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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 – Carotenoides (pigments)
- Small Hydrocarbons (volatile aromatics)

Olive Oil

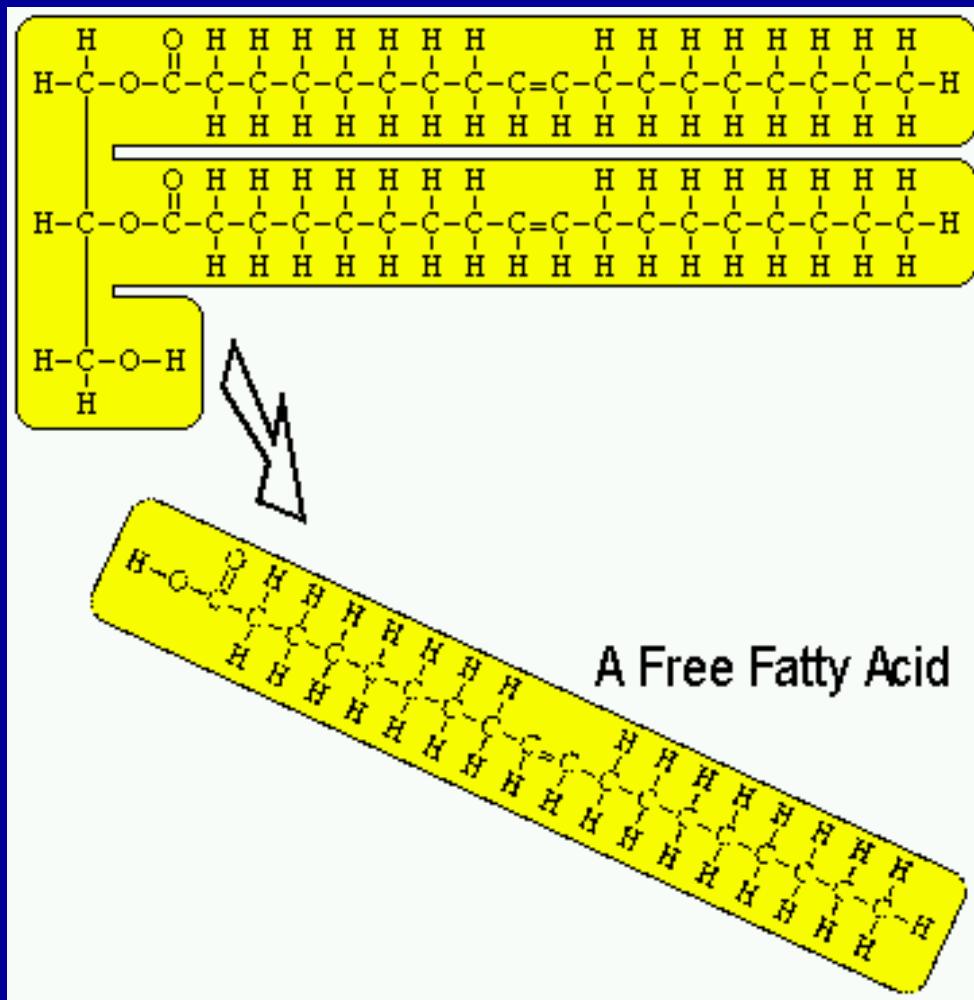
POSITIVES

- 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

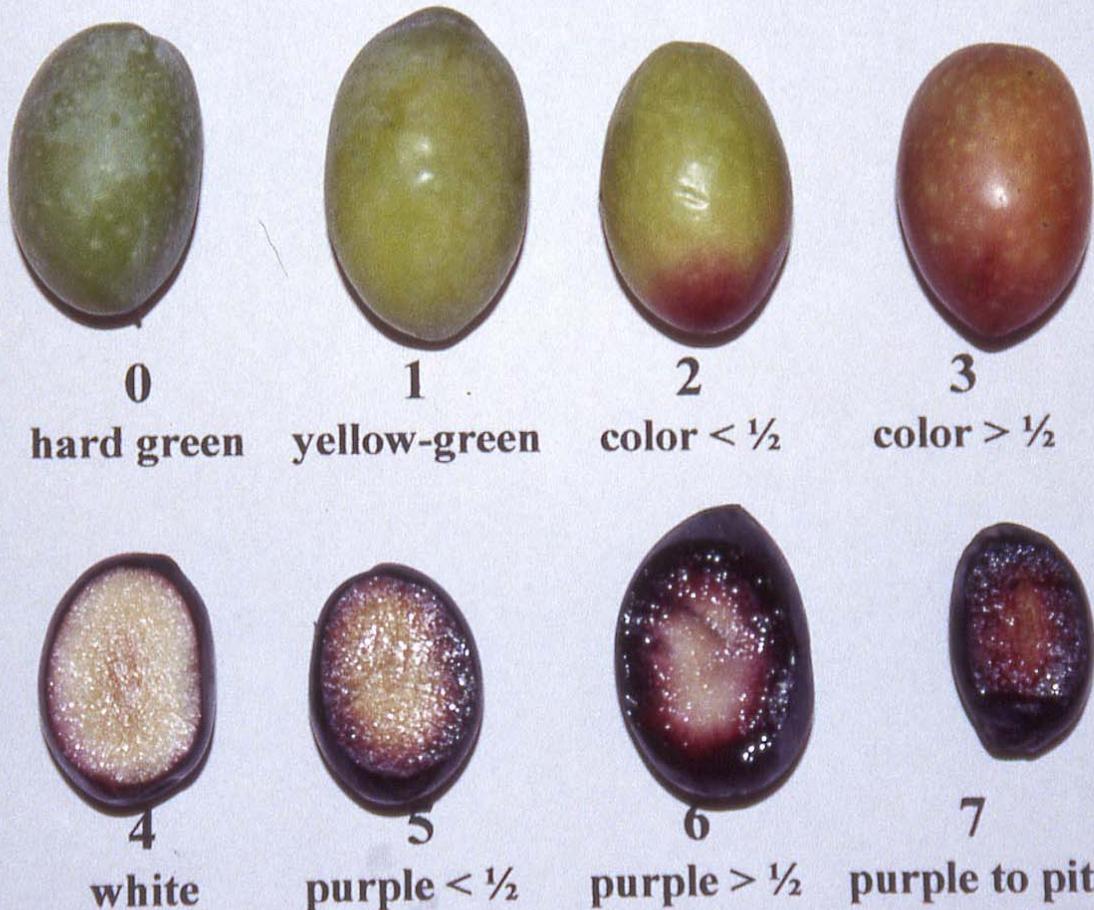


Copper Sprays
GF-120 Sprays

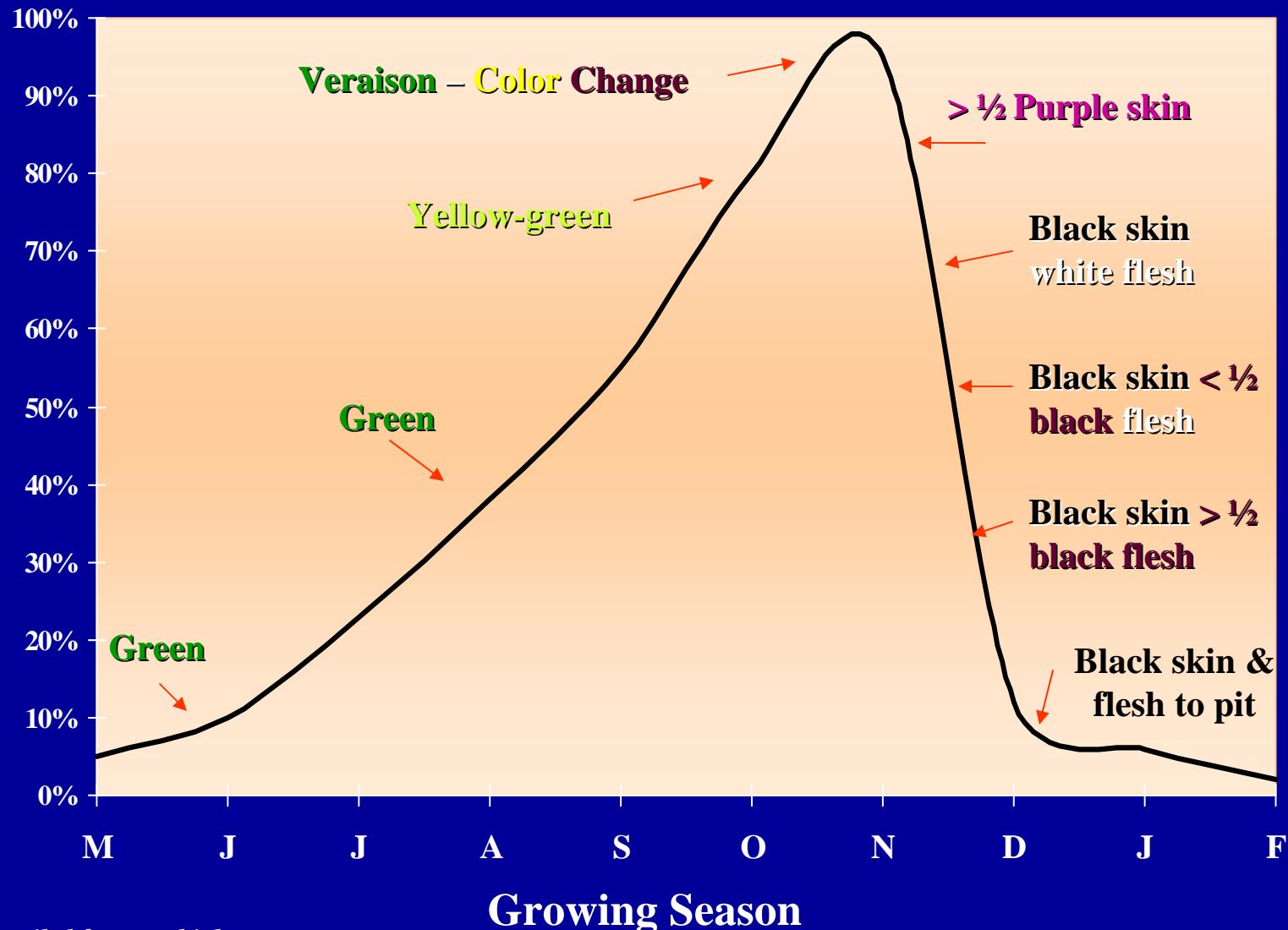
MUST BE
