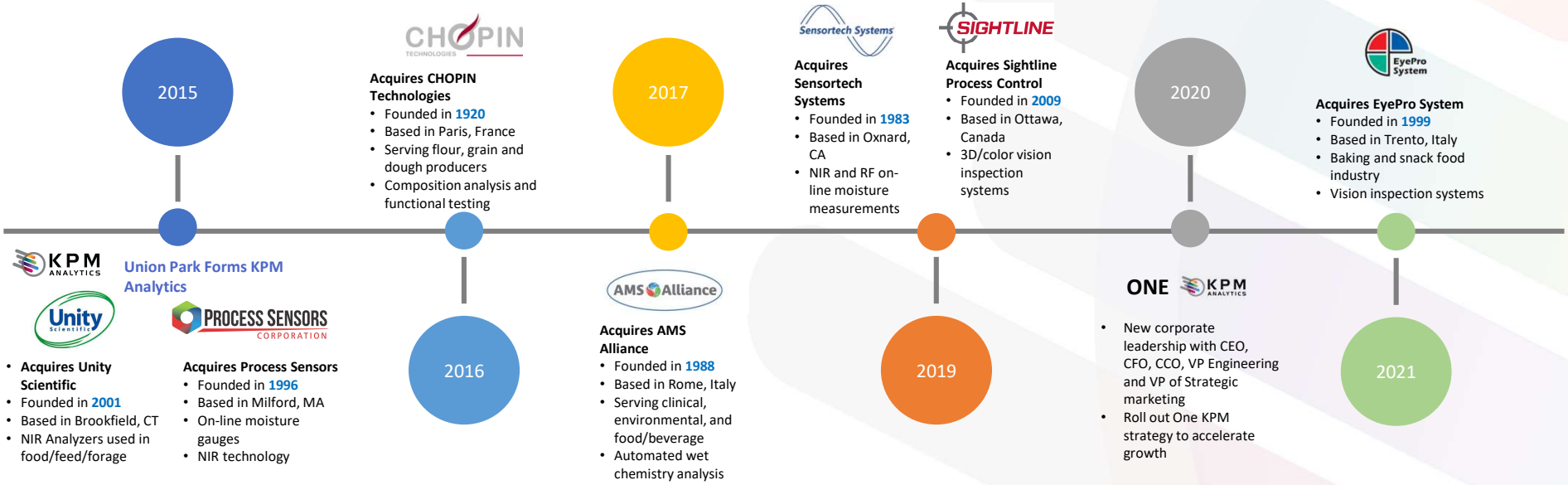
PROCESS SENSORS

SIGHTLINE

EyePro System VISION TECHNOLOGY

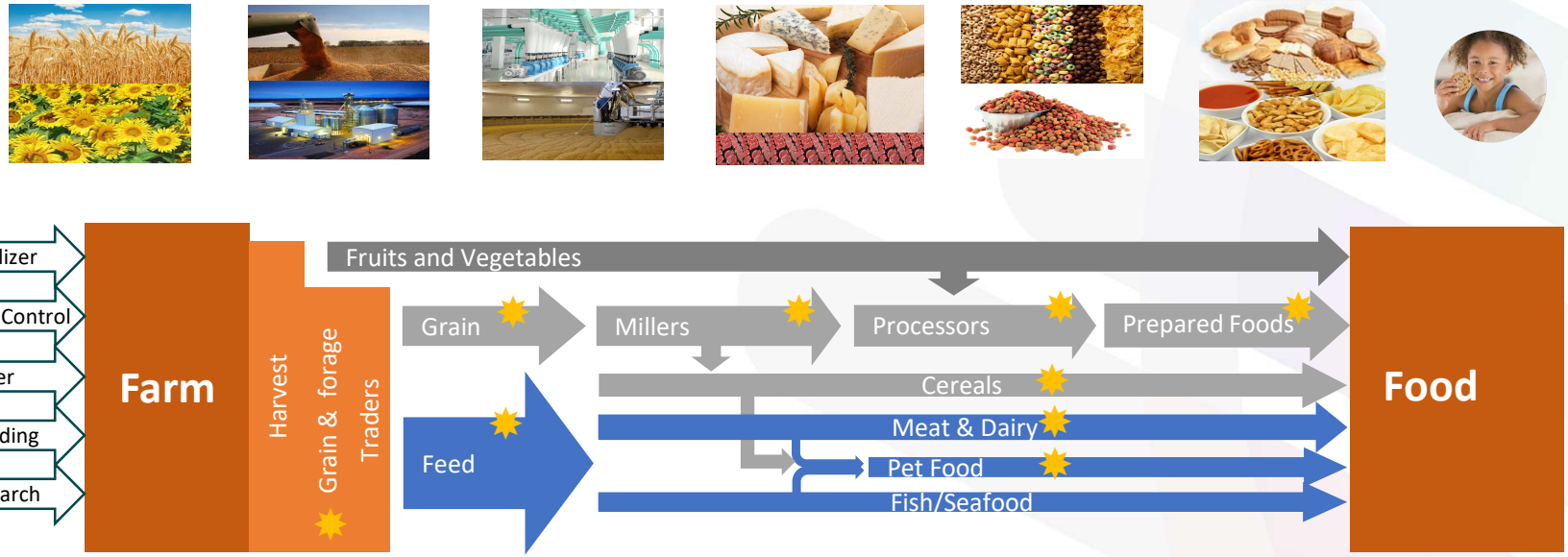
Timeline and Progression of KPM Analytics

