Optimized process when using Microencapsulated Ingredients

1st European Tortilla Conference, 14th September 2017

Mercè Pinol del Olmo
INTRODUCTION

• Concepts in microencapsulation
• Basics in flour tortillas
• Baking powders importance and how this related to optimized use of encapsulated acids
  – New Baking poder options
• Impact optimized process on quality of flour tortillas
Microencapsulation Technology overview
TECHNOLOGY OVERVIEW

• Lipid *Encapsulation* Technology
  – Protect the core material from environmental factors (light, moisture, temperature, oxygen)
  – Extend shelf life¹
  – Improve the release properties of compounds²
  – Optimize costs

1. Shahidi and Han, 1993; Gouin, 2004
2. Müller et al., 2002
ENCAPSULATION GEOMETRIES

Single Coating

Multiple Coatings

Irregular shape

Matrix Particle

Multiple Actives

Plated Liquid
PHYSICAL ENCAPSULATION TECHNIQUES

Fluid bed technology³
- Mononuclear coating
- Complete coating particles

Spray drying technology⁴
- Matrix coating
- Not complete coating particles

- Complete coating particles
- Particles coated homogeneously
- Control release for specific application
- Consistent release for all batches production
CONTROLLED RELEASE ENCAPSULATES

• Type of Fats
  – HVO, NON HVO, Palm, Non Palm
• Thickness of encapsulation
• Raw Material Characteristics
  – Particle size
  – Solubility
### RELEASE OF ENCAPSULATES

<table>
<thead>
<tr>
<th>Large particle raw</th>
<th>Smaller particle raw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass = Mass</td>
<td></td>
</tr>
<tr>
<td>Surface Area &lt;</td>
<td>Surface Area</td>
</tr>
<tr>
<td>Lipid applied (w/w) =</td>
<td>Lipid applied (w/w)</td>
</tr>
<tr>
<td>Coating thickness per particle &gt;</td>
<td>Coating thickness per particle</td>
</tr>
<tr>
<td>Release in water &lt;&lt;</td>
<td>Release in water</td>
</tr>
</tbody>
</table>
RELEASE CHARACTERISTICS OF AN ENCAPSULATE

Lipid melts and disperses

TEMPERATURE

FORCE

&

MOISTURE

Shear from processing, mastication, etc.

Water migrates inside, substrate leaches out
Optimized use of microencapsulated ingredients
Main Ingredients for Commercial European Flour Tortillas:
- Flour
- Water
- Shortening/Fat
- Salt
- Baking powder
- Acid (citric, malic, fumaric)
- Preservatives (sorbic, calpro)
- Emulsifier (mono&di)
- Enzymes
- Humectant
PARAMETERS TO DETERMINE SHELF LIFE TORTILLAS

- Mould growth
- Dryness
- Rollability/Foldability
- Degree of toughness
- Extensibility

Texture Analyzer
ROLE OF ENCAPSULATES IN SHELF LIFE

pH + preservatives

Mould control growth
OPTIMIZING SHELF LIFE

Determine Shelf life targets
What shelf life I want to achieve? What country am I servicing (regulatory allowances)?

Selection of chemical leavening
What type tortilla I want to make (fluffy, thin, thick, White, etc)? What is the target client (Customer desires)? What will be my choice of baking powder? What is pH tortillas without acid/preservative?

Adjusting pH and shelf life control
Determine final pH (desired) – adjust pH with acidulant to optimal performance of preservatives
Aerate the dough
The bubbles created by the leavening expand during baking creates the crumb structure.
Influences the color of the crumb
REACTION BAKING POWDERS

• Thermal decomposition Sodium bicarbonate:
  \[ 2 \text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2 \]

• Reaction base (p.ex bicarbonat sòdic) with an acid (SAPP, SALP, MCP, and other acidic ingredients in formula) in presence humidity and/or heat to produce CO₂
  \[ \text{HX} + \text{NaHCO}_3 \rightarrow \text{NaX} + \text{H}_2\text{O} + \text{CO}_2 \]
BAKING POWDERS IN EUROPE

- Sodium bicarbonate
  - Released max. 50% CO$_2$ above 60°C or presence of humidity
  - Higher dosage required compared when combined with SAPP
  - Higher pH tortillas
  - Soapy taste

- Sodium bicarbonate + Encapsulated GDL
  - GDL approved as acid source for tortillas
  - Encapsulation helps to slow reaction GDL
  - Encapsulation should be designed to provide a release similar to SAPP 28
  - Combination will help to reduce sodium bicarbonate
  - Less sodium contribution
**pH INFLUENCE VARIOUS BAKING POWERS**