WASHED OFF

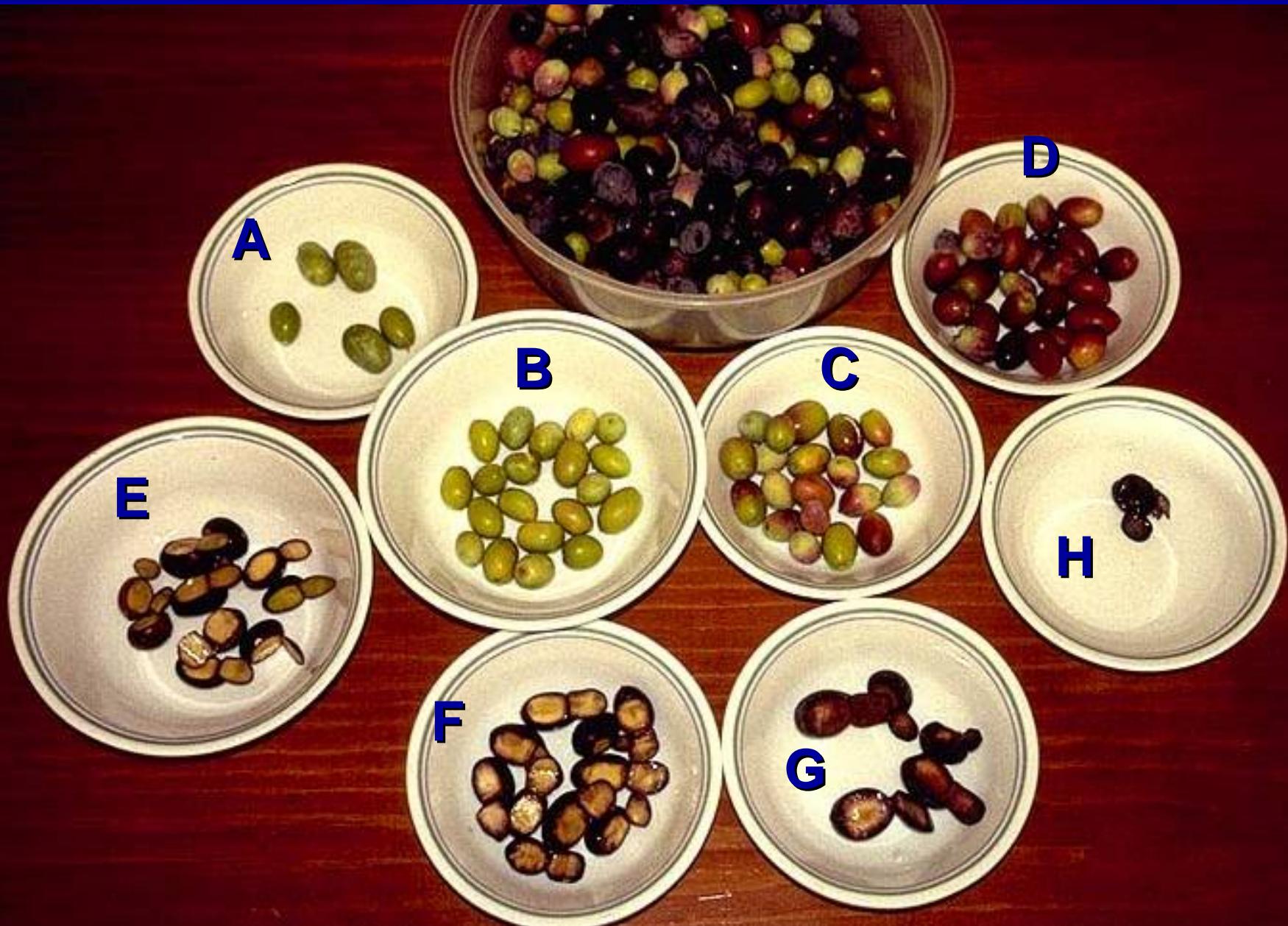


MATURITY INDEX



FRUIT POLYPHENOL LEVEL & COLOR DURING THE GROWING SEASON





Maturity Index Example

Random Sample of 100 Fruit

Formula

