Non PHO Solutions
Tortilla Shortening Overview

Agenda

Opening Remarks	Introduction:
Lipid Chemistry (just a little)	Basic chemistry important to understanding product characteristics,
Requirements for Fats in Tortillas	Functional and Operational Needs for Fats used in Tortillas
Non PHO Strategies	Non PHO Approach to regain functionality
Tortilla Frying	Industrial Processing; Functional Requirements

Oil Chemistry

- Chemical Structure of Fats
  - Triglycerides (aka Triacylglycerols or TAGs)
  - Fatty Acids
- Impact of Structure on Melting Properties
  - Saturation
  - Chain Length
  - Chemical Structure
- Impact of Structure on Oxidative Stability
  - Saturation
  - Chain Length
- Interesterification
  - Functional Modification
  - Without Partial Hydrogenation OR Trans Fats

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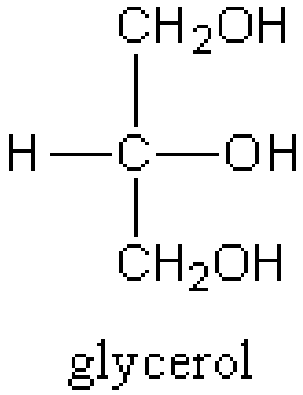
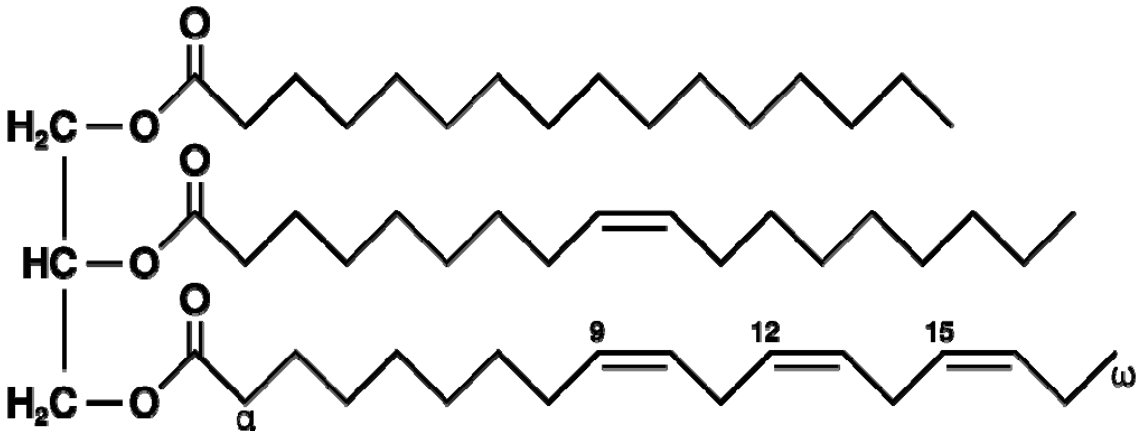
Chemical Structure

Triglyceride Molecule (TAG)

Glycerol + 3 Fatty Acids





Chemical Structure

Nutrition Facts

Serving Size 1 tortilla (49g)

Servings per Package 10

Amount per Serving

Calories 140	**Calories from Fat** 30

	% Daily Value*
Total Fat 3.5g	5%
Saturated Fat 1.5g	8%
Trans Fat 0g	
Polyunsaturated Fat 0g	
Monounsaturated Fat 1g	
Cholesterol 0mg	0%
Sodium 420mg	18%
Total Carbohydrate 24g	8%
Dietary Fiber 1g	4%
Sugars 1g	
Protein 4g	

Vitamin A 0%	*	Vitamin C 0%
Calcium 8%	*	Iron 8%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 * Carbohydrate 4 * Protein 4

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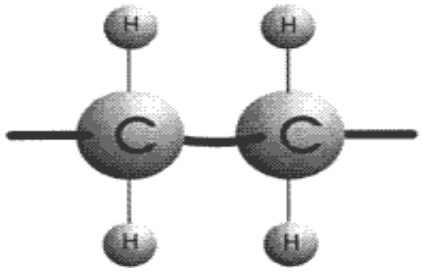
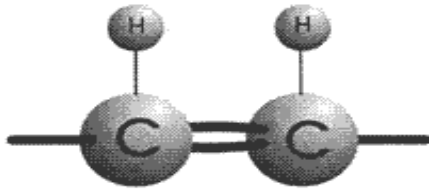
Saturated, Monounsaturated and Polyunsaturated

