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Together. Better Baking.

The background of the image is an aerial photograph of a large, modern industrial facility. The building is composed of several interconnected wings with flat roofs and numerous windows. A prominent feature is a central, multi-story glass-enclosed structure with a circular top. The surrounding area includes parking lots with a few cars, trees, and streetlights. The entire scene is overlaid with a semi-transparent white filter.

Chemical Leavening & Other Reformulation Challenges

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What We Will Cover Today

Agenda

- 01 Chemical Leavening Science
- 02 The Tortilla Spectrum: styles, appearance, quality standards, defects
- 03 SAPP / MCP / SAS Deep Dive: grades, differences, trade-offs
- 04 Lab Data & Instrumentation: Farinograph, Texture, Colorimeter, graphs
- 05 Overview

Chemical Leavening Science

How Acids Work · Key Terms · CO2 Timing · The Reaction

What Is Chemical Leavening?

The Basics

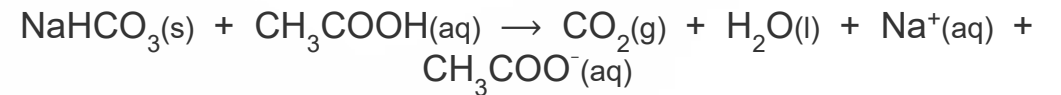
Production, inclusion and trapping of gas (CO_2) in doughs and batters.

Chemical, Biological, Physical.

Baking Powder in Tortillas.

Balanced system of acids and bases that produce gas and water in food systems.

Base + Leavening Acid \rightarrow Salt + Water + CO_2



Base / Alkaline

Sodium Bicarbonate

Acid Salts

MCP, SAPP, SALP, SAS

Starch as **diluent**

What Is Chemical Leavening?

Controlled production of CO₂



- **Two-stage CO₂ release:** Hot Press action + Reaction in the oven
ratio defines the acid character
- **Perfect balance:** no excess Sodium bicarbonate and no excess acid
- **Neutralizing Value (NV):** grams of Sodium Bicarbonate (NaHCO₃) neutralized per 100g acid used to calculate the correct ratio

Key Terms

ROR — Rate of Reaction

% CO₂ released in 8 minutes at 27°C

- Higher grade number = slower hot press reaction
- SAPP 10 = fast | SAPP 40 = slow
- MCP: ~60% (very fast, immediate on water contact)
- SAPP 28: ~28% (standard, balanced)
- SAPP 40: ~40% (slow, maximizes reaction in the oven)
- SAS: <8% (heat-activated only, >50°C)

Source: AACC International Methods 56-11; Baking Leavening Acids, Stauffer (1990)

NV — Neutralizing Value

Grams of NaHCO₃ neutralized per 100g of acid

- Used to calculate the correct acid:bicarb ratio
- SAPP: ~72 | MCP: ~80 | SAS: ~104
- Higher NV = more efficient — less acid needed per gram of bicarb
- Formula: $NV \times (\text{acid g} / 100) = \text{NaHCO}_3 \text{ g neutralized}$
- Verify every time you change acid type or level
- Excess acid = sour flavor | Excess Sodium bicarbonate = soapy + yellow color

Source: Stauffer, C.E. (1990). Functional Additives for Bakery Foods. AVI/Van Nostrand Reinhold.

The Main Leavening Acids Used in Tortillas

ACTIVATION TEMPERATURE

MCP

~20°C
immediate

Immediate on water contact — process fast

SAPP 10

20–25°C

Fast — very sensitive to temperature

SAPP 28

25–30°C

Standard — balanced Hot Press and Reaction in the oven

SAPP 40

30–35°C

Slow Hot Press — best Reaction in the oven

SAS

>50°C
oven only

Heat-activated only — no reaction in the oven until >50°C

Sources: Stauffer (1990) Functional Additives for Bakery Foods; Lai & Lin (2006) Cereal Science; AACC Method 02-52 (phosphate activation); Cauvain & Young (2006) Baked Products: Science, Technology and Practice

The Tortilla Spectrum

Styles · Appearance · Quality Standards · Defects

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Not All Tortillas Are Created Equal

The spectrum from Sonora to thick burrito style

- **Sonora / Translucent:**

very thin, high fat, minimal leavening

- **Standard Flour Tortilla:**

medium thickness, balanced fat and water, moderate leavening

- **Thick:**

high hydration, balanced fat, more leavening

- **Home made style:**

tortilla that pillows during baking and heating

Each style has different leavening needs — there is no single universal formula

Understanding your target product is Step 1 in any formulation decision

Sonora / Thin Tortilla

Key parameters

0 – 1.5%

Baking Powder

Baker's %

10 – 20%

Fat Level

Baker's %

High

Translucency

Target

< 2 mm

Thickness

After press

HOW TO ACHIEVE IT

Baking Powder

Low or zero — 0 to 1.5% bakers. Use MCP and SAPP or SAS if any. Minimal CO₂ keeps tortilla thin and translucent.

Fat Choice

High fat (10–20%). Lard or high-melt shortening. Fat provides extensibility and is responsible for the translucent appearance.

Dough Temperature

Cold to warm 24–32°C. Warm dough are more elastic but also stick more

Cooling

Cool quickly, crash the product. Rapid cooling locks in the translucency

Reducing Agent

L-cysteine or SSL essential. Without gluten relaxation the dough tears on the press at thin gauges.

Standard Tortilla

Key parameters

1.5 – 2.5%

Baking Powder

Baker's %

6 – 15%

Fat Level

Baker's %

cream-white

Translucency

Target

1.5 – 2.5 mm

Thickness

After press

HOW TO ACHIEVE IT

Baking Powder

1.5–2.5% bakers. SAS is the standard acid. Balanced Hot Press action and Reaction in the oven. Balance NV for target pH 5.1–5.4.

Fat Choice

Mid fat (6–15%). Palm shortening or hydrogenated vegetable fat. Even fat distribution critical for uniform blistering pattern.

Dough Temperature

26–30°C. Monitor water temperature, warm doughs raises effective ROR and risks grey discoloration.

Cooling

Cool evenly and fast 5 to 8 minutes, in cooling conveyors with sufficient cooling to achieve pacing temperature.

Hydrocolloid

Hydrocolloids can stabilize the crumb structure CO₂ gas cells and ensures consistent crumb structure.

Thick Tortilla

Key parameters

2.5 – 5.0%

Baking Powder

Baker's %

6 – 15%

Fat Level

Baker's %

fully opaque

Translucency

Target

3.0 – 4.0 mm

Thickness

After press

HOW TO ACHIEVE IT

Baking Powder

2.5–5.0% bakers. Mixture of SAS, SAPPs and MCP for an optimal combination reaction in the press and oven

Fat Choice

6–15% fat shortening or hydrogenated vegetable fat. Even fat distribution critical for uniform blistering pattern.

Dough Temperature

Cold doughs 24–26°C. Warm dough activate the baking powder to early and waste the leavening capacity. no effect in press or oven.

Cooling

Cool Thicker tortillas evenly max 8 minutes to packing temperature

Flour & Hydrocolloid

Protein 11–13% for strong gluten to hold CO₂. HPMC 0.5–0.8% for structure.

Home Made Style Tortilla

Key parameters

0 – 4.0%

Baking Powder

Baker's %

10 – 15%

Fat Level

Baker's %

High pillowing

Translucency

Target

Variable

Thickness

After press

HOW TO ACHIEVE IT

Baking Powder

0–4% bakers depending on pillowing desired. High CO₂ creates the characteristic puff.

Fat Choice

10–15%, often lard for authentic flavor. Fat provides extensibility and flavor

Dough Temperature

24–36°C. Home style often uses warmer dough to encourage early CO₂ release and visible surface blistering.

Cooling

Cool evenly. The pillowed pockets need to set before handling

Mix Notes

Shorter mix times, minimal reducing agents. Preserving the gluten structure gives the characteristic chew and fold.

SAPP, MCP & SAS Deep Dive

Grades · Differences · Grey Problem · Decision Framework

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MCP

Monocalcium Phosphate

CHEMISTRY

- Formula: $\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot \text{H}_2\text{O}$
- NV: ~80 (higher than SAPP, lower than SAS)
- ROR: ~60% in 8 min at 27°C
- Very soluble — reacts almost immediately on water contact

ADVANTAGES IN TORTILLAS

- Strong early fast Hot Press action
- No grey discoloration risk — does not react with iron
- Higher NV = more efficient per gram of Sodium Bicarbonate (NaHCO_3)
- Better color (higher L*) vs. SAPP equivalents

LIMITATIONS

- Fast reaction = must process dough quickly
- Can make dough stiff if over-used
- Higher cost vs. SAS

WHEN TO CHOOSE MCP

- Fast-run production lines
- Grey discoloration is a recurring problem
- Baking powder blend component (paired with SAPP or SAS)
- Sonora / thin tortilla style

SAPP 28

Sodium Acid Pyrophosphate

CHEMISTRY

- Formula: $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$
- NV: ~72 | ROR: ~28% at 8 min / 27°C
- Activation: 25–30°C — balanced Hot Press and Reaction in the oven
- Contains iron-reactive phosphate — grey risk exists but is manageable

ADVANTAGES IN TORTILLAS

- Balanced CO_2 split — good Hot Press + strong Reaction in the oven
- Even blistering on standard commercial tortillas
- Lower grey risk vs. SAPP 10 — slower ROR reduces iron reaction rate
- Most cost-effective phosphate acid for standard lines