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

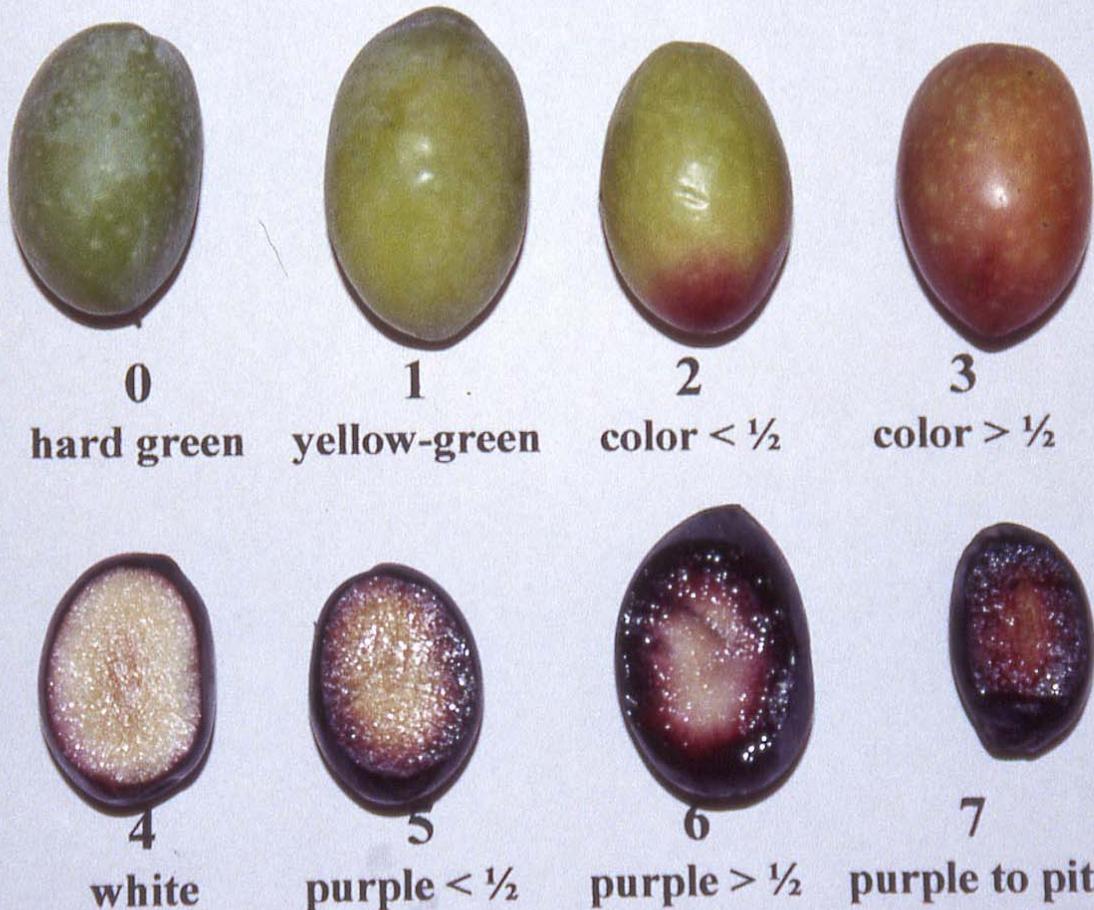
Number of fruit in each class (example)

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



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

Yeast, lactobacillus, and acetobacter + sugars = ethanol, lactic acid, ethyl acetate, & acetic acid

(fusty and winey/vinegary)

DAY 6 – Mold growth

Fungus mycelium (musty)