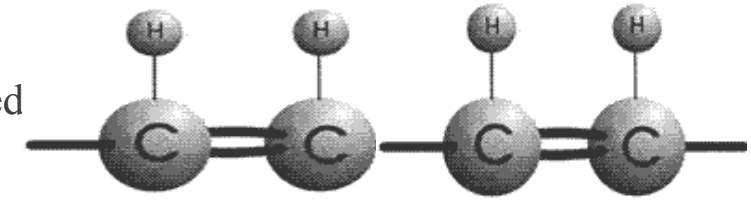
- Saturated Fatty Acid are made up of Carbons which are bonded to other atoms at all 4 sites.
  - Meat Fats, Palm, Butter, PKO and Coconut Oils are high in saturated fats



- Monounsaturated Fatty Acids have a single unsaturated site often called a “double bond”. A fatty acid with only one double bond is called a Monounsaturated fatty acid
  - Olive, Canola and Sunflower Oils are high in mono-unsaturated fats



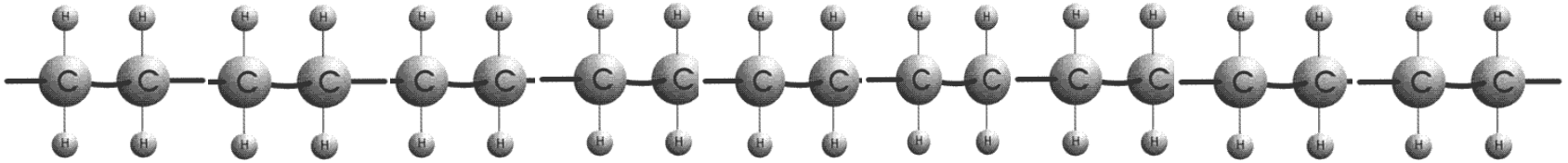
- Polyunsaturated Fatty acids have two or more double bonds along the carbon chain
  - Corn, Soy and Sunflower Oils are high in polyunsaturated fats



Impact of Fatty Acid Length on Melt Point

The longer the Fatty Acid, the higher the Melt Point

C18:0	Stearic Acid	158 F
C16:0	Palmitic Acid	145 F
C14:0	Myristic Acid	129 F
C12:0	Lauric Acid	112 F



Impact of Saturation on the Melt Point of Fatty Acids

C18:0	Stearic Acid	158 F
C18:1	Oleic Acid (cis)	59 F
C18:2	Linoleic Acid (cis)	23 F
C18:3	Linolenic Acid (cis)	10 F

The more Double Bonds the Lower the Melt Point of the Fatty Acid

Impact of Double Bonds on a Fatty Acid's Resistance to Oxidation (Rancidity)

Relative Rates of Oxidation

C18:0	Stearic Acid	1
C18:1	Oleic Acid	10X less stable
C18:2	Linoleic Acid	120X less stable
C18:3	Linolenic Acid	250X less stable

Oils are/were hydrogenated to improve stability

The more Double Bonds, the Less Resistant to Oxidation

Summary: Effects of Saturation and Unsaturation

More Saturation	-Higher Melting Point -More stable against Oxidation
More Unsaturation	-Lower Melting Point -More Likely to react with Oxygen to cause rancidity