LIMITATIONS

- Grey discoloration risk if mix temp >25°C or dough hold is long
- Slight astringency if over-used above recommended level
- Sodium contributor — relevant for sodium reduction programs

WHEN TO CHOOSE SAPP 28

- Standard commercial flour tortilla
- Switching from SAPP 10 to reduce grey discoloration
- Moderate-speed production lines with controlled dough temp
- Baking powder blend component paired with MCP or SAS

SAS

Sodium Aluminum Sulfate

CHEMISTRY

- Formula: $\text{Na}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3$
- NV: ~104 (very high efficiency)
- ROR: <8% Hot Press action at 27°C
- Requires heat (>50°C) to activate fully
- Classic baking powder: MCP (fast) + SAS (slow) = balanced double-acting

PERFORMANCE

- Minimal Hot Press action → very long dough working time
- Does NOT contribute to SAPP grey problem
- Best for operations with long dough hold times
- Maximum Reaction in the oven for thick tortillas

THE ALUMINUM QUESTION

- SAS contains aluminum — a label concern for consumers and retailers
- EU regulations restrict aluminum in some food categories
- Many retailers mandate aluminum-free (Whole Foods, etc.)
- If customer requires aluminum-free label — SAS is off the table

ALTERNATIVES TO SAS

- SAPP + MCP blends for double-acting behavior
- Encapsulated acids for delayed release
- DCPD for slow release without aluminum
- GDL for clean label slow-acting systems

Lab Data & Instrumentation

Farinograph · Extensograph · Texture · Colorimeter · Lab Checklist

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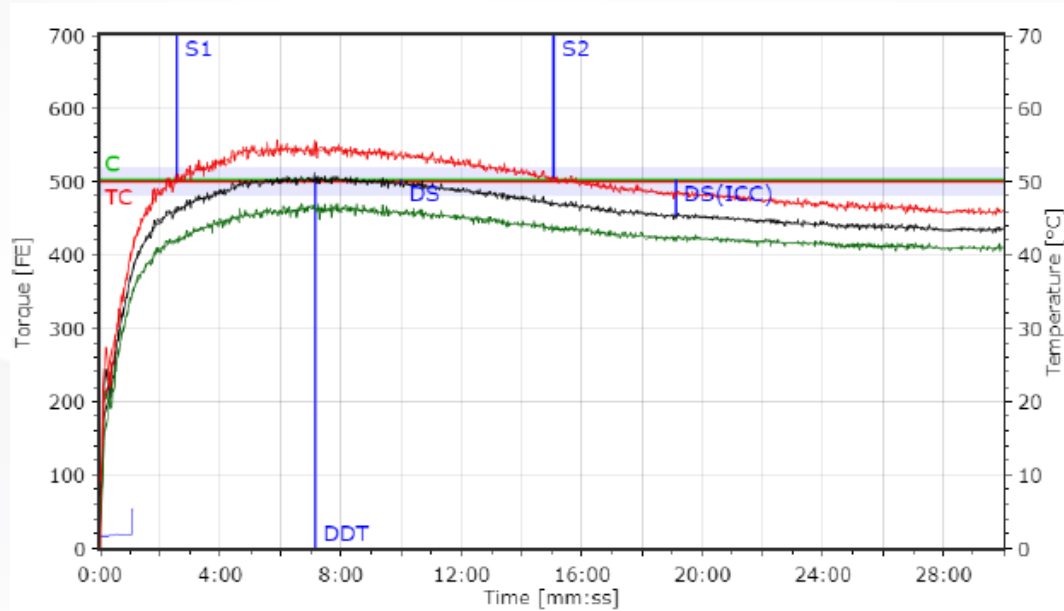
Farinograph

- Mixing behaviour
- Water absorption
- Dough development time
- Stability
- Softening

