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# WHAT IS OLIVE OIL?

## An olive is made up of:

- Water (40 to 60%)
- Oil (10 to 30%)
- Solids (30% - dry wt.)
- Sugars (3%)
- Proteins (2%)
- Other – acids, vitamins, minerals, pectins (2%)



Water	40%	50%	60%
Oil	30%	20%	10%
Solids	30%	30%	30%

# Olive Oil Composition

## WATER FRACTION

0.5 to 1.9%

Water soluble  
compounds

- Phenols
- Polyphenols
- Terpenes
- Tocopherols
- Esters
- Volatile
- Hydrocarbons



## OIL FRACTION

98-99%

Lipids – Fatty  
Acids

- Oleic (61-83%)
- Palmitic (7-18%)
- Linoleic (2-18%)
- Linolenic (1.5%)

# WATER SOLUABLE COMPONENTS OF OLIVE OIL

- Squaline – a terpene (bitterness)
- Polyphenols - tirosol, oleuropin, anthocyanins, flavenoids (flavors & antioxidants)
- Tocopherol (vitamin E) (anti-oxidant)
- Chlorophylls – Caratenoides (pigments)
- Small Hydrocarbons (volatile aromatics)

# Olive Oil

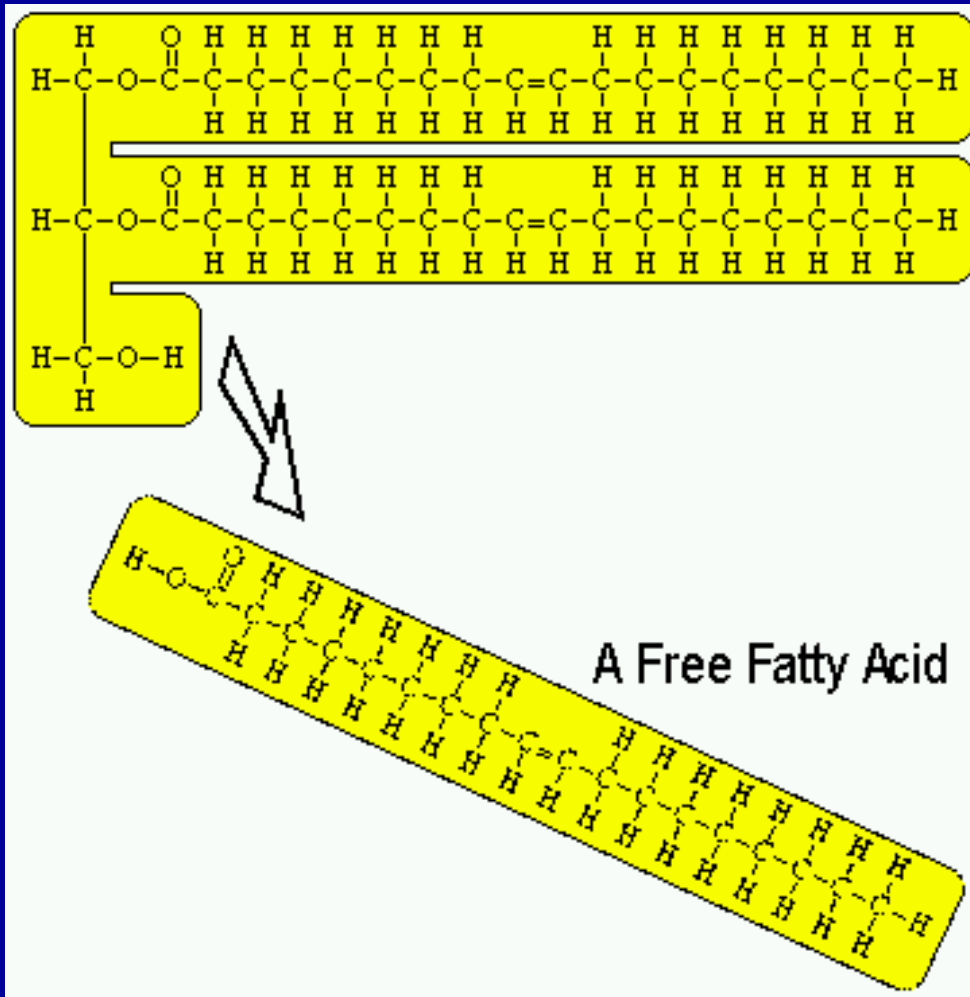
## POSITIVES

- Mono-unsaturated Fat
- Natural Anti-oxidants
- Real Flavor

## NEGATIVES

- Oxygen
- Water
- Microorganisms
  - Enzymes
  - Raw Metal
- Temperature
  - Time

# Free Fatty Acid



**Fruit Breakdown**

**Fermentation**

**Decomposition**

**Oil Breakdown**

**Rancidity**

**Off flavors**

# GOOD OLIVE OIL STARTS WITH GOOD FRUIT





# OLIVES on the TREE

- Quality is the best it can be
- Good fruit = extra virgin
- Fly damage = grubby defect
- Drought stress = bitterness
- Excess water = blandness