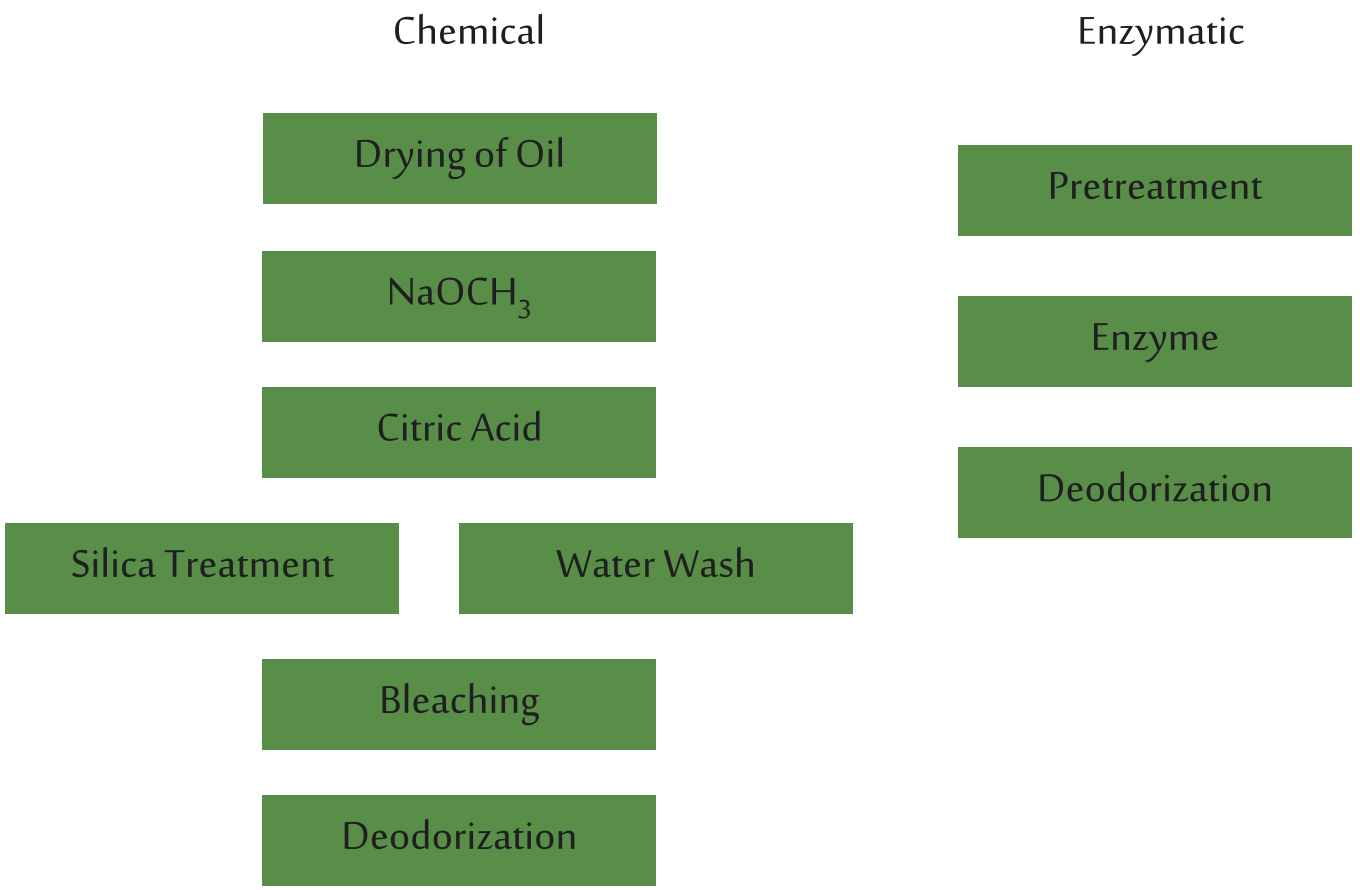
Functional Modification Interesterification:

Method of interesterification:

Chemical – It is the process by which fatty acids are randomly distributed across the glycerol backbone of the triacylglycerol.

Enzymatic – This process rearranges the fatty acids (can be position specific) on the glycerol backbone of the triacylglycerol.

Interesterification Process Comparison



Why Enzyme Interesterification?

- Interesterification allows for the exchange and rearrangement of fatty acids on the glycerol backbone to yield functional triglycerides. Enables the concentration of specific functional triglycerides.

- Provides a more uniform and consistent melting event similar to traditional shortening.

- Considered a *Natural or Green Process*

- Enzymes facilitate many natural biological processes required to sustain life

- The resulting triglycerides are found naturally in traditional oils.