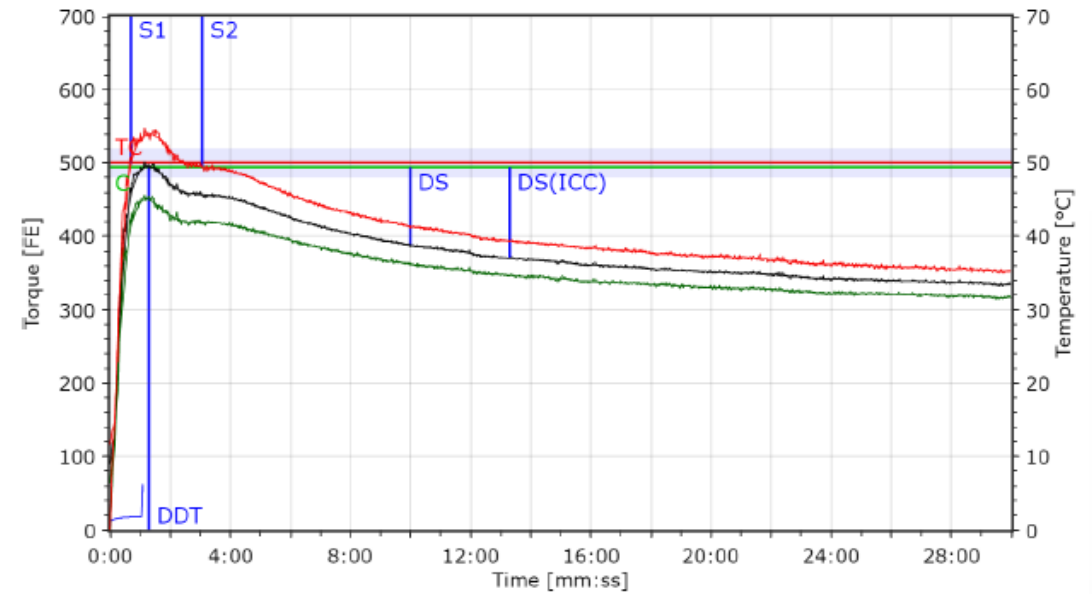


Interpreting the curve

Farinograph



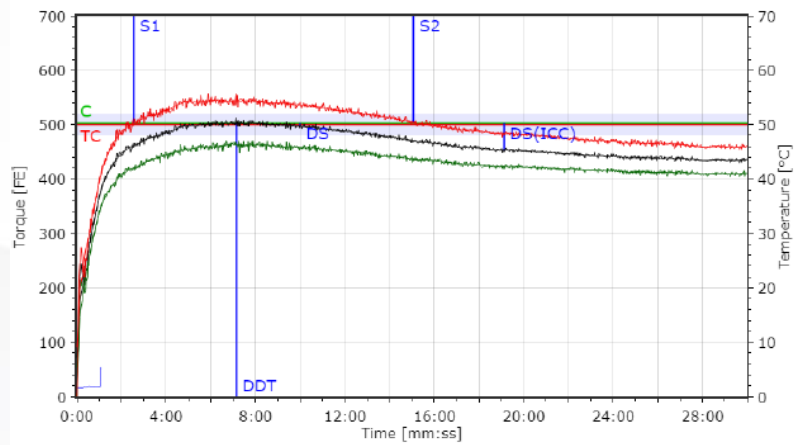
CWRS



CESRW

Interpreting the curve

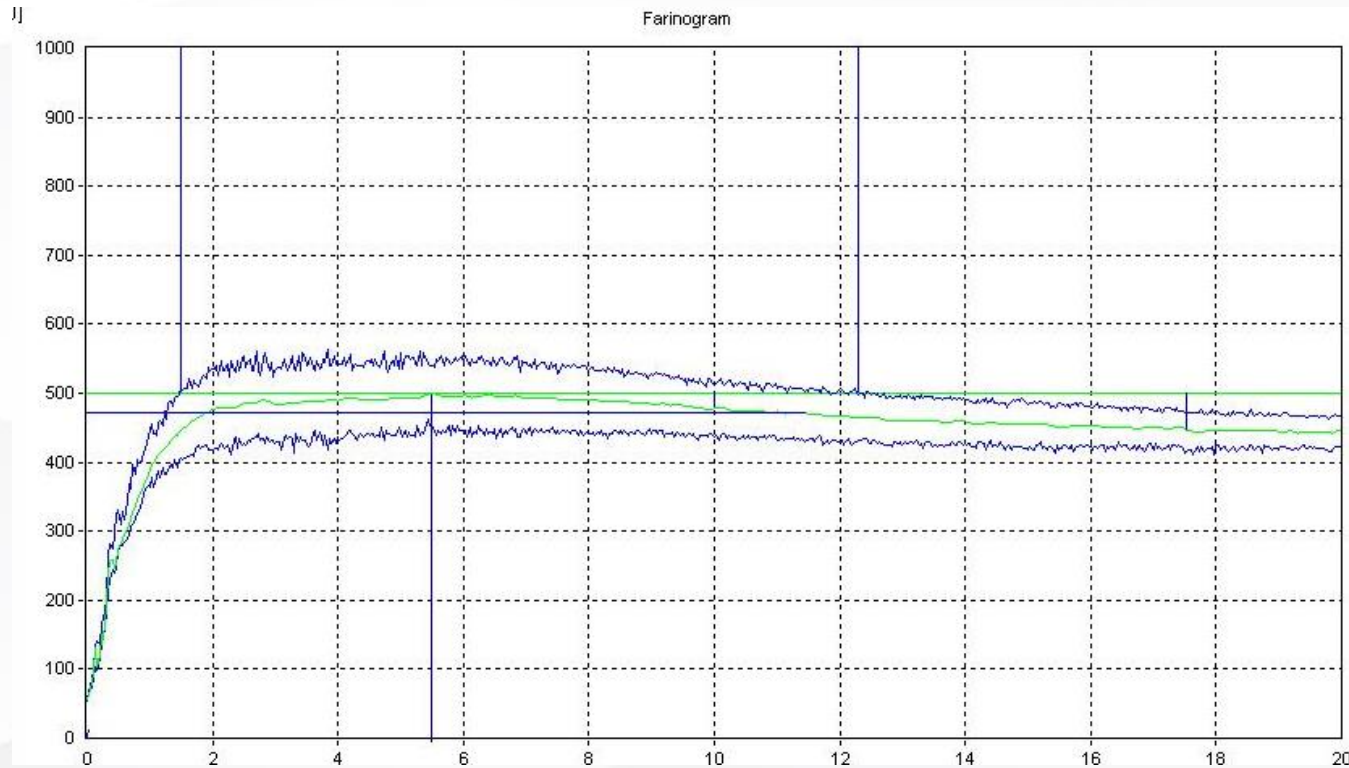
Farinograph



	Low	Normal	High
Water absorption (%)	<54	56	>60
Dough Development Time (min)	<1.5	1.5-5	>5
Stability (min)	<3	5-7	>10
Softening (BU)	<30	30-70	>70

Farinograph

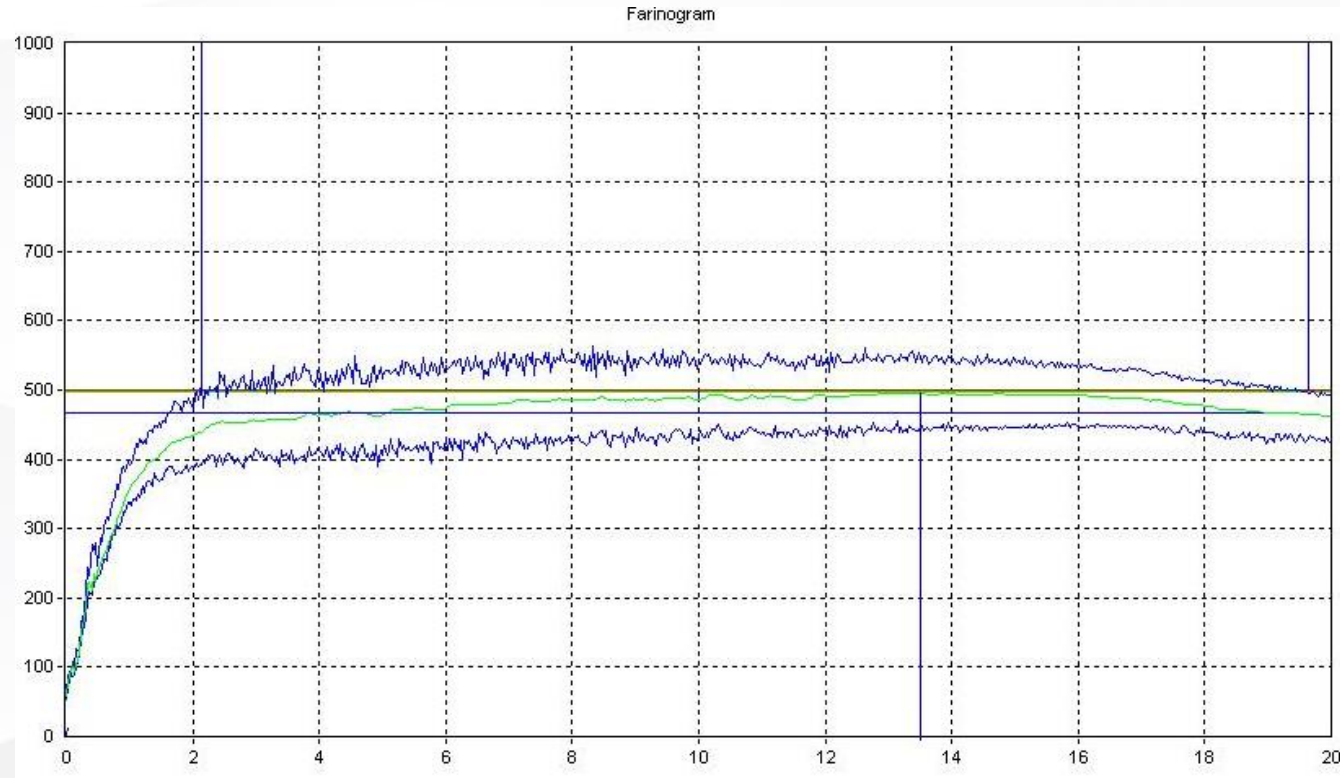
Base



Absorption	63%
Development time	5.5 min
Stability	10.8 min
Degree of Softening	22 FU
Quality number	115

Farinograph

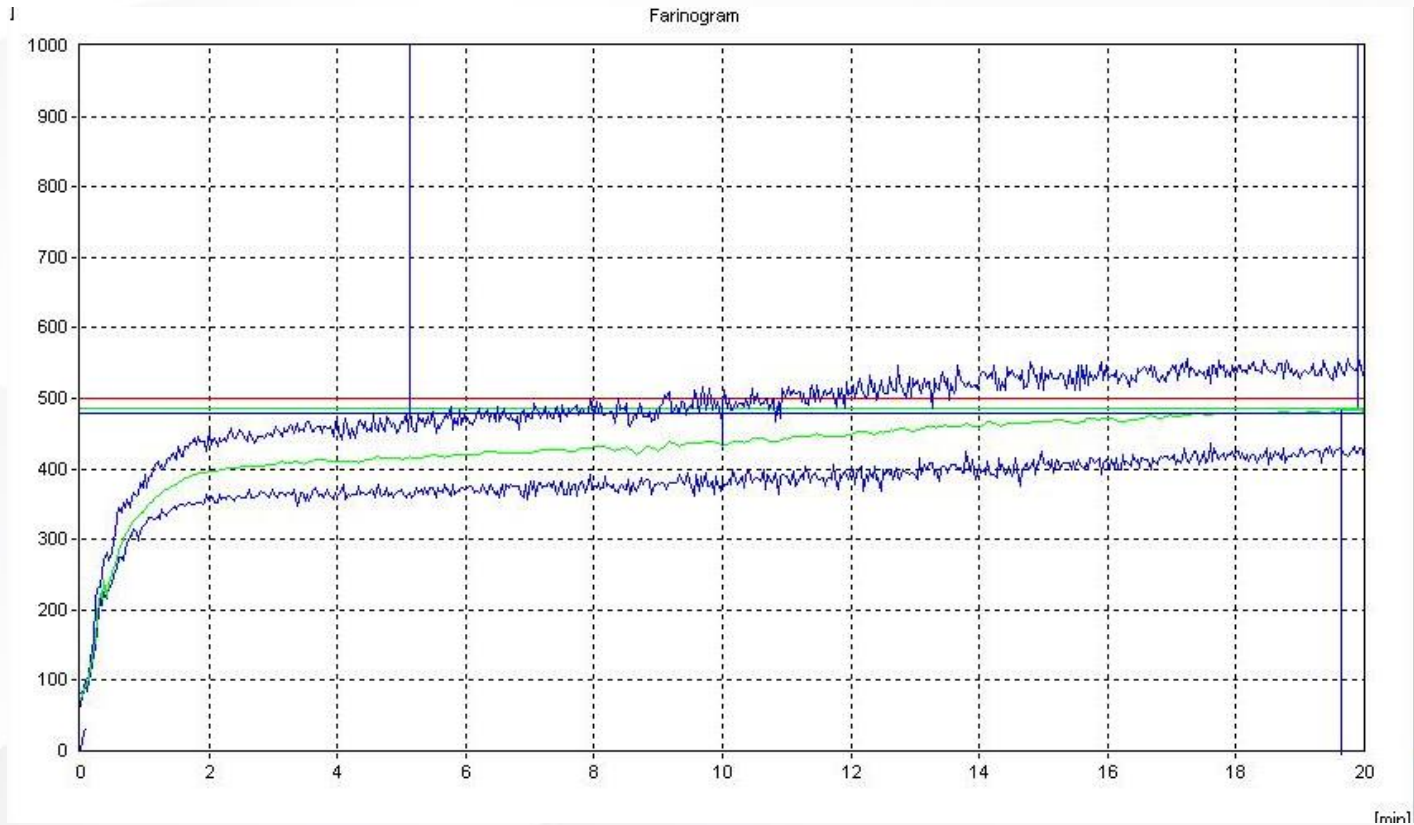
Sodium Bicarbonate 1%



Absorption	62%
Development time	13,5 min
Stability	17,5 min
Degree of Softening	11 FU
Quality number	189

