Technology of Corn Cooking and Masa Flours

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TORTILLA / SNACK PRODUCTS PROCESSING FLOW

MASA

OPTION 1 - COOKING CORN

FORMING OF PRODUCT

BAKING / TOASTING

EQUILIBRATOR OR COOLER

FRYING OF CHIPS

PRE-COOLING OF CHIPS

SEASONING

PACKAGING OF TORTILLAS

COUNTER/STACKER

PACKAGING OF TORTILLA CHIPS

PACKAGING OF CORN CHIPS

PACKAGING OF CORN CHIPS

MASA

OPTION 2 - USING MF

FRYING OF TACOS

COOLING OF TACOS

PACKAGING OF TACOS

FRYING OF CORN CHIPS

PRE-COOLING OF CORN CHIPS

SEASONING

PACKAGING OF CORN CHIPS
OPTION 1: COOKING CORN

1. SELECTION OF CORN HYBRIDS
2. SUPPLIER
3. BULK STORAGE
4. CORN CLEANING
5. SCREENINGS
6. BAG STORAGE
7. PROCESSING AREA
8. COOKING
9. STEEPING
10. DEWATERING
11. WASHING
12. MILLING
13. MASA

- CORN
- WATER
- LIME
- ADDITIVES (FOR TORTILLAS)
- WATER
- WASTE WATER
- HEAT (BOILER/GAS)
OPTION 2 - USING INSTANT CORN MASA FLOUR (MF)

MF → MIXER → MASA
WATER
TYPICAL PROCESS FOR PRODUCING MF

1. RECEIVING CORN
2. LONG TERMS STORAGE
3. RAW CORN
4. Q.A
5. Q.A
6. CORN CLEANER
7. SHORT TERM STORAGE
8. PRODUCTION SILOS
9. RAW CORN
10. Q.A
11. PRODUCTION SCALE
12. PRODUCTION

CORN FLOW

1. RECEIVING CORN
2. RAW CORN
3. Q.A
4. Q.A
5. CORN CLEANER
6. RAW CORN
7. Q.A
8. PRODUCTION SCALE
9. PRODUCTION

10. 1
COOKER

STEEPING

MILL

HEAT

DRYER

COOLER

FLOUR SILOS

SECURITY SYSTEM

PACKAGING

CORN MASA

PROOF SIFTERS

METAL DETECTORS

MAGNETS

50 LB./BAG

25 LB./BAG

4.4 LB./RETAIL

BULK OR TANKER

RAILROAD CAR

TRUCK (900 BAGS)

CORN MASA FLOUR

TOTE BAG 1850 LB.
SELECTING AND HANDLING THE RIGHT CORN HYBRIDS:

• INTENSIVE PROGRAM:

- ACQUISITION OF QUALITY CORN FROM DIFFERENT GROWING AREAS
- INVOLVES DIFFERENT INDIVIDUALS AND ORGANIZATIONS
- LONG TERM

• USE OF ONLY APPROVED HYBRIDS:

- TO PRODUCE THE HIGHEST QUALITY FINISH PRODUCT
- TO OBTAIN THE PROPER MILLING CHARACTERISTIC
- SHOULD HAVE GOOD AGRONOMIC CHARACTERISTICS
SELECTING AND HANDLING THE RIGHT CORN HYBRIDS:

• **LONG TERM STORAGE OF CORN:**
  - PROPER MATURITY
  - SEGREGATION OF CORN BY ITS CHARACTERISTICS
  - PEST CONTROL PROGRAM

• **FIELD TEST PROGRAM:**
  - FOR NEW HYBRIDS AS WELL AS FOR APPROVED ONES
  - CONTINUOUS TESTING PROGRAM (LONG TERM)
  - INVOLVES: MF MANUFACTURERS, SEED COMPANIES,
    UNIVERSITIES, GRAIN ELEVATORS AND FARMERS
    (SLIDES)
Cooking considerations

- In general, nixtamal should have 50% moisture- corn tortillas and 48% moisture- tortilla chips
  - Nixtamal for tortillas is cooked more thoroughly to achieve higher water absorption, starch gelatinization and a softer nixtamal texture.
  - Nixtamal for corn and tortilla chips is cooked less so to produce a coarser and less moist masa and less moist tortilla before frying. This is required to absorb less oil during frying.
  - Quenching or not?
Control of Cook

Batch # ________
Product ________

(Simmer) Time
220
210
200
190
180
170
160
150
140

TEMP

3 MIN 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

RISE TIME
LBS OF CORN
LBS OF LIME
START TIME

COOL DOWN
SHUT OFF TIME
STEEP TIME
MOISTURE CONTENT

CORN COOK QC DATA
Production Issues

Cooking for Corn Tortillas
- Relative overcook
- Relative underwash
- Quality
- Yield
- Moisture content/particle size dist.
- pH
Production Issues

Cooking for Chips

- Relative undercook
- Relative overwash
- Quality – oil absorption
- Oil degradation
- Moisture content/particle size dist.
- pH
Steeping

Step necessary to allow water and lime diffusion into the grain structure. Grain becomes softer and therefore is easier to grind it into masa.

During steeping, the pericarp continues to degrade and detaches from the nixtamal.

Steeping is necessary to enhance the liberation of starch granules during stone grinding.
Nixtamal Washing

- Operation required to eliminate loose pericarp, excess lime and steep liquor or nejayote.
- The operation is usually done by nixtamal stirring or by spraying pressurized water.
- Washing affects nixtamal pH (tortilla microbial stability), tortilla flavor and color and yield.
- Nixtamal washing decreases nixtamal temperature in dry masa flour operations.
Stone Grinding

- Objective: produce masa that meets particle size requirements, moisture and degree of starch gelatinization.