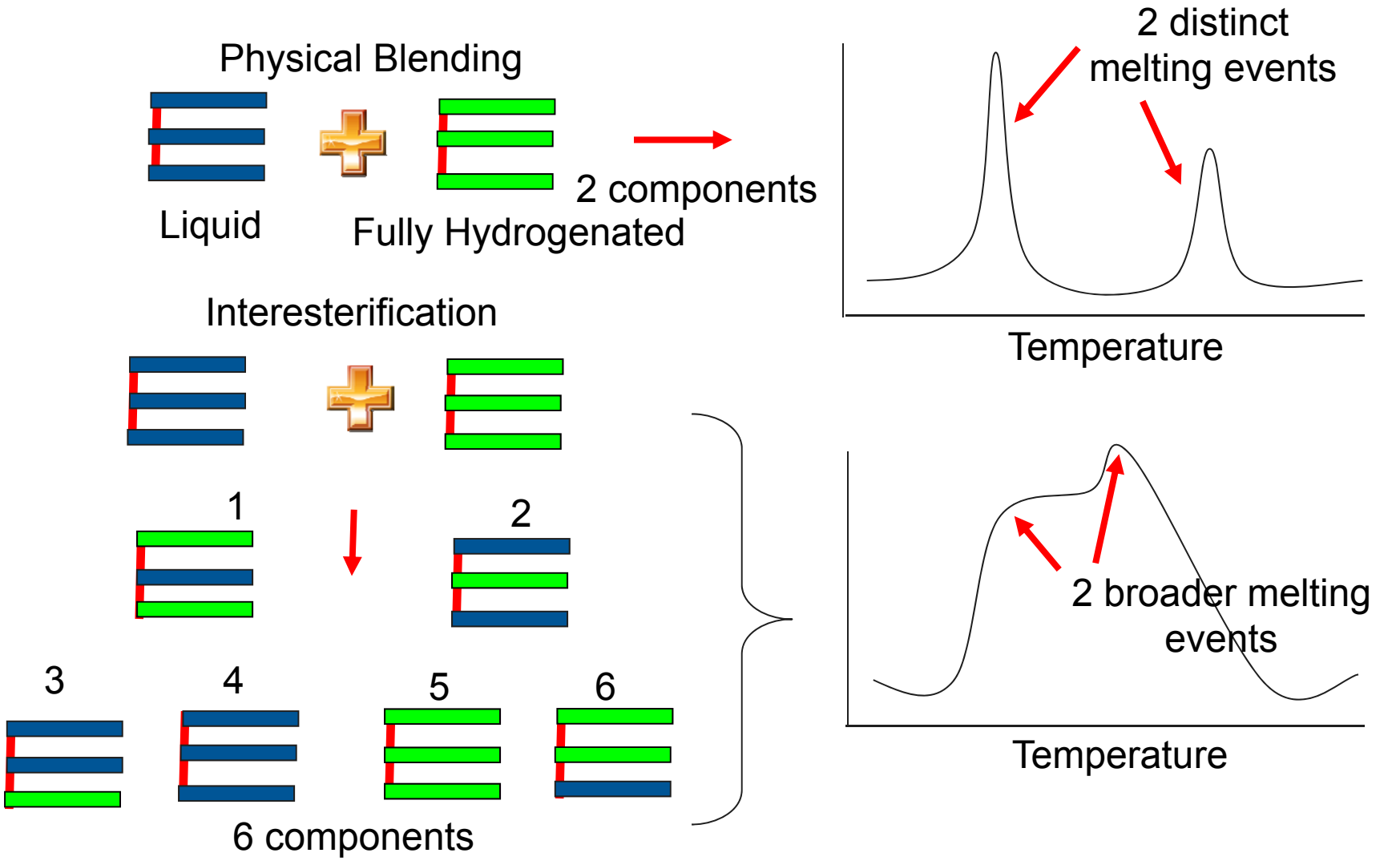
Functional Modification: Interesterification

- Process:

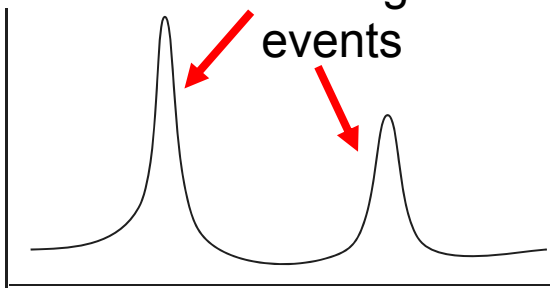
  - Liquid Soy oil and Fully Hydrogenated Soy oil are blended to specific ratio. Both components have been refined and bleached but not deodorized.
  - Blended oil is treated with silica to remove minerals and metals which might interfere with enzyme activity.
  - After silica treatment, the blend is pumped through a series of enzyme beds.