Farinograph

Sodium Bicarbonate 2%

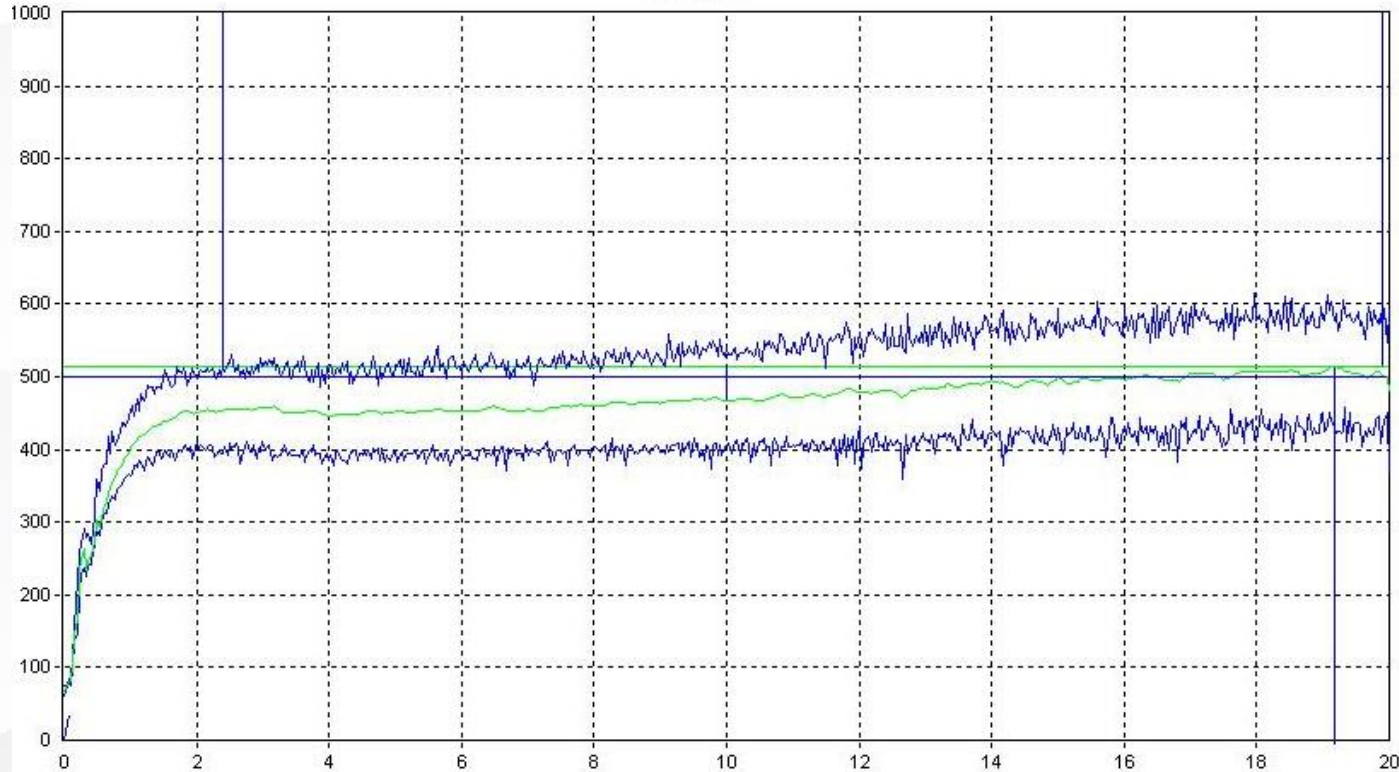


Absorption	60,6%
Development time	19,7 min
Stability	14,8 min
Degree of Softening	52 FU
Quality number	200

Farinograph

Sodium Bicarbonate 5%

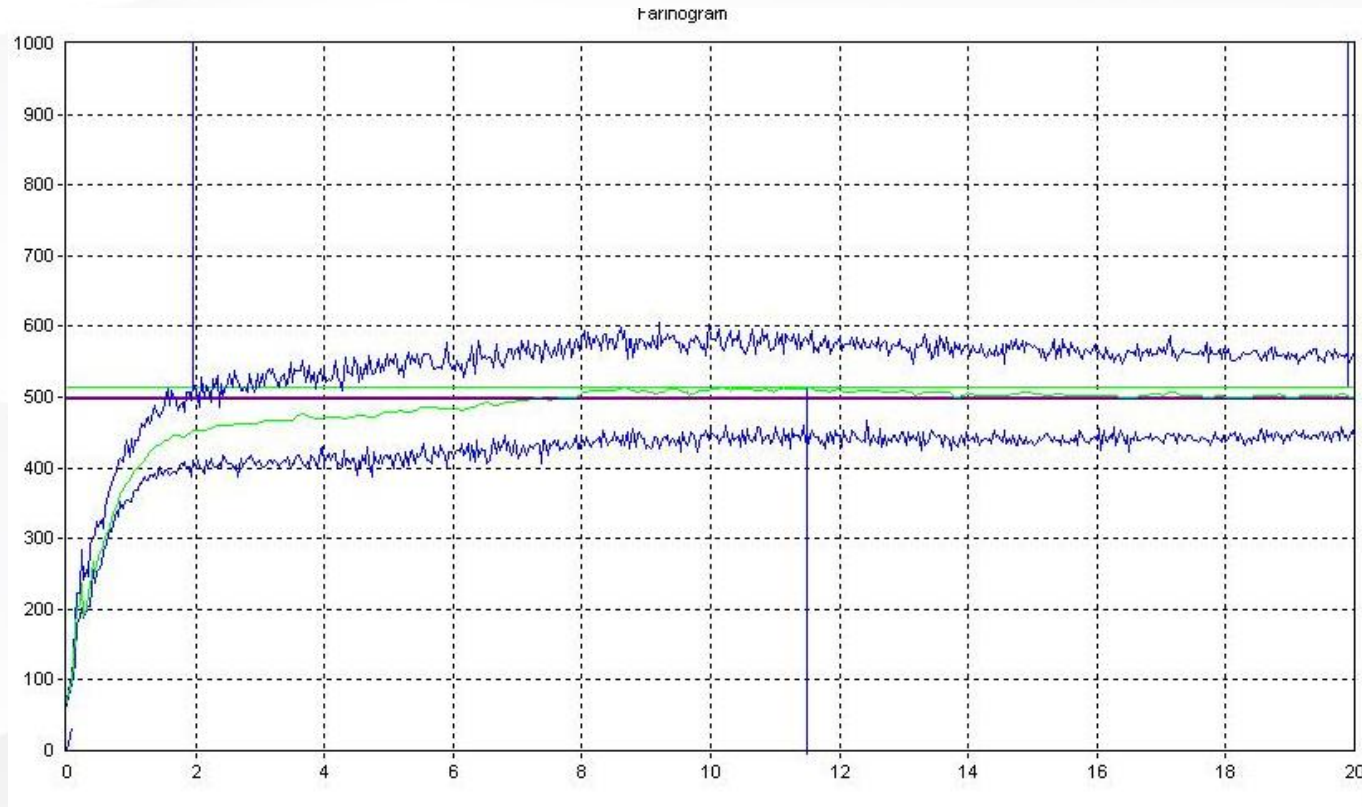
Farinogram



Absorption	57,3%
Development time	19,2 min
Stability	17,5 min
Degree of Softening	46 FU
Quality number	200