# RAW MATERIAL DEFECTS

- *Sanitary Conditions* (Olive Fly – Dirt)
- *Pesticide Residue* (Chemical flavor – blue color)
- *Climatic Factors* (Frozen - Shriveled Dry)
- *Picking and Transport* (Bruised – Smashed - Oxidized)
- *Mill Yard* (Fermentation):



Winey  
Sour  
Fusty  
Yeasty  
Moldy  
Woody  
Grubby  
Rancid



# Olive Fly Damage and Oil Quality







# Pesticide Residue



**Copper Sprays**

**GF-120 Sprays**

**MUST BE  
WASHED OFF**



# MATURITY INDEX



0

hard green



1

yellow-green



2

color <  $\frac{1}{2}$



3

color >  $\frac{1}{2}$



4

white



5

purple <  $\frac{1}{2}$



6

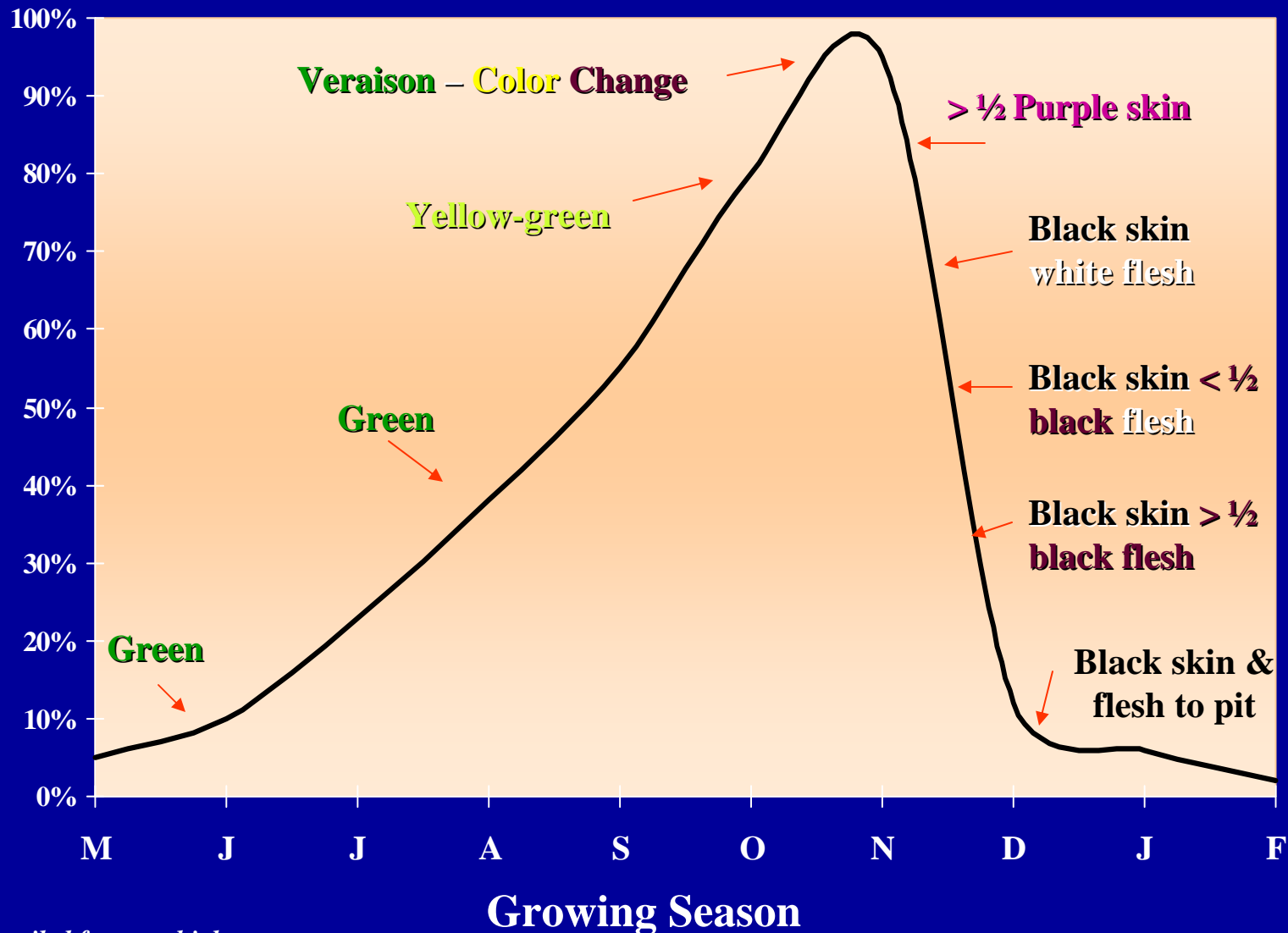
purple >  $\frac{1}{2}$



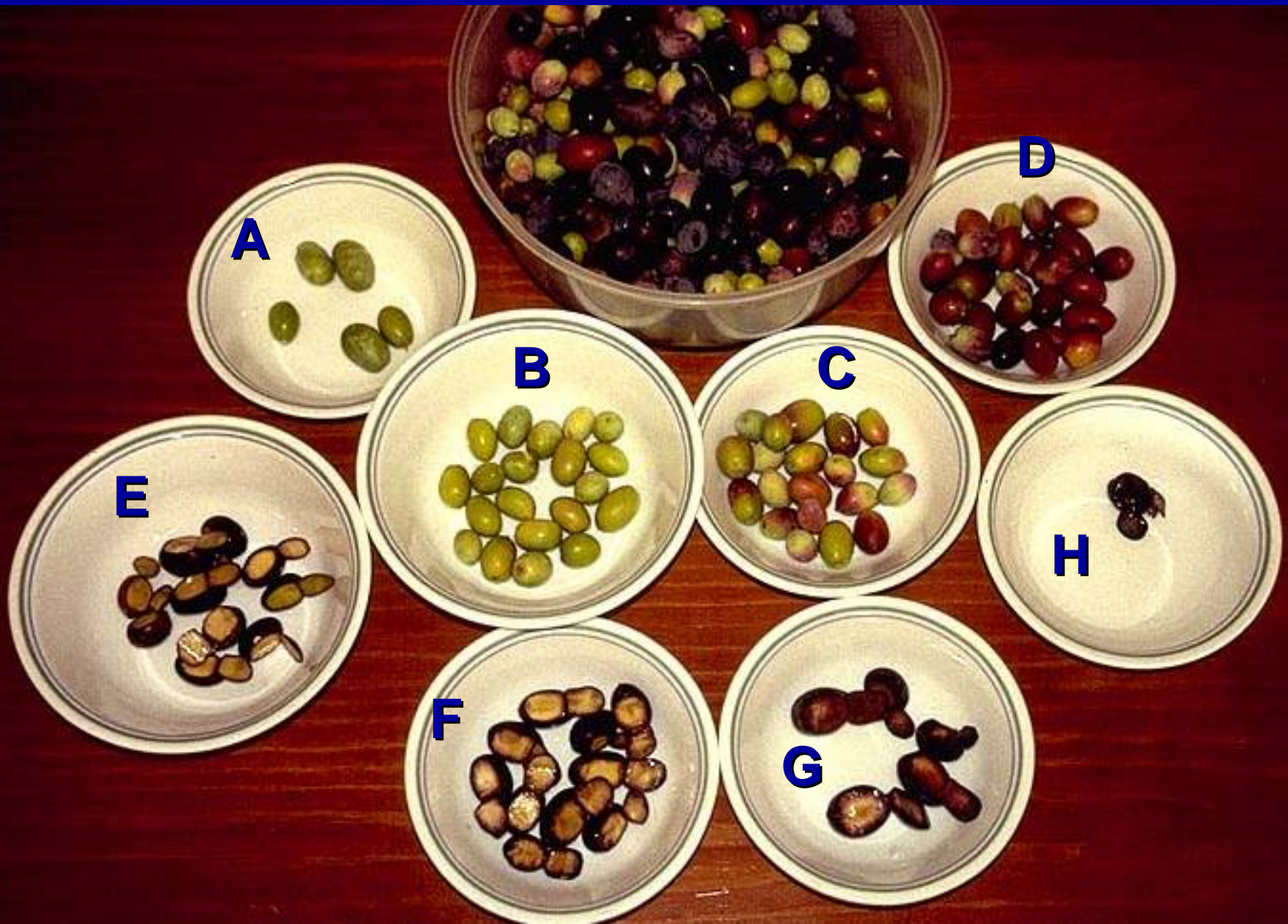
7

purple to pit

# FRUIT POLYPHENOL LEVEL & COLOR DURING THE GROWING SEASON







# Maturity Index Example

*Random Sample of 100 Fruit*

Formula

$$MI = \frac{A(0)+B(1)+C(2)+D(3)+E(4)+F(5)+G(6)+H(7)}{100}$$

*Number of fruit in each class (example)*

**A=3, B=13, C=26, D=35, E=12, F=8, G=3, H=0**

$$0 + 13 + 52 + 105 + 48 + 40 + 18 + 0 = 276$$

**2.76**



# MATURITY INDEX



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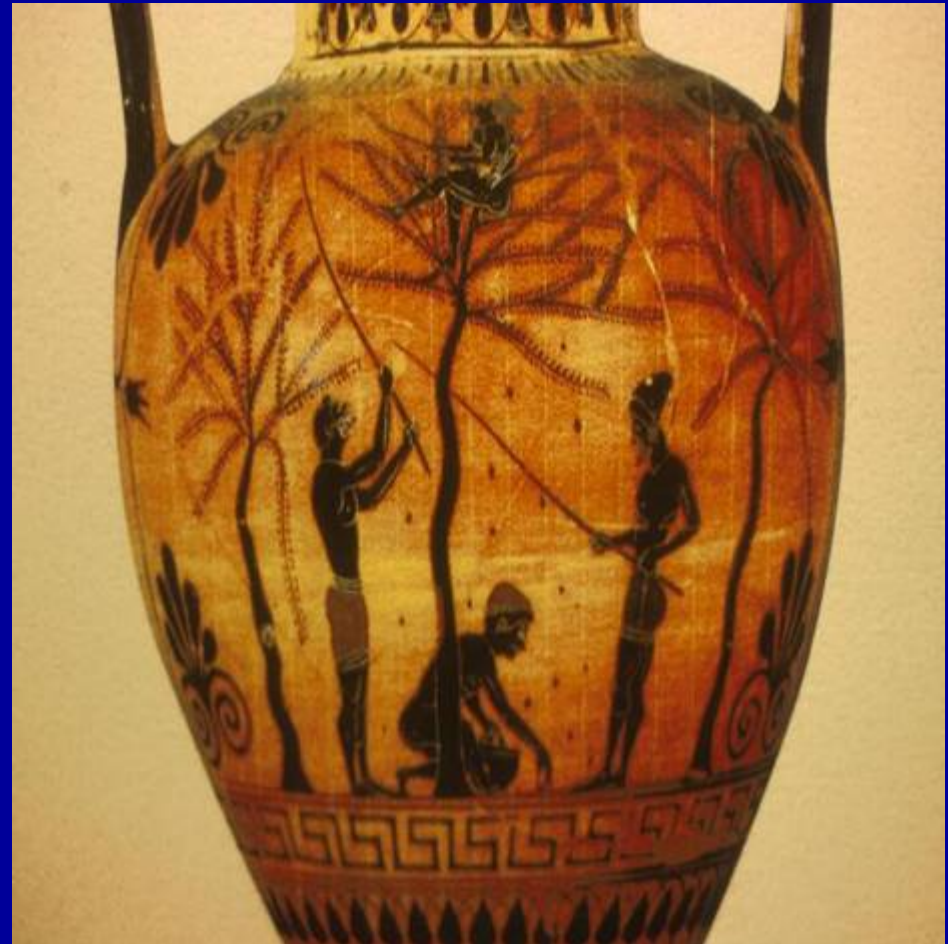


7

purple to pit

# OLIVE HARVEST

- Hand picking
- Beating with poles
- Trunk shaker
- Natural fall
- Rakes
- Over-the-Row Machine







**Hand Harvest**  
**Damage Level**  
**1 fruit per pound**  
**INSIGNIFICANT**





**Ground Fruit  
Damage Level**

**CAN BE  
SIGNIFICANT**







# Shaker and Pole Harvest

Damage Level  
5 fruit per pound

**ALMOST  
INSIGNIFICANT**