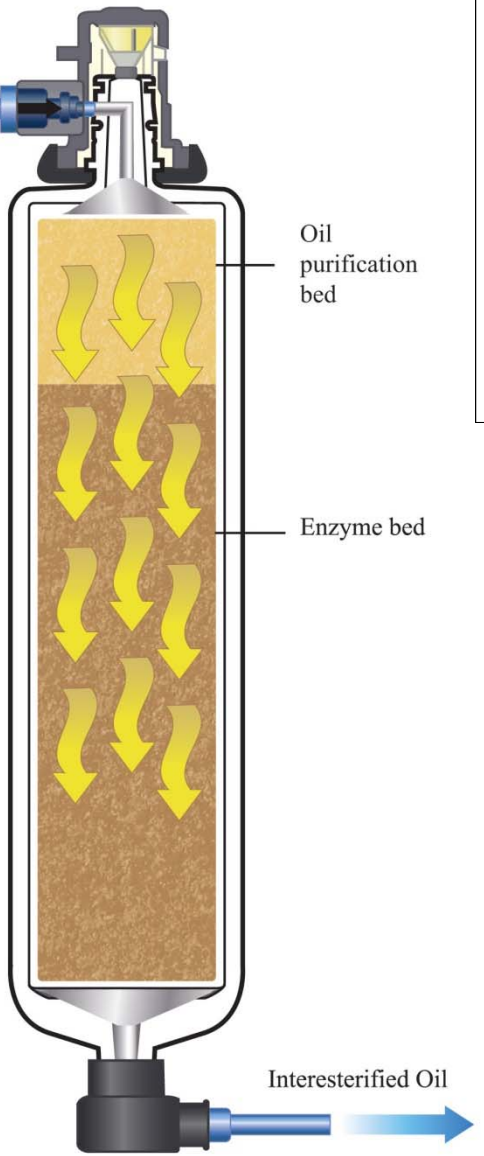
Interesterification vs. Physical Blending