Farinograph

Baking powder 2%

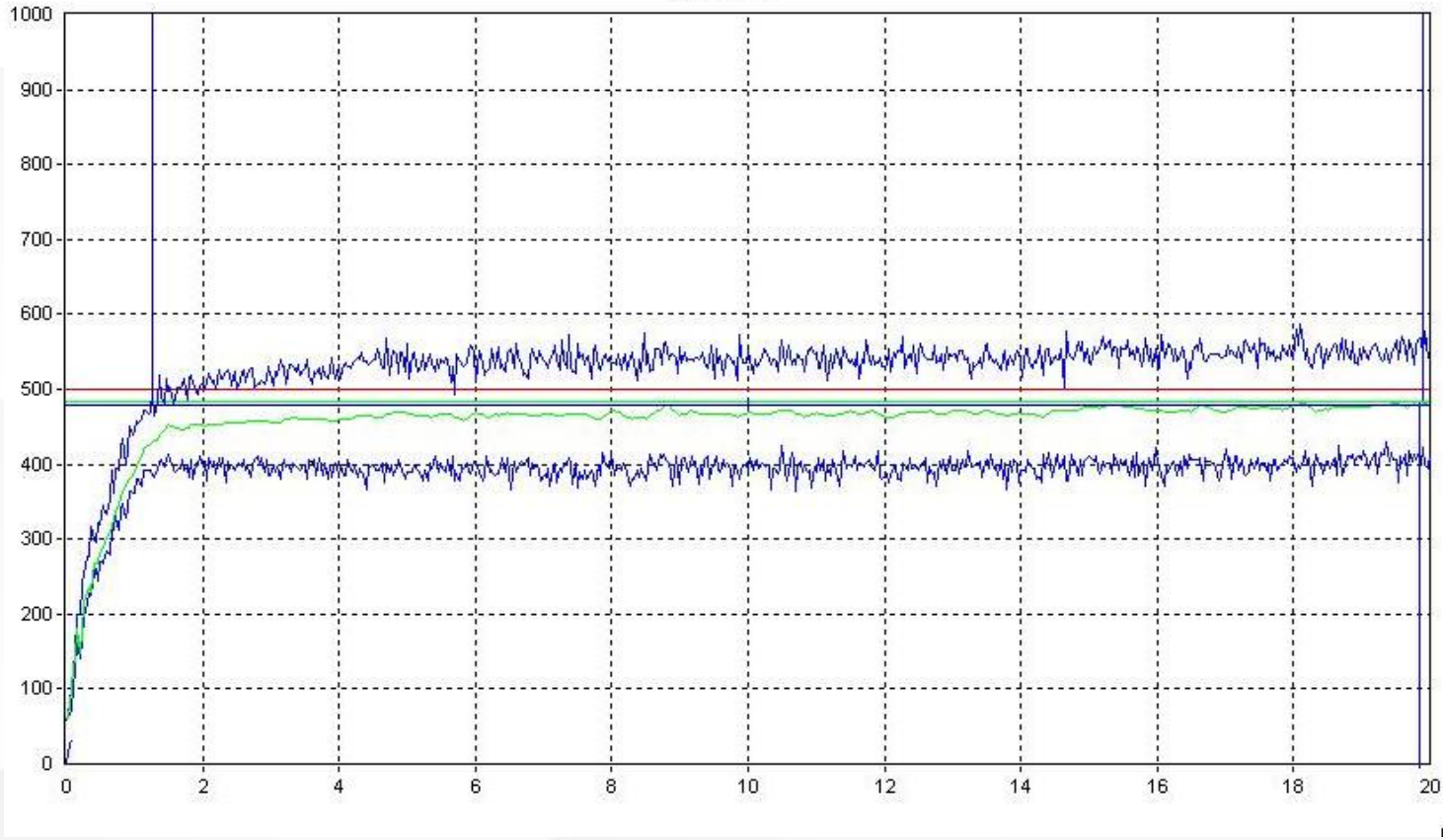


Absorption	60,1%
Development time	11,5 min
Stability	17,9 min
Degree of Softening	2 FU
Quality number	200

Farinograph

Baking powder 5%

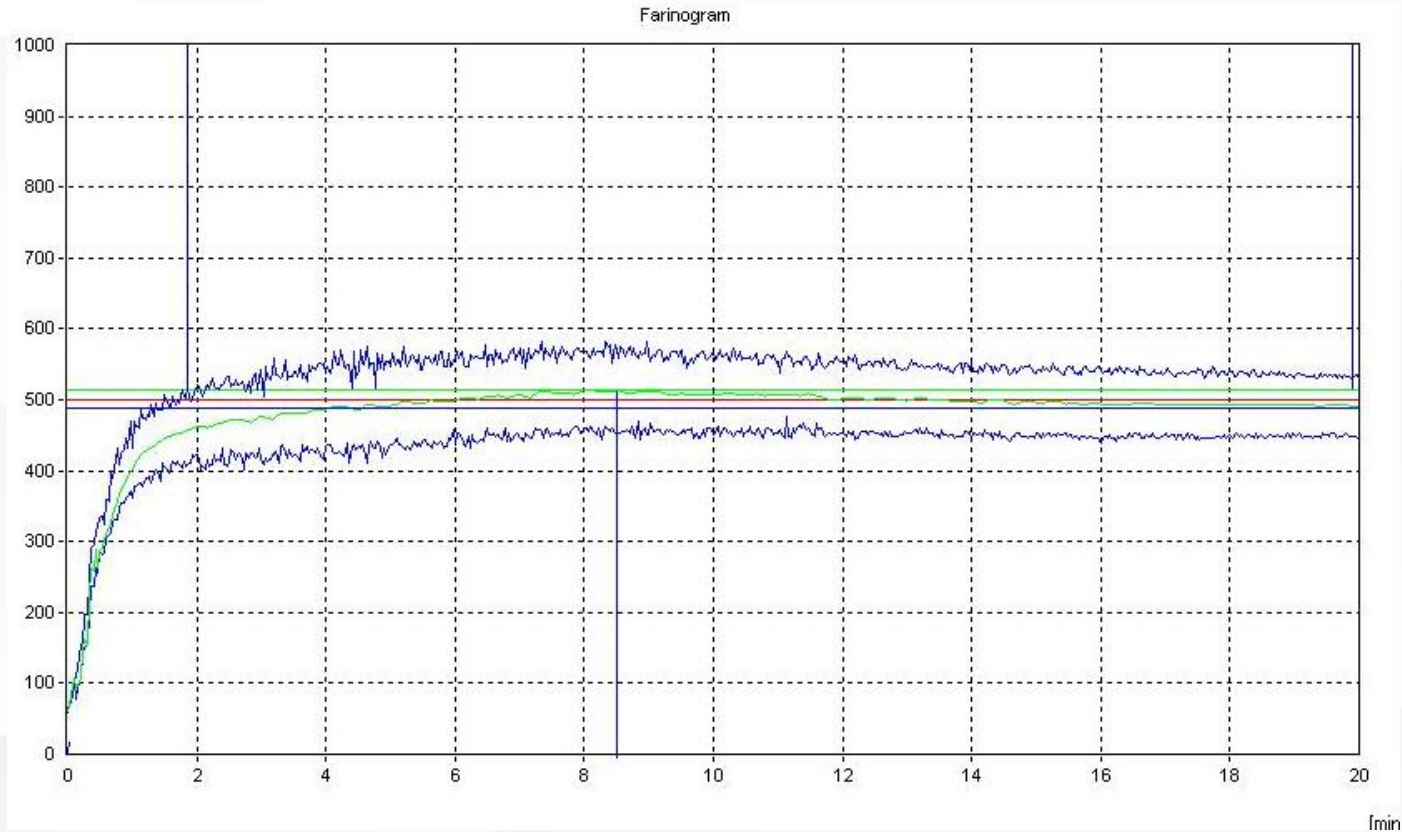
Farinogram



Absorption	52,5%
Development time	19,9 min
Stability	18,6 min
Degree of Softening	14 FU
Quality number	200

Farinograph

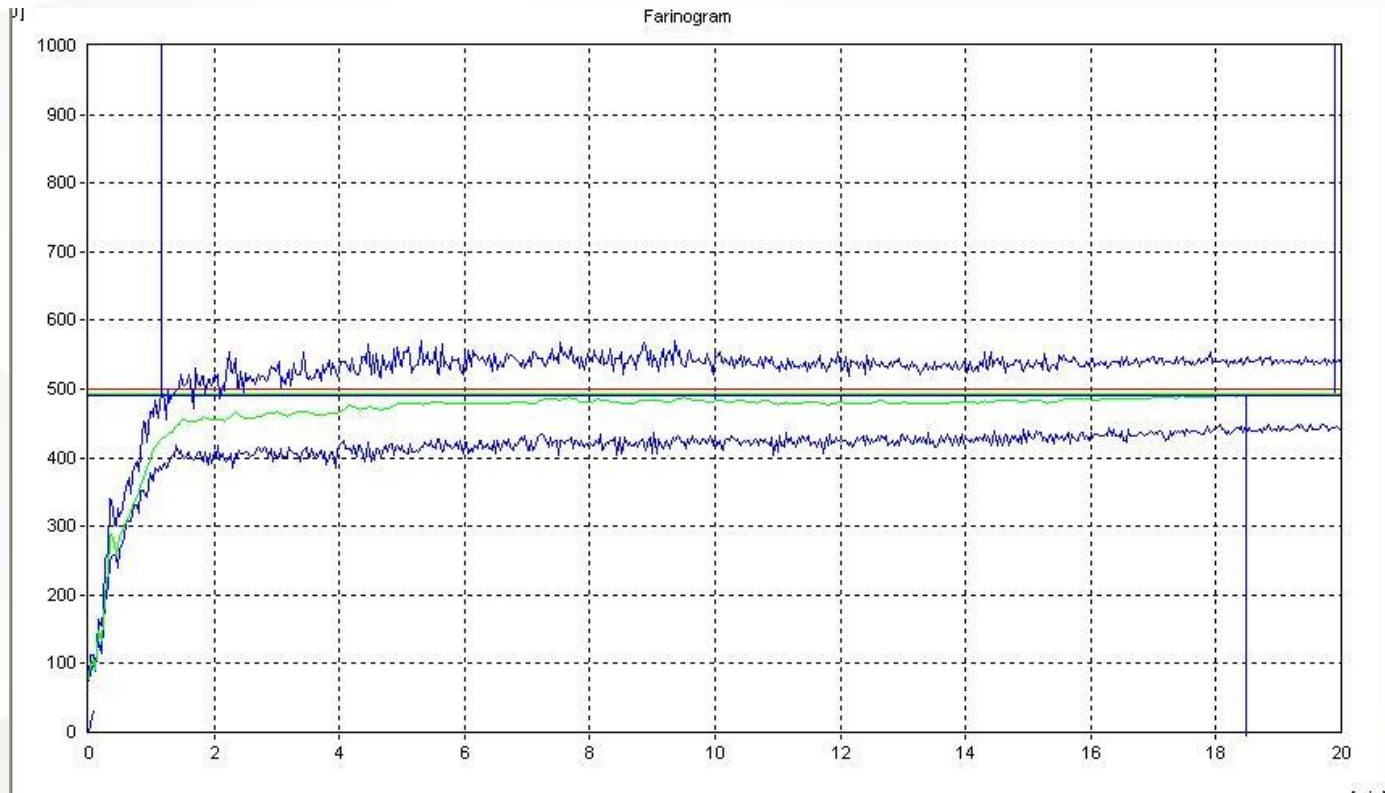
2A Baking powder 2%



Absorption	60,6%
Development time	8,5 min
Stability	18 min
Degree of Softening	6 FU
Quality number	200