KPM Analytics brands have long and successful histories servicing customers worldwide



Impacting Quality Across the Entire Value Chain

From raw ingredients to prepared foods, our products rapidly assess critical properties and overall quality



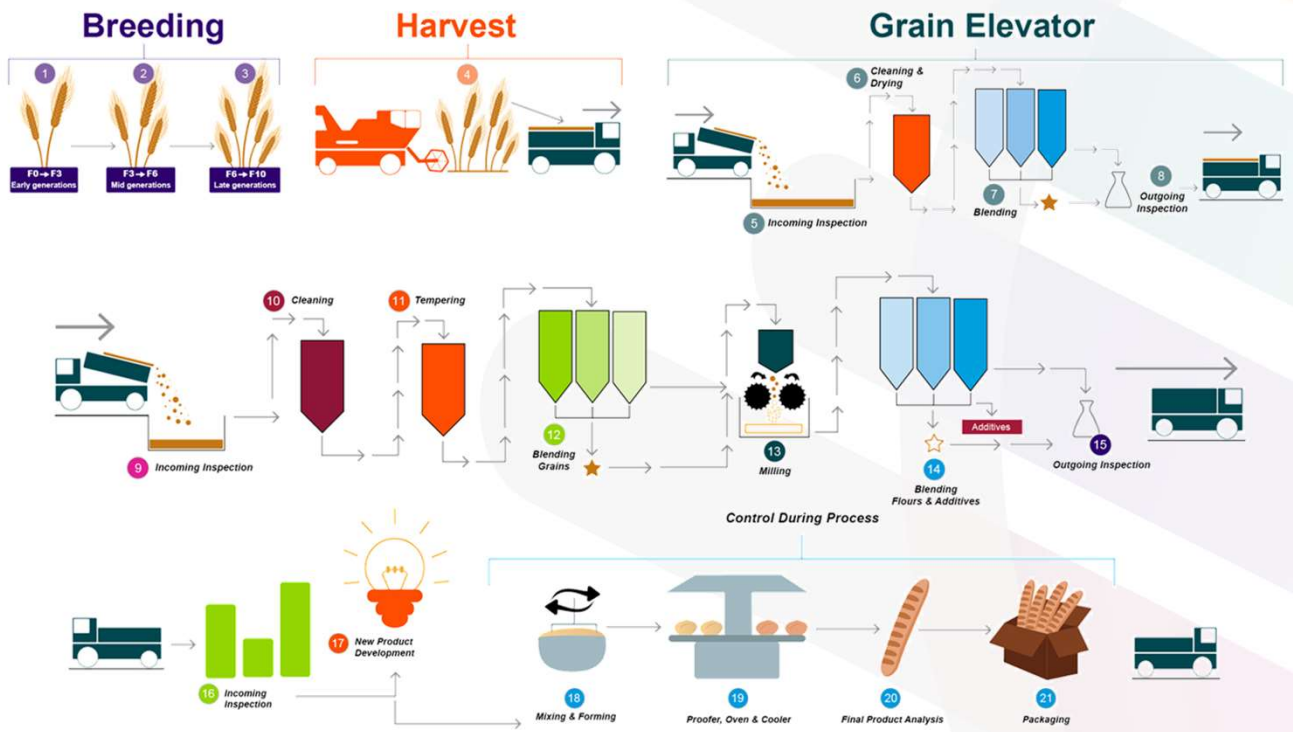
Trusted Partner Supporting Every Step of the Food Production Process