# Most damage from workers stepping on the fruit on the nets





**Fruit with 4 fruit damaged per pound**





**Damage Level  
Variable  
Can be Significant**







**Damage Level  
Can be Significant**



# Bruising and Oxidation





# TRANSPORT

## Farm to mill

- Bins - Boxes - Bags
- Shallow Depth
- Ventilation
- Short Distance or Time

*The olives should not  
have broken skin*



# MILL YARD

- Separate Olives by Quality
- Wash Dirty Olives
- Remove Leaves and Stems
- Short Storage Time (2-24 hrs.)
- Ventilated Storage Containers
- Cold Storage 40°F and dry



# BIOGENESIS OF DEFECTS

**DAY 0** - Present in and on fruit

Enzymes, bacteria, yeast, molds

**DAY 2** – Beginning of texture loss (skin breakdown)

Enterobacter and Clostridium (**fusty & winey**)

**DAY 4** – Fermentation

Yeasts, lactobacillus, and acetobacter + sugars = ethanol, lactic acid, ethyl acetate, & acetic acid  
(**fusty and winey/vinegary**)

**DAY 6** – Mold growth

Fungus mycelium (**musty**)

*Angerosa et al. 1998*



**30 days in Cold Storage  
without pre-cooling**



# HOW OLIVE OIL IS MADE

**Simple !**

- Crush the fruit
- Separate the oil from fruit-water and solids

# **PROCESSING STEPS**

- 1. Fruit Cleaning**
- 2. Fruit Washing**
- 3. Fruit Crushing**
- 4. Paste Malaxation**
- 5. Oil Separation**
- 6. Oil Cleaning**
- 7. Oil Settling**
- 8. Oil Storage**
- 9. Oil Filtration**
- 10. Oil Bottling**
- 11. Bottle Labeling**
- 12. Bottle Storage**



# Pesticide Residue



**Copper Sprays**

**GF-120 Sprays**

**MUST BE  
WASHED OFF**