Farinograph

2A Baking powder 5%



Absorption	58,7%
Development time	18,5 min
Stability	18,7 min
Degree of Softening	9 FU
Quality number	200

Farinograph Results — Effect of Leavening on Flour Rheology

Harina Virgen — Control vs. TopRise vs. Sodium Bicarbonate (NaHCO₃)

Sample	W.A. (500FU)	W.A. (14%)	Dev. Time	Stability	DS (FU)	Quality #
Base Flour (Control)	63.0%	60.3%	5.5 min	10.8 min	22 FU	115
Base Flour + 2% TopRise	60.6%	57.9%	8.5 min	18.0 min	6 FU	200
Base Flour + 5% TopRise	58.7%	56.0%	18.5 min	18.7 min	9 FU	200
Base Flour + 1% Sodium Bicarbonate	62.0%	59.3%	13.5 min	17.5 min	11 FU	189
Base Flour + 2% Sodium Bicarbonate	60.6%	57.9%	19.7 min	14.8 min	52 FU	200

Key Findings

- **Baking powder dramatically increases Stability** (from 10.8 min to 18.0–18.7 min) and Development Time
- **Degree of Softening drops near zero with baking powder** (DS = 6–9 FU vs. 22 FU for control)
- **Sodium Bicarbonate (NaHCO₃) alone raises Development Time** significantly (13.5–19.7 min) but 2% level shows high DS = 52 FU
- **Water Absorption decreases with baking powder** (58.7–60.6% vs. 63.0% control)

Lab data: STERN Ingredients México R&D Lab | Method: Brabender / ICC / BIPEA | Flour moisture: 11.6% | Mixer: 300g | Speed: 63 rpm | Date: 21/04/2026