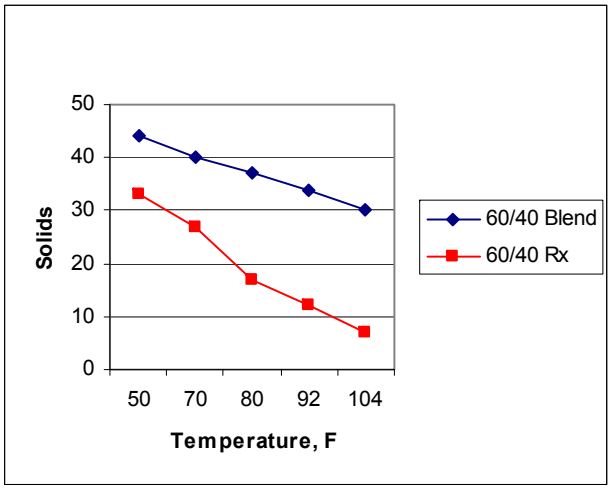
In very basic terms

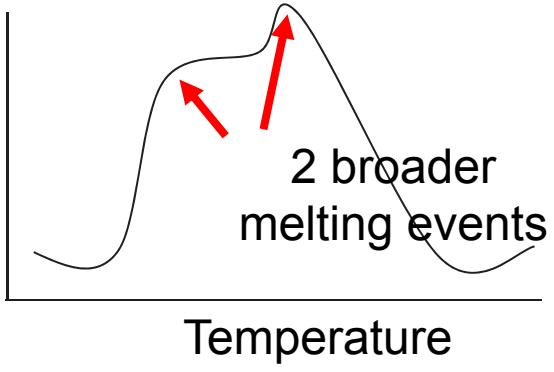


The EIE Process in 1 Slide

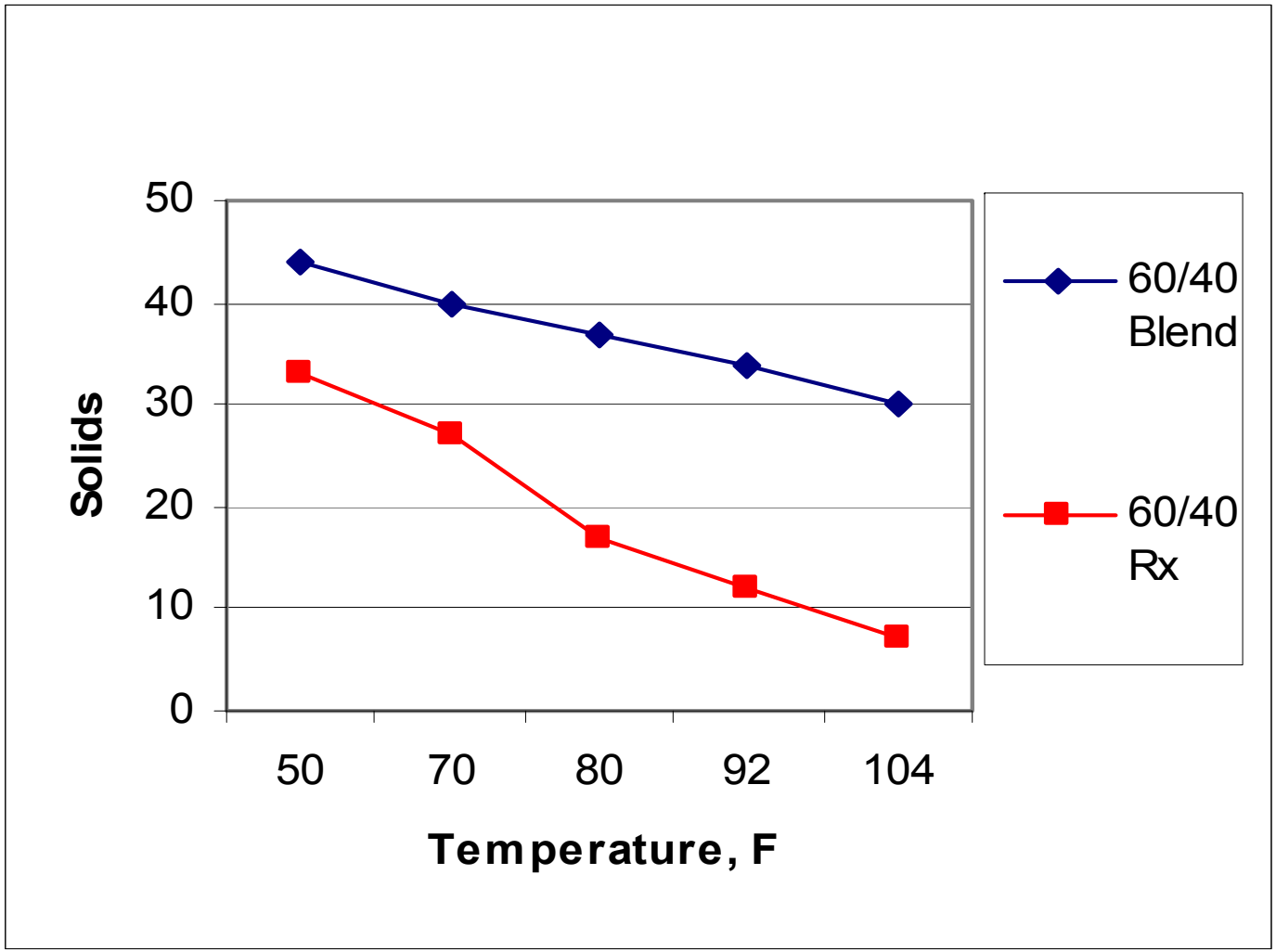








Effect of Interesterificaton on Solid Fat Content



Enzyme Interesterification of Soy

- Benefits
  - Functional, Low trans shortening based upon domestic soybean oil.
  - Sustainable supply chain.
  - Broad plastic range
  - The EIE reaction is a “Green” process that is much more environmentally and resource friendly process vs CIE

What makes EIE a Good Solution Today?