# OLIVE CRUSHING

Stone Mill  
Disc Crusher  
Fruit Pitter  
Hammermill





# PASTE FINENESS

## COARSE

- Less oil released from the olive
- More oil extracted from the paste
- Less polyphenols released from the fruit
- Produces milder oil

## FINE

- More oil released from the olive
- Less oil extracted from the paste
- More polyphenols released from the fruit
- Produces stronger oil

# Stone Mill

- Inefficient, difficult to clean, more oxidation
- Fermentation on stones
- Used for bitter varieties
- Coarse paste



# Hammer Mill

- Fast & efficient
- Easy to clean
- Oil flavor is stronger
- Oil is emulsified
- Stainless steel leaves no metallic flavors





# Disc Mill

- Two opposing discs with steel protrusions
- Creates a coarse paste
- Produces little heat
- Continuous flow
- Easy to clean



# Pitter Mill

- Revolving auger pushes fruit through stainless steel rods
- Fruit milled without crushing the pits (enzymes)
- Creates a coarse paste
- Continuous flow
- Easily cleaned
- Produces a unique product



# MALAXATION PASTE MIXING

- Slow mixing to form larger droplets
  - Reverses Homogenization
- Oxygen Exposure
- 30 minutes to 1.5 hours
- Max Temperature 80 - 86°F





A photograph of a malaxation tank, a piece of industrial equipment used in food processing. The tank is open, revealing a thick, red, textured paste inside. The tank's lid is covered with a metal mesh screen. The tank is made of stainless steel and has a grey cable connected to it. The brand name "PIERA" is visible on the side of the tank. The background is a plain, light-colored wall.