KPM brand solutions are used in every process step throughout the grain, milling and baking supply chain

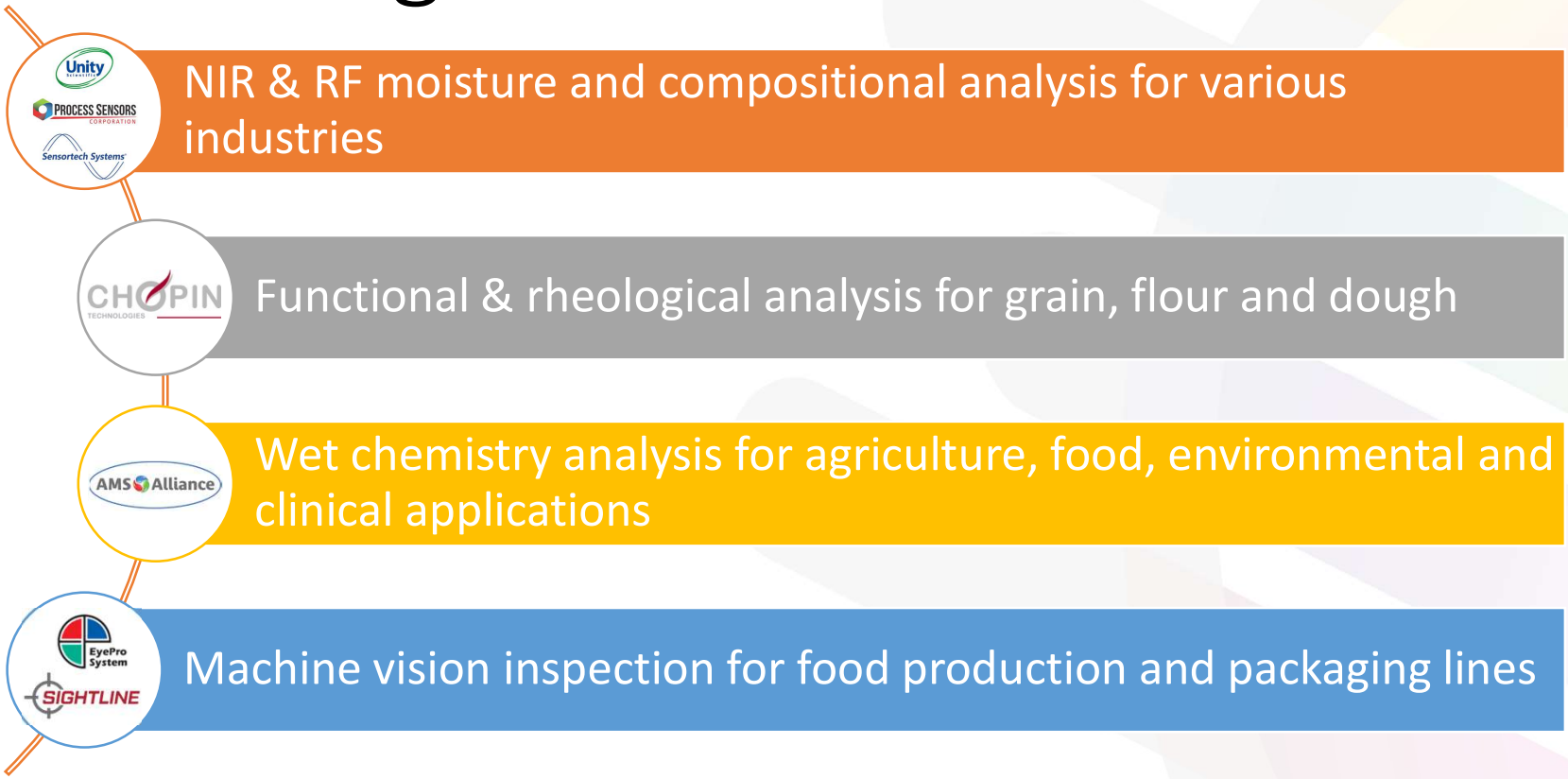
Breeding Through Elevator

Milling

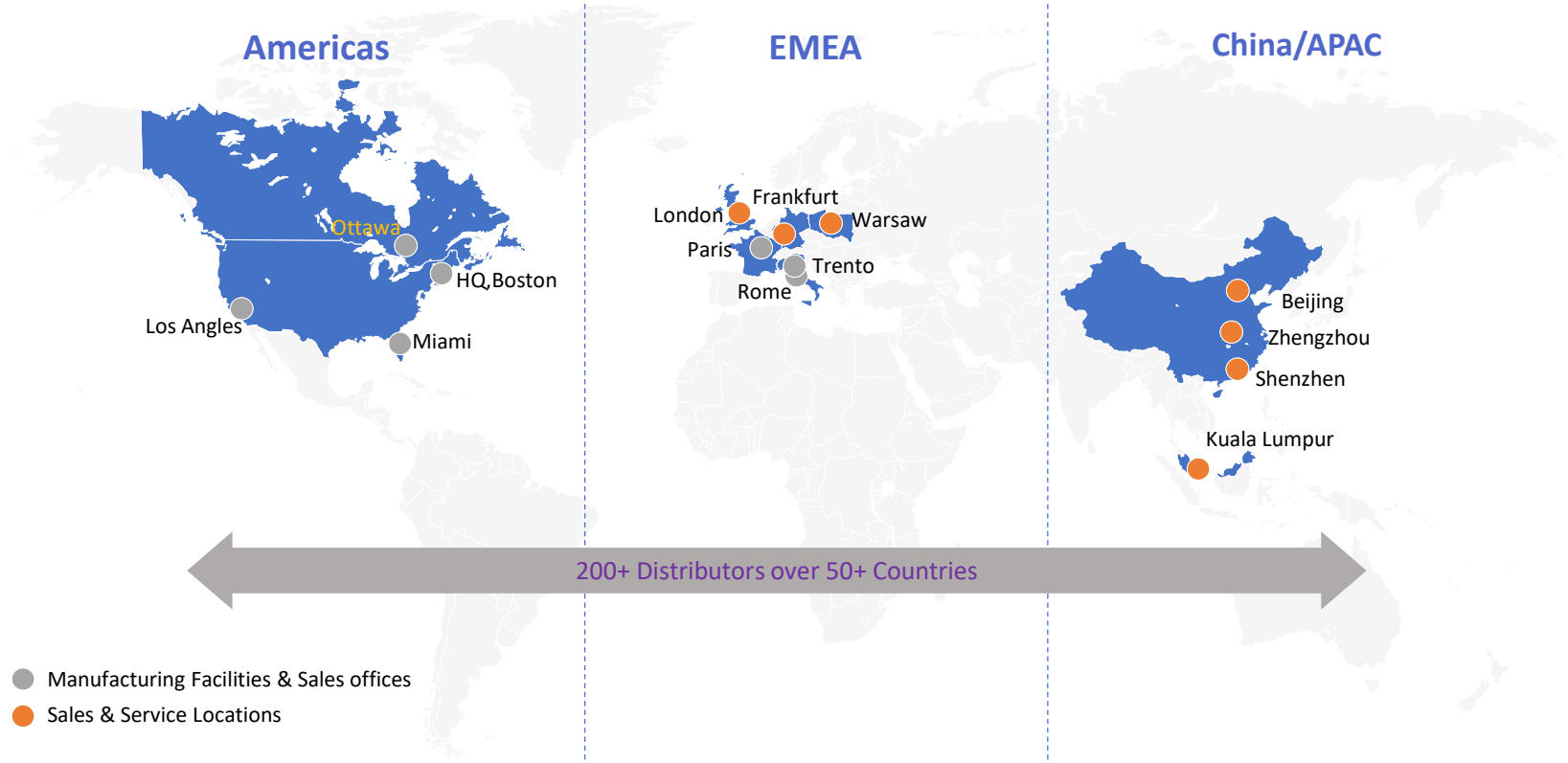
Baking



Broad Range of Products and Technologies



Extensive Global Sales and Service Network



THANK YOU FOR YOUR ATTENTION
ANY QUESTIONS ?

hboyacioglu@kpmanalytics.com

CHOPIN TECHNOLOGIES

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