- **Control**
  - 0.45% Sodium bicarbonate
  - + 0.62% SAPP 28
  - pH = 5.39

- 0.90% Sodium bicarbonate
  - pH = 7.13

- 0.45% Sodium bicarbonate
  - + 1.3% encap GDL
  - pH = 4.77
NEUTRALIZING BAKING SODA

• Neutralizing Value: is calculated by dividing the amount of the carbon dioxide carrier by the amount of the leavening acid needed for neutralization. The resulting quotient is multiplied by 100¹

\[ \text{NV} = \frac{\text{grams of sodium bicarbonate}}{\text{grams of leavening acid}} \times 100 \]

\[ \text{NV}_{\text{GDL}} = 45 \quad \text{--- For every 100 gr acid we need 45 gr of Sodium bicarbonate} \]

\[ \text{NV}_{\text{SAPP}} = 72 \quad \text{--- For every 100 gr acid we need 72 gr of Sodium bicarbonate} \]

RATE OF REACTION

![Graph showing the rate of reaction with time elapsed and total CO\(_2\) produced. The graph compares SAPP NBC, rGDL NBC, and eGDL NBC.](image-url)
Adjusting pH and shelf life control (mould)
CONDITIONS OF MOULD GROWTH

Mould growth

- T > 27 C
- rH = 80%
- Presence of O₂, C, H, N
- Aw = 0.8-1.0
- pH > 5.3

Air conditioning
Refrigeration
Heat sterilization
Air conditioning
MAP Packaging
Glycerol
Hydrocolloids
Encapsulated acids
Sorbic acid Calcium propionate
PRESERVATION PYRAMIDE

- Map Packaging
- Sorbic acid
- Calcium propionate
- Temperature control
- pH Control: Bakeshure acidulant
- Moisture (aw)
- Cleaning, sanitazing
### pH vs DISSOCIATION PRESERVATIVES

<table>
<thead>
<tr>
<th></th>
<th>% undissociated (active) at pH:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.0</td>
</tr>
<tr>
<td>Propionic acid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>99</td>
</tr>
<tr>
<td>Sorbic acid</td>
<td>98</td>
</tr>
</tbody>
</table>

**Effectiveness**

**Taste**

**Weak acids vs Strong acids**

Sauer (1977), Sofos and Busta (1981)
ACIDIFYING TORTILLAS FOR LONG SHELF LIFE

Goals with Microencapsulation:

- No interaction with Baking poder prior to baking
- Progressive pH drop
- Drop pH start at press, higher release during baking and balance system over first 24 hours
PRESERVATIVES AND SHELF LIFE

0,90% NBC

pH= 7,13

0,45% NBC

+ 0,62% SAPP 28

pH= 5,39

0,45% NBC

+ 1,3% encap GDL

pH= 4,77

Increase on shelf life

0,8% calpro

x30

0,6% sorbic

30 % calpro

25 % sorbic

56 % calpro

42 % sorbic

SensoryEffects®
WHY ENCAPSULATION (VS RAW ACID)?

- Control pH
  - discourage undesirable microbial growth in foods
  - activate mold inhibitors: sorbic acid, calcium propionate
- Optimize use baking soda
- Improve thickness tortillas
- Improve size tortillas
- Optimize pressure – easier to press
PERFORMANCE DIFFERENCES ENCAPSULATES

Activity: Malic acid 70%
Coating: HVO Palm Fat 30%

Activity: Malic acid 70%
Coating: HVO Palm Fat 30%
DISPERSION ENCAPSULATED ACID IN DOUGH

CONTROL

ENCAP 1

ENCAP 2

- Bromocresol Purple 0.04% Solution Used for Testing
- A pH of 7.0 is blue (No Acid)
- A pH of 5.0 is yellow

Potential growth mould – strong blue – high pH
SUPERIOR THICKNESS

ENCAP 1

ENCAP 2
IMPROVED SIZE TORTILLAS

ENCAP 1

ENCAP 2
What Balchem can do for you:

• Offers preservation systems: acidulants – citric, malic, fumaric
• Offers Clean label – low sodium acids for leavening systems-GDL
• Helps to optimize processes
• Helps to design the best encapsulate that releases at the appropriate time in the tortilla process
• Produces very consistent encapsulates – for reliable and consistent productions
• Offers application lab resources: risograph, bakign trials, texture analyzer, shelf life studies
• Provides technical support: On-site
Thank You!

Mercè Pinol del Olmo
European Sales Manager, Food ingredients
Balchem Corporation
Home office: Barcelona, Spain
+34.673.70.95.51