*Malaxation tank – jacketed to slightly warm paste*

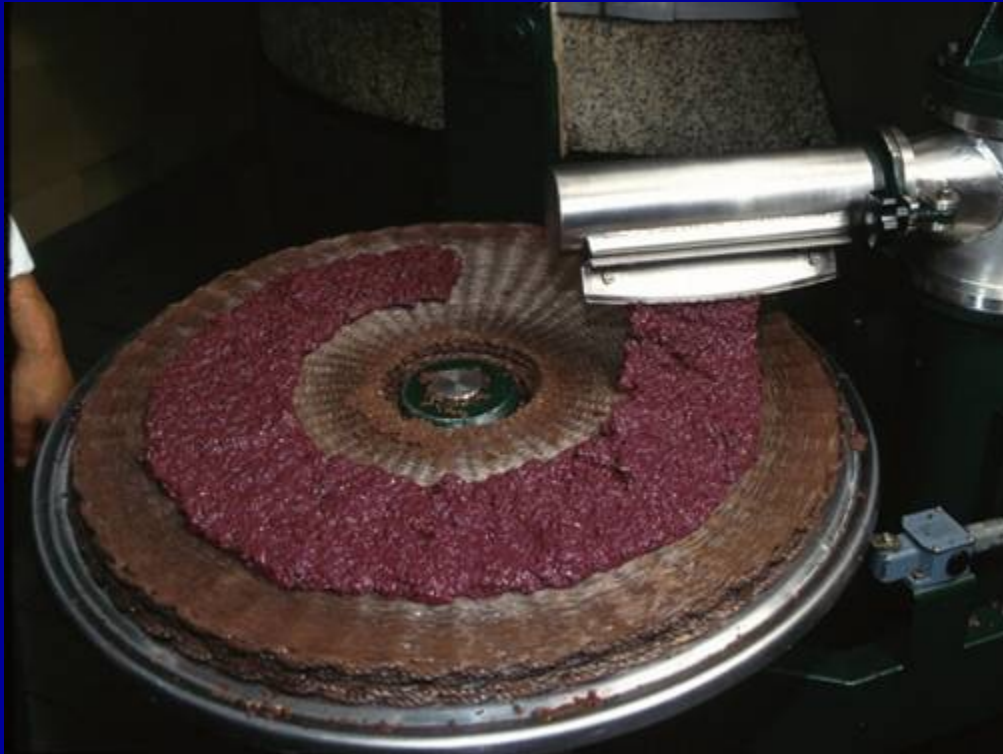
# **EXTRACTION**

## ***Separation of Oil From Solids and Fruit-water***

- **Pressing**
- **Selective Filtration - Sinolea**
- **Centrifugation:**
  - **2 Phases**
  - **3 Phases**

# TRADITIONAL PRESS

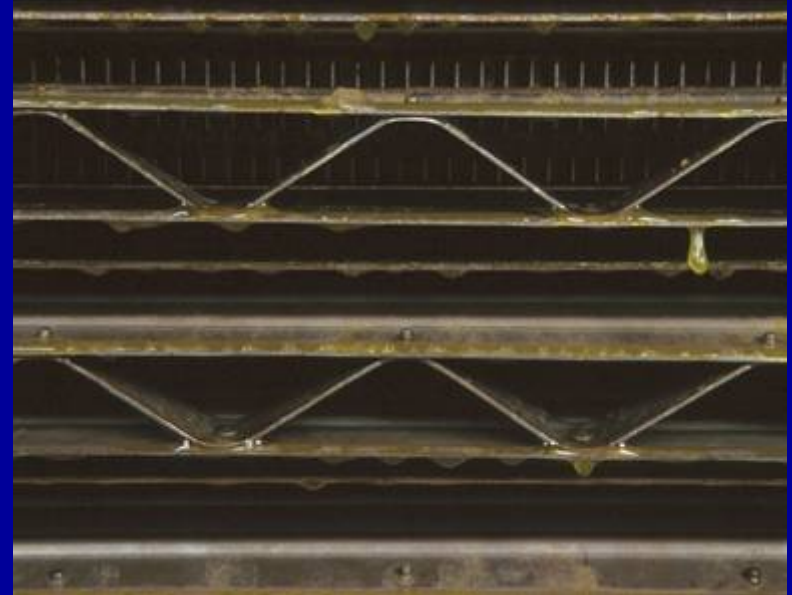
- Paste spread onto a filter mat
- Mats are stacked up
- Press cake is squeezed