**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 course 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





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

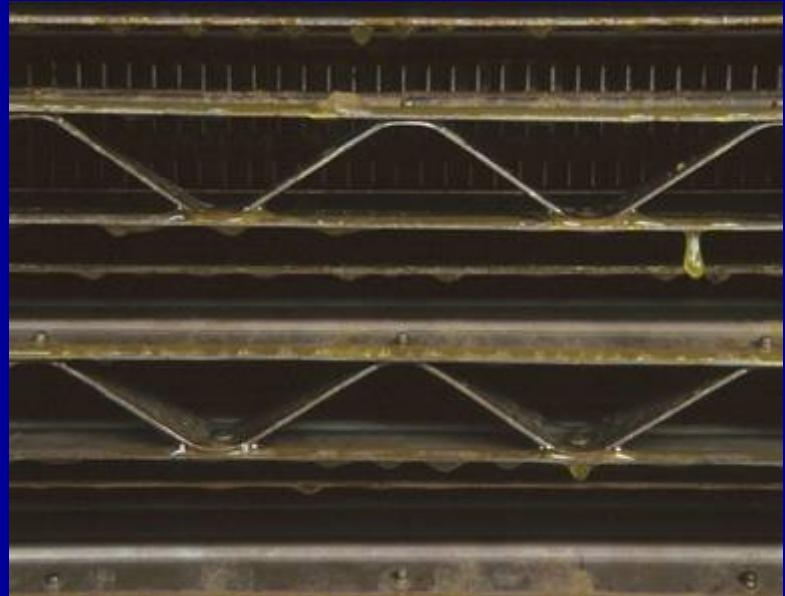
TRADITIONAL PRESS

- 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**