- Machinability

- Equipments: stone mills equipped with natural (volcanic) or artificial (aluminum oxide) stones.

- Control critical factors
  - Stone carving
  - Pressure between stones
  - Degree of nixamal cooking
  - Water addition
Stone Grinding

- Quality Control: particle size distribution, masa moisture and texture (cohesiveness, stickiness etc)
Masa Cohesiveness

When nixtamal is ground into a masa its structure is disrupted by abrasion or friction:

- A cohesive masa is formed mainly due to the liberation of pregelatinized starch granules.

- Undercooked nixtamal yields a non-cohesive masa.

- Overcooked nixtamal yields a sticky masa.
Sheeting and Masa Forming

- Overworking masas in the hopper generally result in sticky doughs.
- Objective: necessary work required to form masa pieces with the desired size and thickness (weight) and the minimum number of defects.
- Faulty lime cooking and/or stone grinding are observed in this particular step.
- Equipment: extrusion and sheeting rolls.
Masa Feeder
Sheeting and Tortilla Forming

- Sheeting rolls (teflon coated)
  - Different cutters
  - Thickness control
Masa Sheeter and Tortilla Forming
Baking

- Objective: heat treat the pre-formed masa to yield tortillas (cohesive, flavor development).
- Control Factors: residence time, temperature on each tier and moisture.
- Operation is considerably different when baking table tortillas and chips.
- Chemical changes:
  - Moisture loss
  - Starch gelatinization (tortilla texture).
  - Flavor and color development (Maillard Reactions)
  - Death of all microorganisms.
Three Tier Gas Fired Oven
Cooling

- Objective: decrease product temperature in preparation for frying or packaging.
- Equipment: cooling racks or moving bands.
- Tortilla shelf life is greatly affected by this operation:
  - Cool down tortillas to 86°F
  - A good equipment sanitation and personnel hygiene is required.
- Critical operation for tortilla chip production
Quality Considerations for Using Masa Flour (MF):

USING MF OFFERS THE FOLLOWING ADVANTAGES:

• PROCESS IS EASIER TO CONTROL (SIMPLER)

• UNIFORMITY IN FINISH PRODUCT:

  **FOR FRIED PRODUCTS:**
  OIL ABSORPTION, BLISTERING, TEXTURE, pH, COLOR AND MOISTURE

  **FOR TORTILLAS:**
  HIGHER WATER RETENTION
  BETTER RETENTION OF WATER THROUGHOUT SHELF-LIFE
  SOFTER PRODUCT
QUALITY CONSIDERATIONS:

• QUICKER RESPONSE TO PROCESS ADJUSTMENTS

• NO UNCERTAINTIES:

  DUE TO CHANGES IN RAW MATERIAL LOTS:
  FROM SEASON TO SEASON
  FROM SHIPMENT TO SHIPMENT

• QUALITY ASSURANCE CERTIFICATES PER SHIPMENT

• QUALITY PROGRAM

(SLIDES )
USING MF ALSO OFFERS THE FOLLOWING ADVANTAGES:

• REDUCTION IN MANPOWER REQUIREMENTS:
  - LESS LABOR MANUFACTURING
  - LESS LABOR IN SUPPORT (MAINT., SANITATION, CORN
    CONSERVATION, ETC.)
  - LESS SKILLED LABOR

• REDUCTION IN UTILITIES COSTS:
  - LESS CONSUMPTION OF WATER
  - LESS CONSUMPTION OF GAS
  - LESS USAGE OF ELECTRICITY
DIRECT IMPACT ON OPERATIONAL COSTS:

• REDUCTION IN EQUIPMENT INVESTMENT COST
  - REDUCTION ON SPARE PARTS
  - REDUCTION IN PROCESSING SPACE
  - ELIMINATION OF WASTE TREATMENT COSTS

• IMPACT ON CASH FLOW (FINANCIAL BURDEN DUE TO CORN, EQUIPMENT, INSTALLATIONS, PAYROLL)

• BETTER YIELD (RAW MATERIAL TO FINISH PRODUCT)
DIFFERENCE IN YIELDS:

TYPICAL YIELD FOR TORTILLA CHIP PRODUCTION:

COOKING CORN: 1 TO 1.06 - 1.11

USING ICMF: 1 TO 1.18 - 1.23

TYPICAL YIELD FOR TABLE TORTILLAS:

COOKING CORN: 1 TO 1.45 - 1.50

USING ICMF: 1 TO 1.70 - 1.80

+ MOISTURE CONTENT IN RAW MATERIAL

CORN: 14 - 15 %

MF: 10 - 11 %

+ LOSS OF CORN SOLIDS IN WASTE WATER: UP TO 5 - 10 %

+ FOR TORTILLAS: HIGHER WATER CONTENT IN FINISH
PRODUCT: 48 % VS. 44 %.
OTHER IMPORTANT CONSIDERATIONS:

• SIMPLER PROCESS

• BETTER SANITATION ENVIRONMENT

• REDUCTION IN DAILY START-UP TIME

• FLEXIBILITY OF PRODUCTION PLANNING:
  - SHORT LEAD TIMES
  - SHORT RUNS

• FLEXIBILITY TO PRODUCE SPECIALTY PRODUCTS:
  - VITAMINS
  - OTHER INGREDIENTS

• TECHNICAL SUPPORT:
  - DEVELOPMENT OF MF TO SUIT CUSTOMER NEEDS
  - TROUBLESHOOTING