# Sinolea Separation

- Stainless steel blades
- Selective removal of oil
- Water & solids remain
- No pressure
- Complicated equipment
- Called selective filtration



# DECANTERS

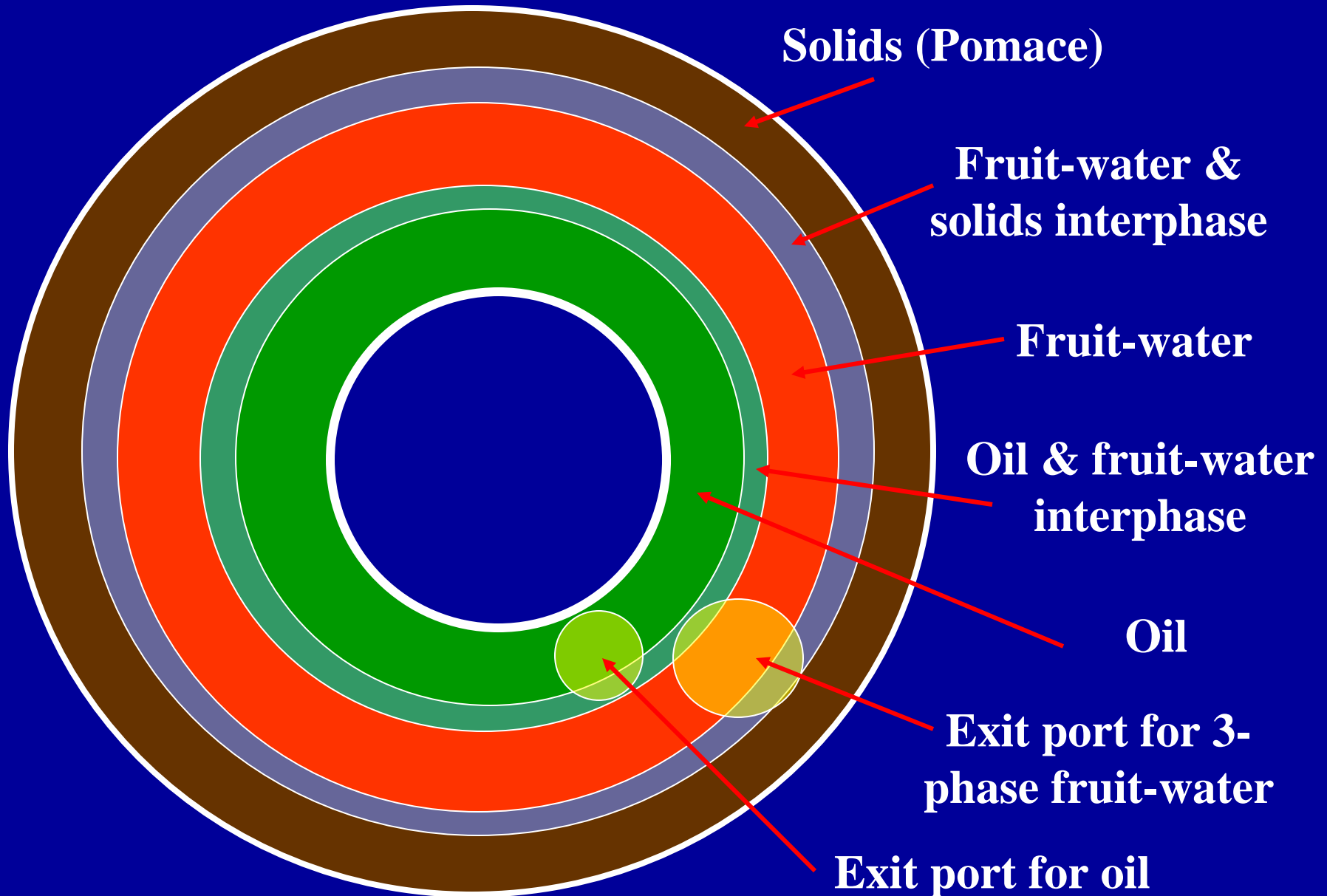
- Horizontal centrifuge
- Spins at 3,000 rpm, force decants oil
- 3-Phase (*Oil - Solids - Fruitwater*)
- 2-Phase (*Oil – Solids mixed with Fruitwater*)
- Separation between phases is not exact
- Water may be added for system flow