Alveolab

- Dough bubble
- Extension properties



Operating video

Alveolab



Interpreting the curve

Alveolab



Alveolab

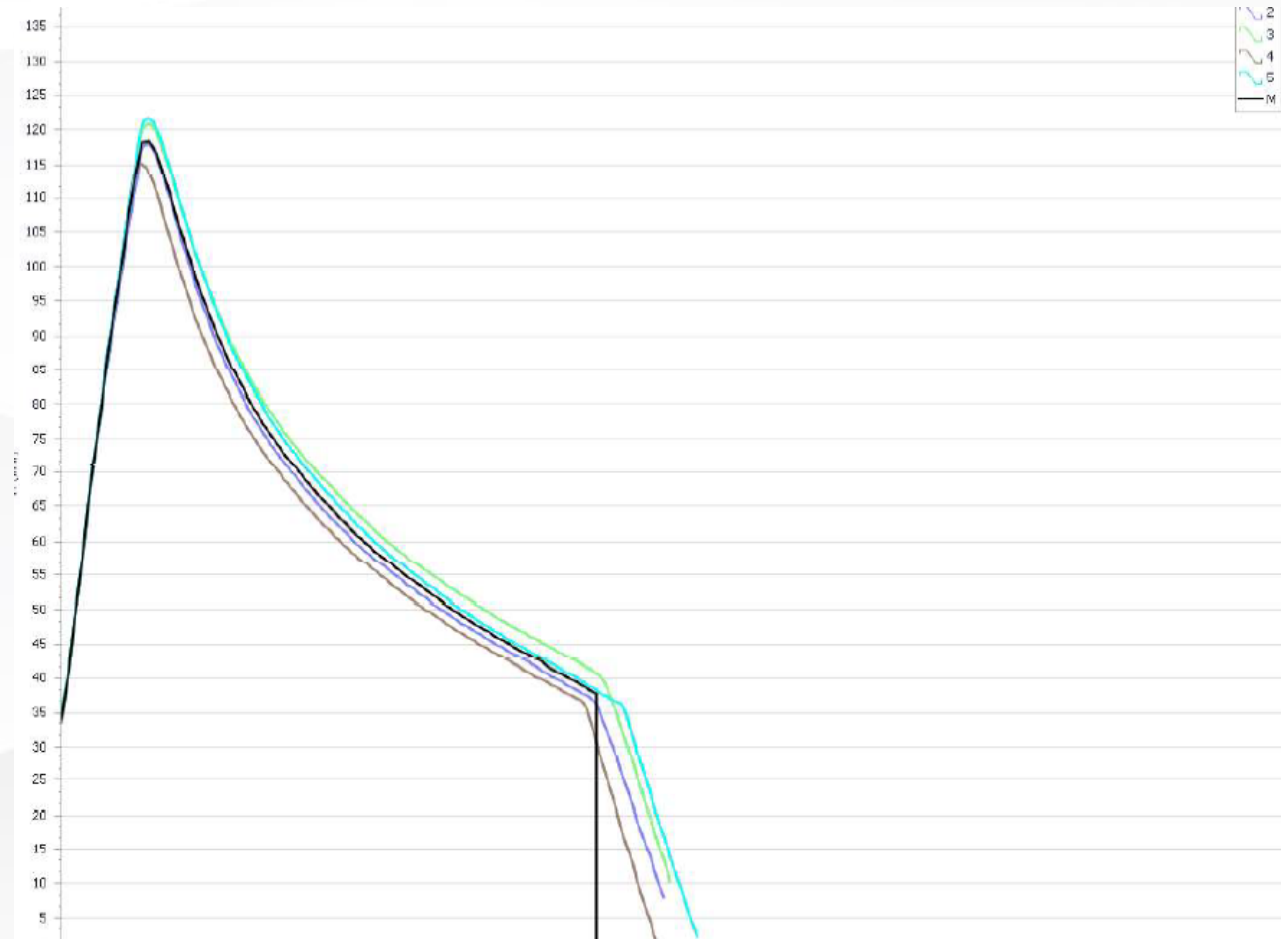
Base



P	96
L	81
W	274
P/L	1,19

Alveolab

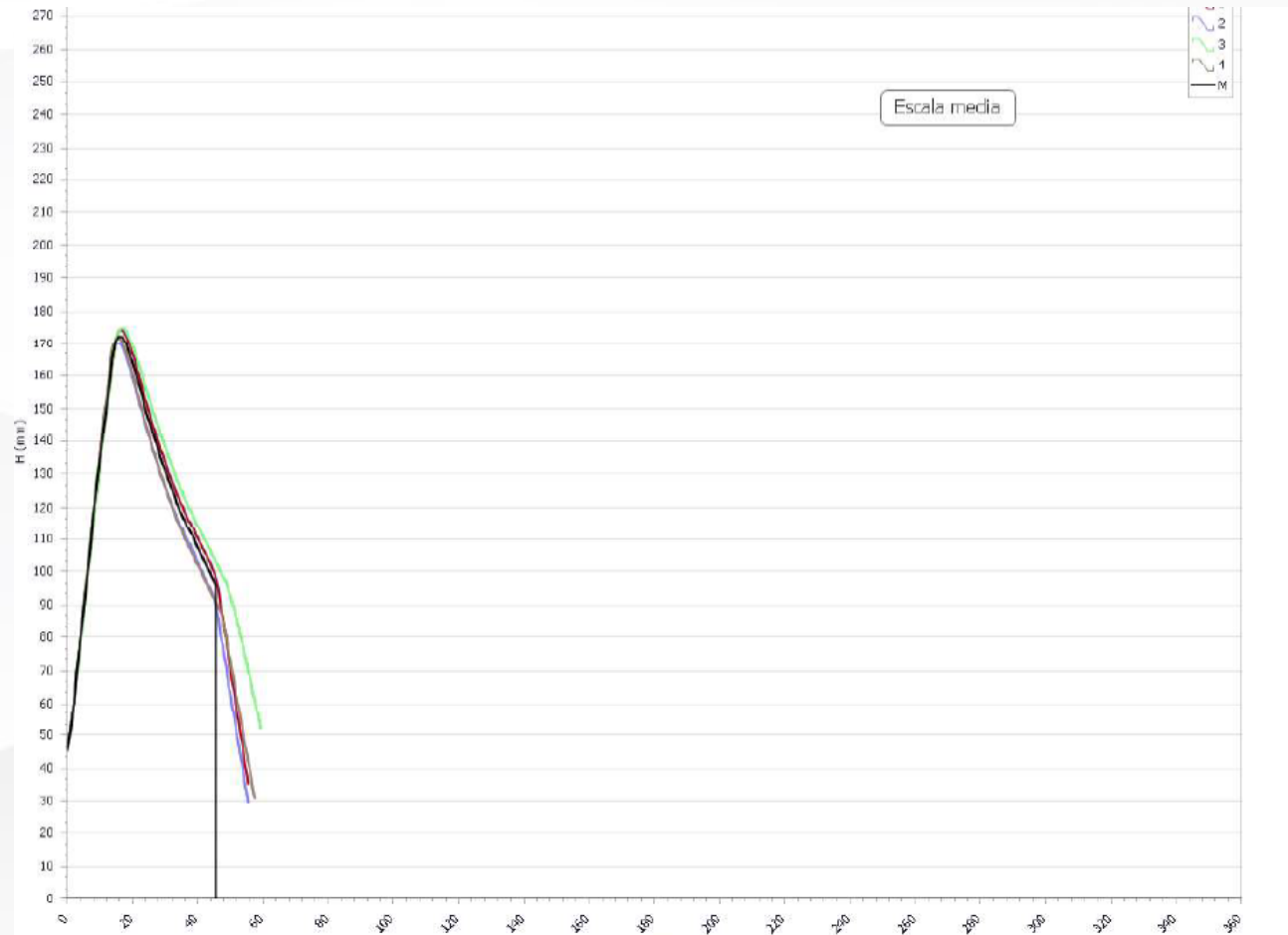
Sodium Bicarbonate 1%



P	130
L	78
W	349
P/L	1,67

Alveolab

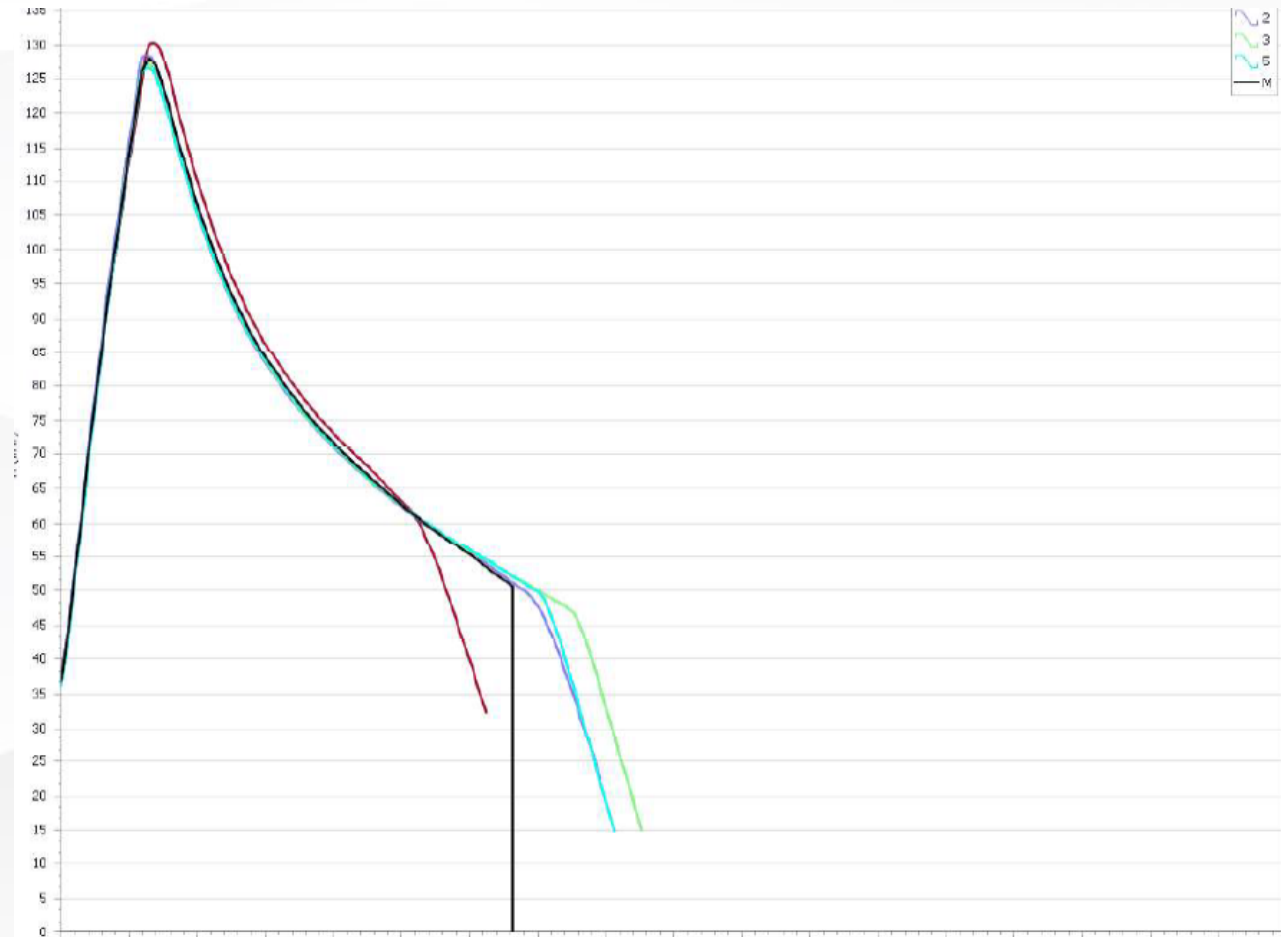
Sodium Bicarbonate 2%



P	190
L	46
W	378
P/L	4,13

Alveolab

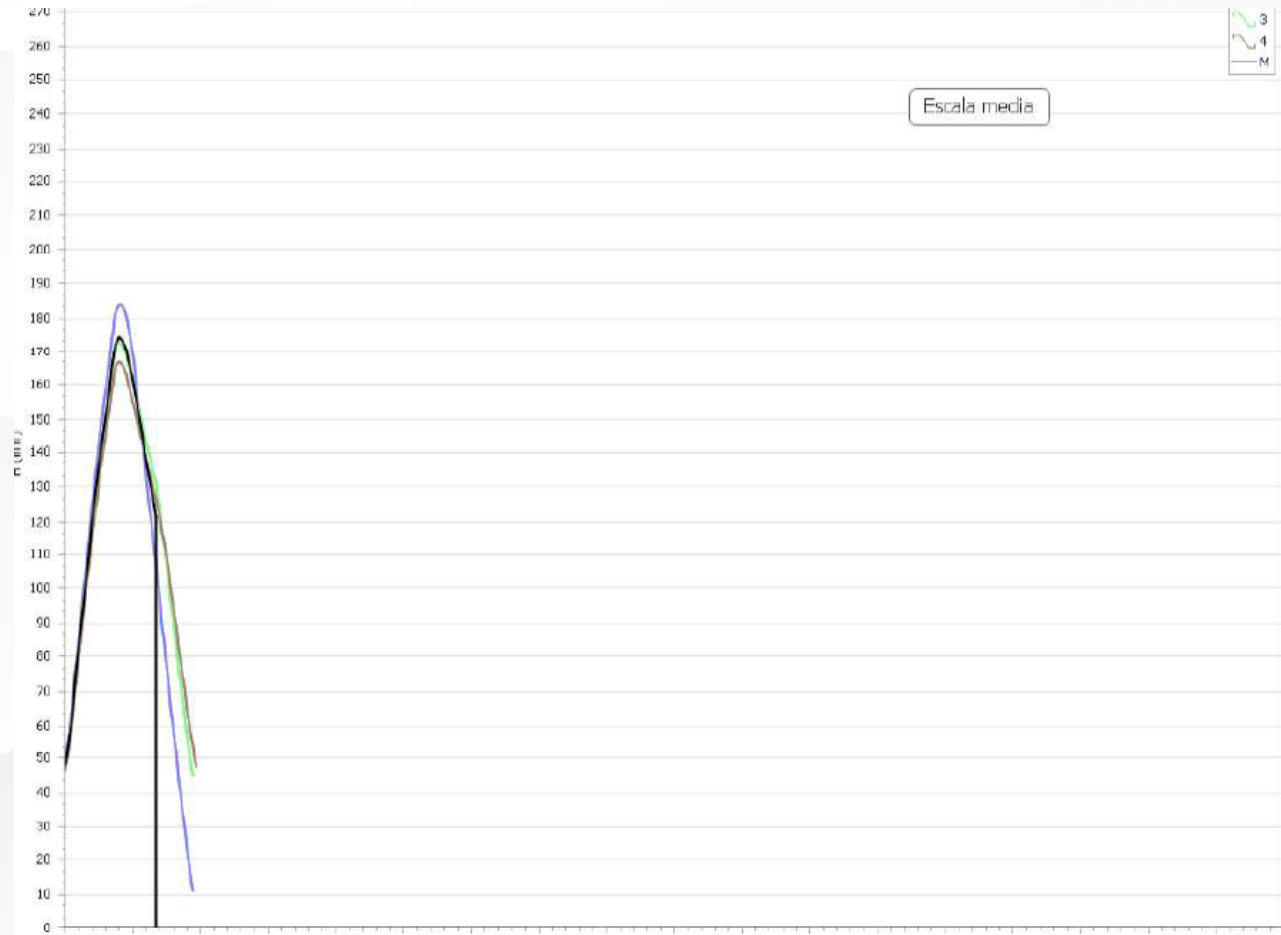
Baking powder 2%



P	141
L	66
W	349
P/L	2,14

Alveolab

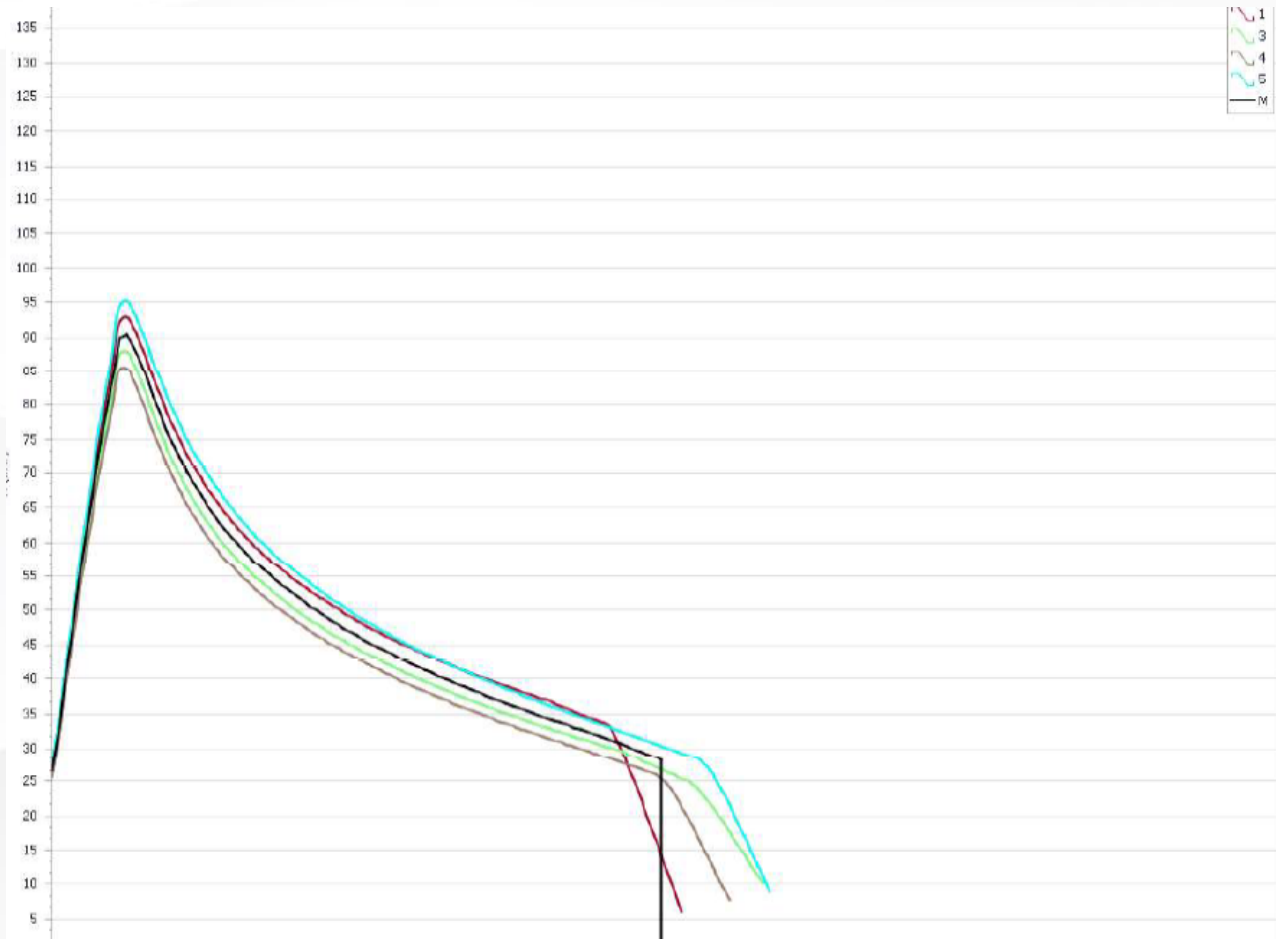
Baking powder 5%



P	192
L	26
W	231
P/L	7,38

Alveolab

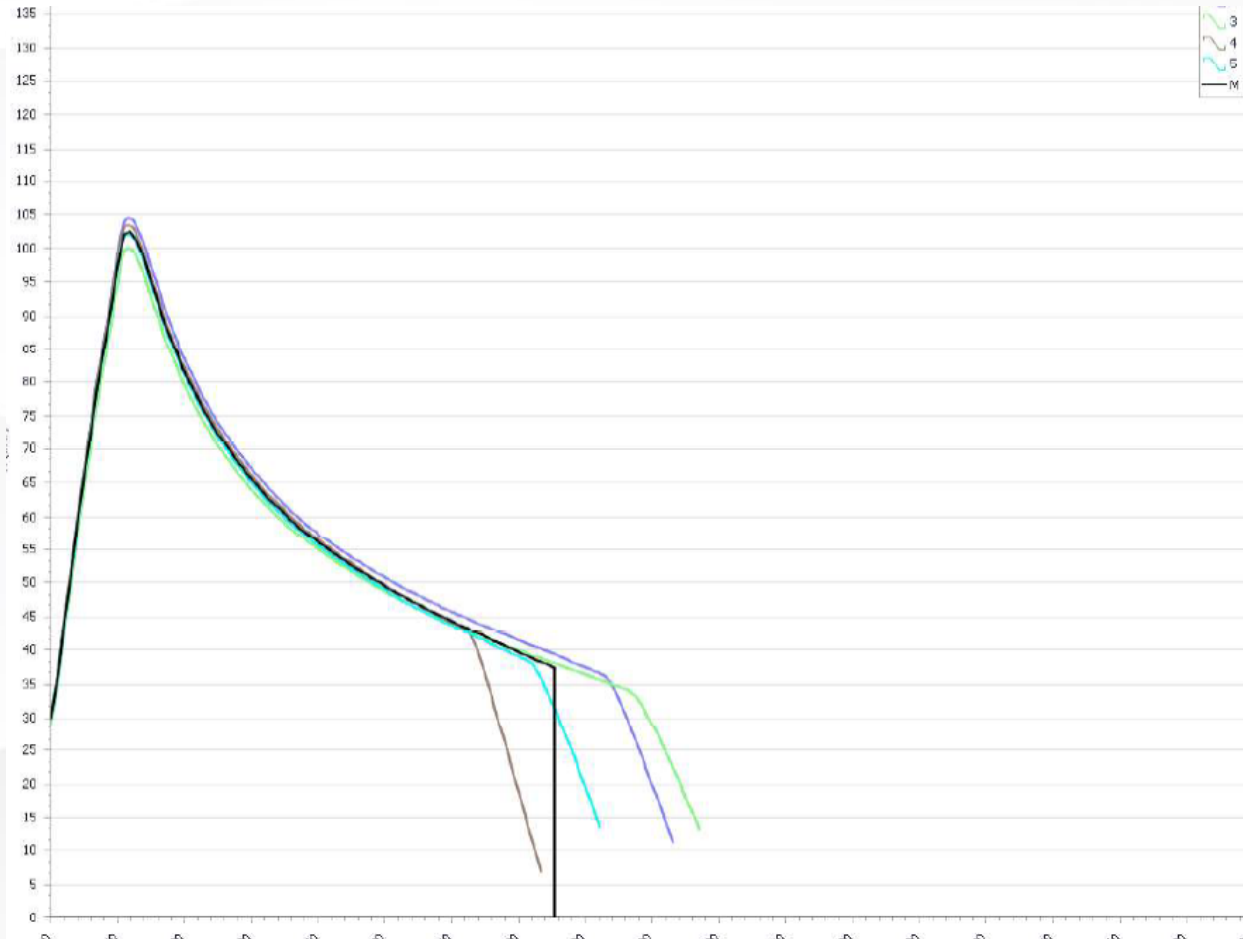
2A Baking powder 2%



P	89
L	75
W	292
P/L	1,11

Alveolab

2A Baking powder 5%



P	113
L	75
W	300
P/L	1,51

Alveograph Results — Effect of Leavening on Dough Strength

Harina Virgen — Control vs. Sodium Bicarbonate (NaHCO₃) vs. Baking Powder | AlveoLab | 21/04/2026



Sample	P (mmH ₂ O)	L (mm)	W (10 ⁻⁴ J)	P/L
Base Flour (Control)	96	81	274	1,19
Base Flour + 1% Sodium Bicarbonate	130	78	349	1.67
Base Flour + 2% Sodium Bicarbonate	190	46	378	4.13
Base Flour + 2% Baking Powder	141	66	349	2.14
Base Flour + 5% Baking Powder	192	26	231	7.38
Base Flour + 2A Baking Powder 2%	89	75	300	1,19
Base Flour + 2A Baking Powder 5%	113	75	300	1.51

Key Findings

- **Sodium Bicarbonate (NaHCO₃) increases P and decreases L**