- **Food Industry was pressured to move away form trans fats quickly**
- **Palm oil became the interim solution**
  - **Taste, formulation and processing challenges remain**
  - **Increased levels of saturated fat to replace trans fat**
  - **Supply Chain and Risk Management concerns**
  - **Sustainability concerns**
- **Food processors still looking for longer term solutions**
- **Improvements in enzyme performance and stability have made the process economically viable for mainstream shortenings.**

Requirements for Shortening in Tortillas

- Often dictated by marketing requirements
  - Desire to make specific label claims
  - Desire for “clean” label
  - Desire for “green” or “sustainable” ingredients

Requirements for Shortening in Tortillas

- Functional Requirements:
- Soft, smooth texture
  - Must have good solid content and moderate Melt Point
    - Too much liquid oil makes a sticky dough
  - Good mixing characteristics
    - Must mix out with dry ingredients to smear onto flour and coat ingredients properly
    - Must not leave lumps of shortening in the dough
      - Can cause holes in the finished tortilla

Requirements for Shortening in Tortillas

- Good Flavor and Stability
  - Resistant to oxidation
  - Good Flavor profile
    - Clean and complimentary to the baked product
    - Good mouthfeel (not waxy or oily)

Requirements for Shortening in Tortillas

- Often contain emulsifier

  - Helps with dough processing
    - Makes doughs less sticky on rollers and belts

  - Improves packaged product stability
    - Extends shelflife by keeping the dough soft
    - Prevents the individual tortillas in a stacked package from sticking together.

Strategies for Zero Trans and Non PHO

- A certain level of Saturates is required
  - Give proper texture
  - Mouthfeel
  - Dough processing
- Saturates can come from:
  - Natural Saturates (Palm, Palm Fractions, PKO)
  - Fully Hyrdogenated Saturates
    - Full Hydro Soy or Cottonseed

Strategies for Zero Trans and Non PHO

- Blends of Palm oil with Liquid oil and Fully Hydrogenated components
- Blends of Palm with Liquid and Fully Hydrogenated components
- Interesterification of liquid oils with Fully Hydrogenated components or with Palm

Application: Tortilla Chip Frying

Chemistry of Frying

Industrial Frying Characteristics

Frying Oil Requirements

Oil Types - Options

Chemistry and Physics of Frying

- Frying Is:
  - Heat transfer using Oil as the Heat Transfer Fluid
  - Oil is Edible HTF!

Chemistry and Physics of Frying

- Reactions that happen when Frying:
  - Browning (carmelization)
  - Gelatinization (starches)
  - Maillard Reaction (proteins / sugars)
    - All these processes help to develop desirable flavors and colors in the food

Chemistry and Physics of Frying

- The Most Important Effect When Frying:

- Moisture Exchange
  - Food gives up water (steam)
  - Takes on oil (ABSORPTION)

  - The Fat becomes a Major Part of the Food.
  - Shelf Life then becomes dependent on the quality of the frying oil

Chemistry and Physics of Frying

- Changes in the Oil when Frying:

- Oxidation:
  - Forms hydroperoxides
    - Which further oxidize to form aldehydes
      - Forms ketones
        - » Etc, etc
  - Some of which are not totally bad!
    - A small amount of these develop a desirable “fried” flavor

Chemistry and Physics of Frying

- Changes in the Oil when Frying:

- Hydrolysis:
  - Fatty acids are split from the glycerin
    - Or may be split at a double bond to give a small radical
    - Free Fatty Acids have a low molecular weight
      - They are the primary source of smoke when oil smokes.

  - A TAG Losing a Fatty Acid then becomes:
    - A Diglyceride or a Monoglyceride (or a near analog)
      - These act like EMULSIFIERS in the frying fat
        - » Cause increased absorption onto the food
        - » Help hold water in the oil and further promote hydrolysis

Industrial Frying

Industrial

- High turnover, high food volumes
- Very consistent volume of one or two food types
- Often require long shelf life of finished product
  - Means the oil quality must be very good in the product
- Requires care in process control
  - Temperatures
  - Filtration
  - TURNOVER must be managed carefully

Industrial Frying

Frying Oil Requirements

- High Oxidative Stability
- High Smoke Point (high Molecular Wt oil)
- Often require long shelf life of finished product
  - Means the oil quality must be very good in the product
- Highly automated
- Specific foods require solid frying shortenings

Industrial Frying

Tortilla Frying Options

- High Stability / High Oleic liquid oils
- Blends of Palm + High Stability oils
- Corn and Cottonseed oils
- Interesterified Soy shortening

Industrial Frying

- Tortilla Frying Options

QUESTIONS??

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