# 2 – PHASE OR 3 – PHASE DECANTER

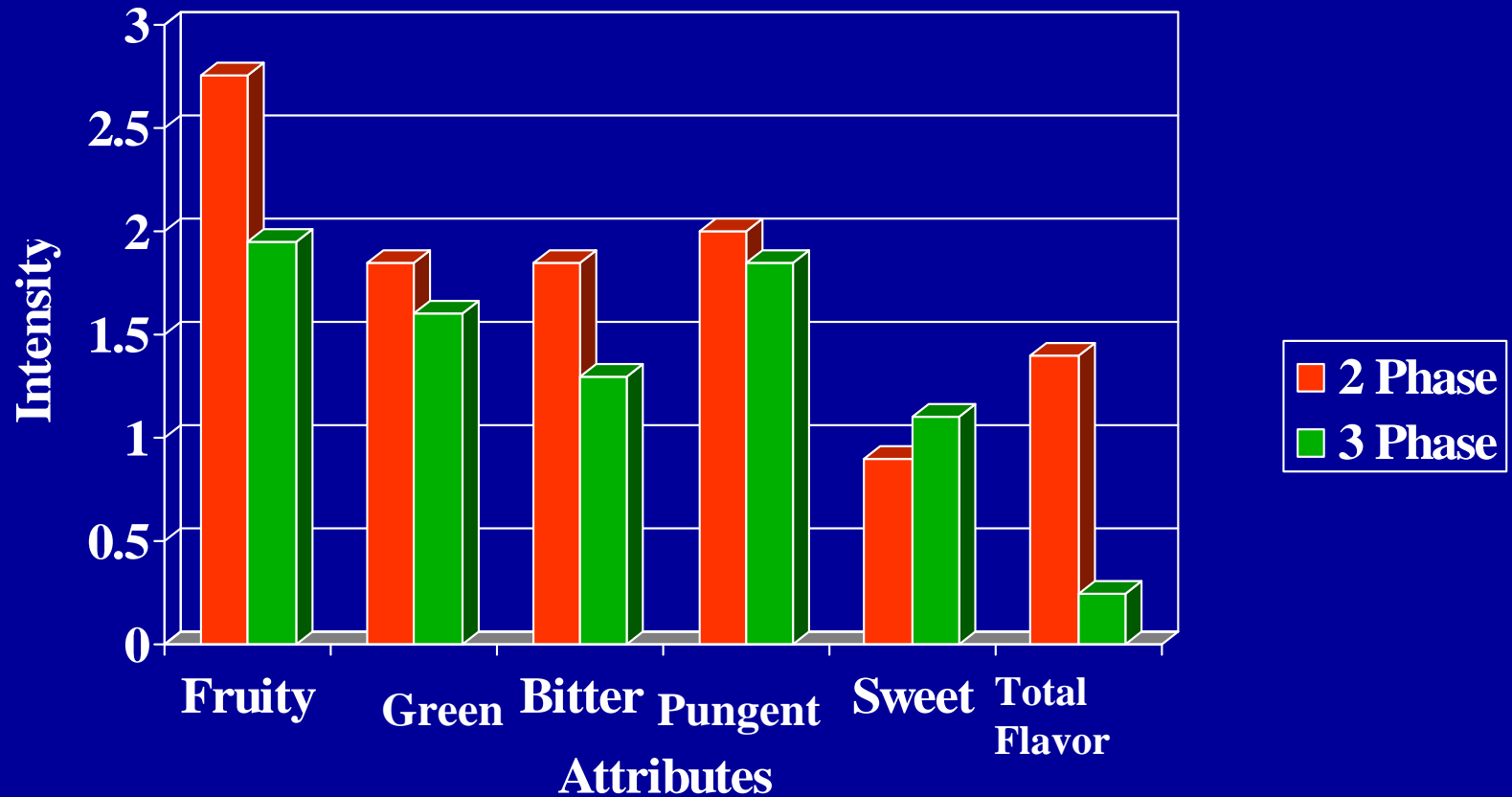




# PHASE SEPARATION WITHIN A DECANTER



# AVERAGE INTENSITY OF ATTRIBUTES FROM 2 & 3 PHASE DECANTER (SEASON 92/93) SPAIN



# OIL CLEANING

## VERTICAL CENTRIFUGE

Spins at 6,000 rpm

Cleans oil of water and solids

Cleans wastewater of oil

Warm water added to increase  
interface





# PROCESSING DEFECTS

- *Fusty* (Piled fruit)
- *Fusty - Winey Vinegary* (Olive Mat)
- *Oxidation* (Dirty Equipment)
- *Burnt* (Excessively Hot Paste)
- *Bland* (Excessive water added)
- *Bitter* (Excessive milling)
- *Dirty* (Poor oil cleaning)



# STAINLESS STEEL STORAGE TANKS

- *Cone shaped bottom to purge sediments periodically*
- *Nitrogen added to the air space*

# OIL STORAGE DEFECTS

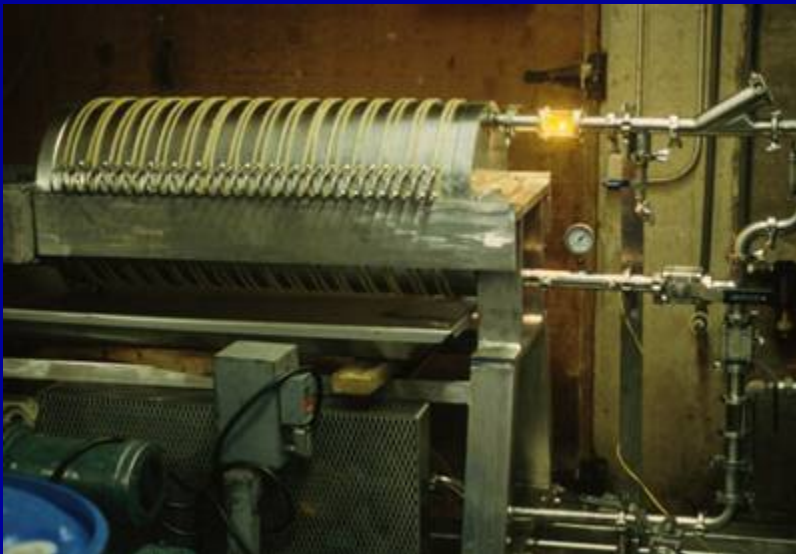
- *Rancidity* (Oxidized - Heat, Light, Time)
- *Metallic – Plastic* (Container Type)
- *Dirty* (No Timely Removal of Sediments)
- *Muddy Sediments* (Anaerobic Fermentation)
- *Putrid* (Long Storage Time)