dough becomes stronger but less extensible. At 2%, P/L = 4.13 indicates very tight, potentially difficult-to-sheet dough.
- **Baking powder at 5% raises P/L to 7.38**
extremely tight dough with very low extensibility (L=26 mm). Use level requires careful formulation balance.
- **2A Baking Powder 5% gives the most balanced result**
P=113, L=75, W=300, P/L=1.51. This is within the normal range and most suitable for standard tortilla production.

Lab data: STERN Ingredients México R&D Lab | Method: Chopin AlveoLab / ICC Standard 121 | Date: 21/04/2026

Overview

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Matching Leavening System to Tortilla

Final reference guide

Tortilla Style	Recommended Acid	Watch For
Sonora / Translucent	SAPP, SAS	Fast Hot Press action — process quickly
Standard Flour Tortilla	MCP, SAPP, SAS	Grey risk if warm mix; balance NV
Street Taco / Small	MCP, SAPP, SAS	Rollability critical; low blister tol.
Thick Burrito / Wrap	MCP, SAPP 10/28/40, SAS	Press and Reaction in the oven needed;
Refrigerated / Extended	MCP, SAPP, SAS - Encapsulated	Coating melt point must match oven
Clean Label / Phosph.-Free	GDL + MCP	Significant performance trade-offs
Gluten-Free / Rice Flour	Baking powder (low level)	Weakened structure



Together. Better Baking.

Thank you very much for your attention
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