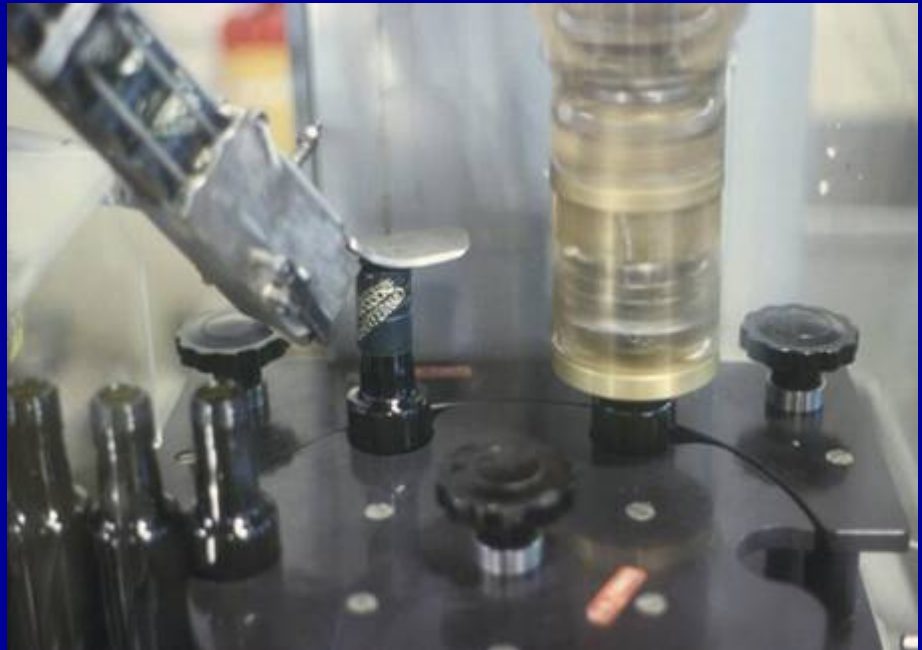
# FILTRATION

- Removal of sediments
- Removal of water
- Removal of some polyphenols



# BOTTLING

- *Bottling - Canning:*
  - Type of container
  - Light
  - Temperature
  - Head space
  - Container Stopper



# BOTTLING DEFECTS

- *Rancidity* (Oxygen, Light, Heat)
- *Sediment* (Non Filtration - Bottling too Soon)
- *Fusty* (Fermentation inside the bottle)
- *Color loss* (Light exposure)





# WASTE DISPOSAL OPTIONS

- Pomace oil
- Livestock feed
- Electricity
- Activated charcoal
- Compost
- Methane



# Removal of Pit Fragments





## Dryer fueled by pit fragments





# **IOOC STANDARDS**

## **for authenticity & typicalness**

- **Sterol Content**
- **Tocopherols – Polyphenols - Pigments**
- **Fatty Acid Profile**
- **Saturated Fatty Acids in 2-position**
- **Unsaponifiable Material**
- **Wax Content**
- **Stigmastadienes**
- **Erythrodiol + Uvaol**
- **Hydrocarbon Content**
- **Presence of *trans* fatty acids**

# **IOOC OLIVE OIL STANDARDS**

- **Sensory Characteristics**
- **Color – Aspect**
- **Free Acidity – Peroxide Value**
- **UV Absorbency (bitterness & stability)**
- **Water and Insoluble Impurities**
- **Flash Point**
- **Metal Traces – Halogenated Solvents**

# NINE OLIVE OILS

1. Extra Virgin

2. Virgin

3. Ordinary

4. Lampante (Lamp)

VIRGIN

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5. Refined

6. Olive Oil

7. Crude Pomace Oil

8. Refined Pomace Oil

9. Olive Pomace Oil

REFINED





# OLIVE OILS ON THE MARKET

# Tasting Oil



*Nancy Lilly*  
*Taste Panel*  
*Member*

## Intensity of:

Olive fruitiness

Ripe fruit

Green “fruit”

Pungency

Bitterness

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Complexity

Harmony - Balance

# Olive Oil Styles in CA

- Late Harvest Mission - Ripe
- Manzanillo - Green or Ripe
- Sevillano – Green
- Ascolano – Green
- New World Tuscan Green
- French Varietals
- Arbequina
- Koroneiki