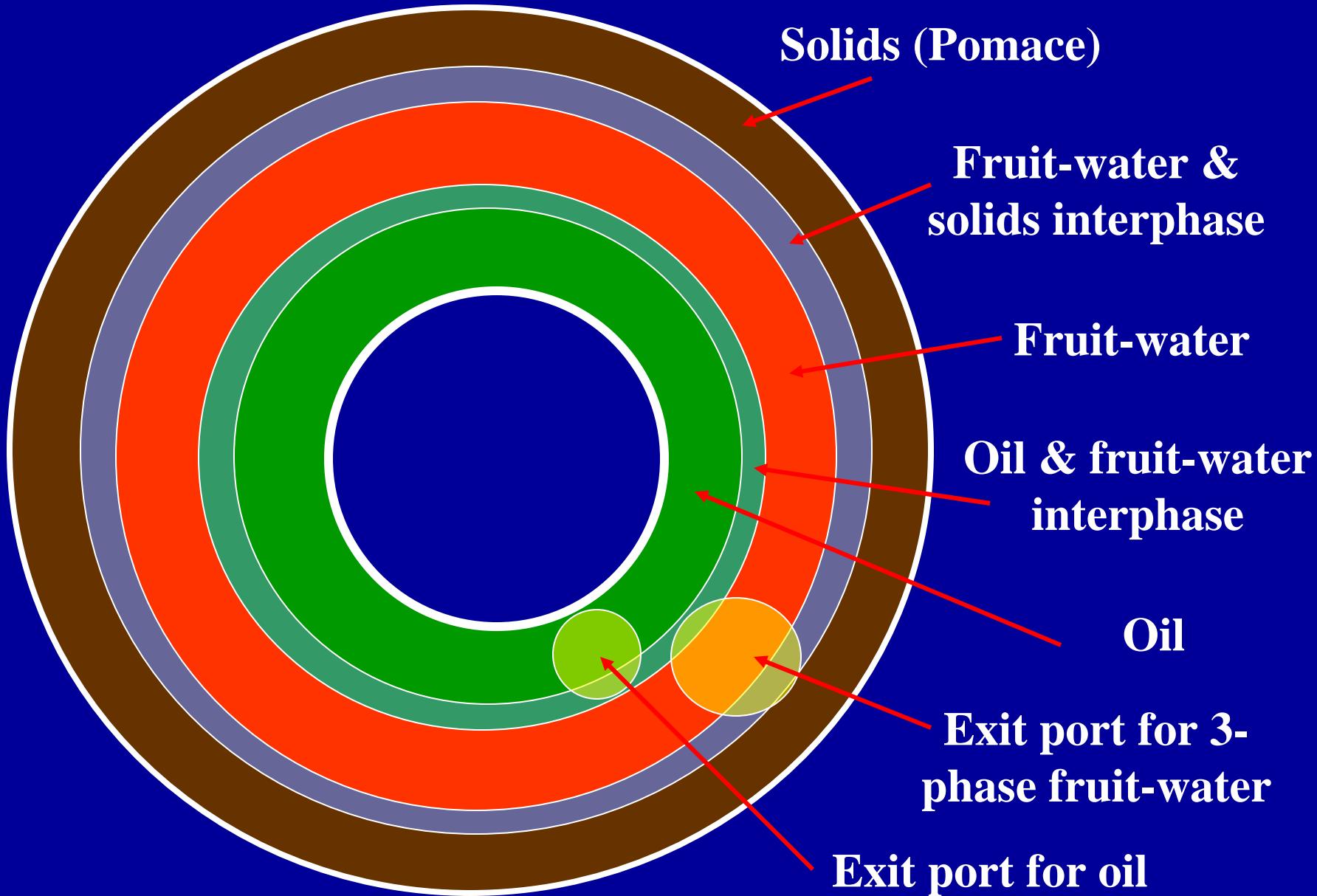
DECANTERS

- 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

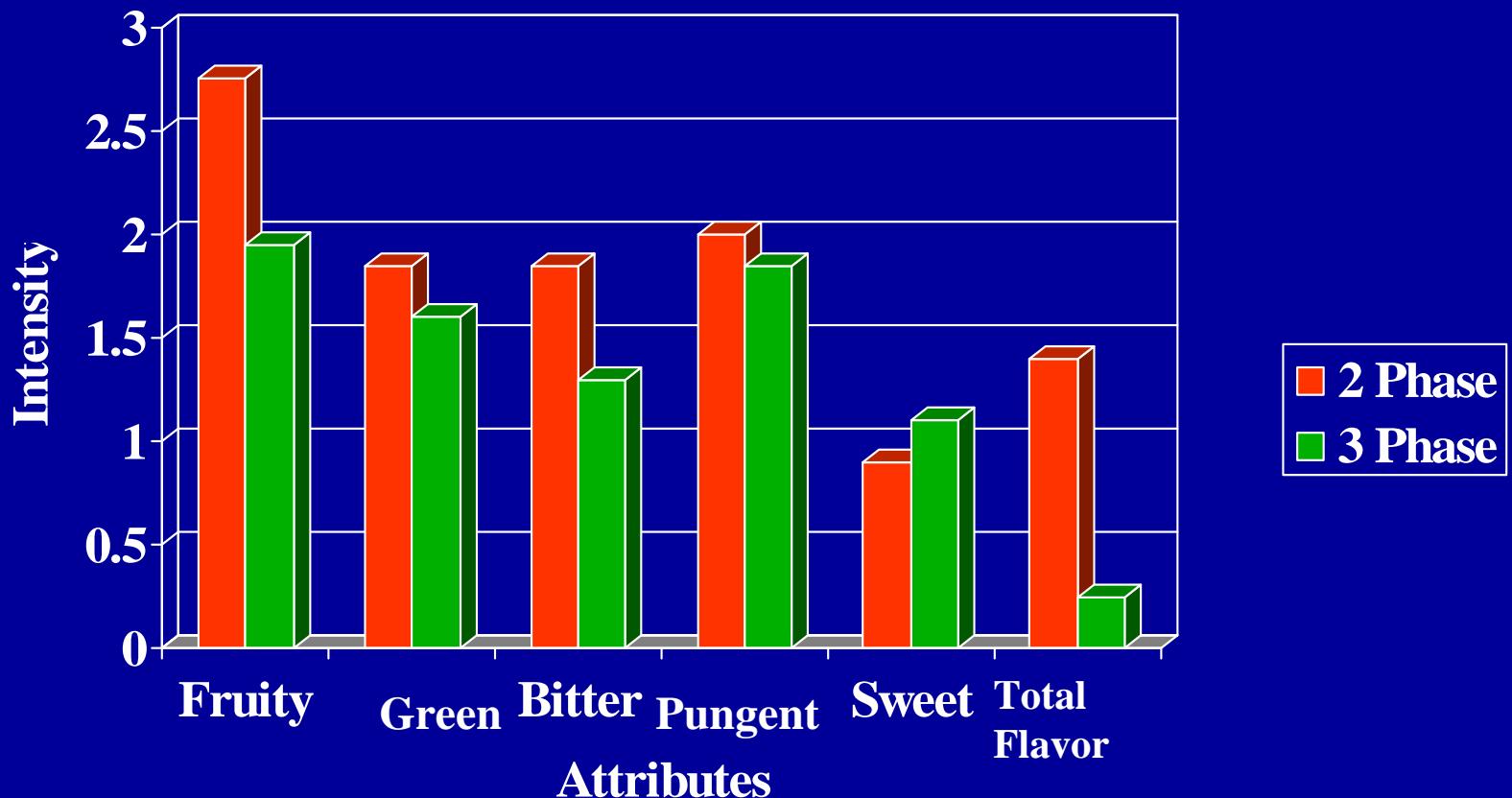
2 – PHASE OR 3 – PHASE DECANTER



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*

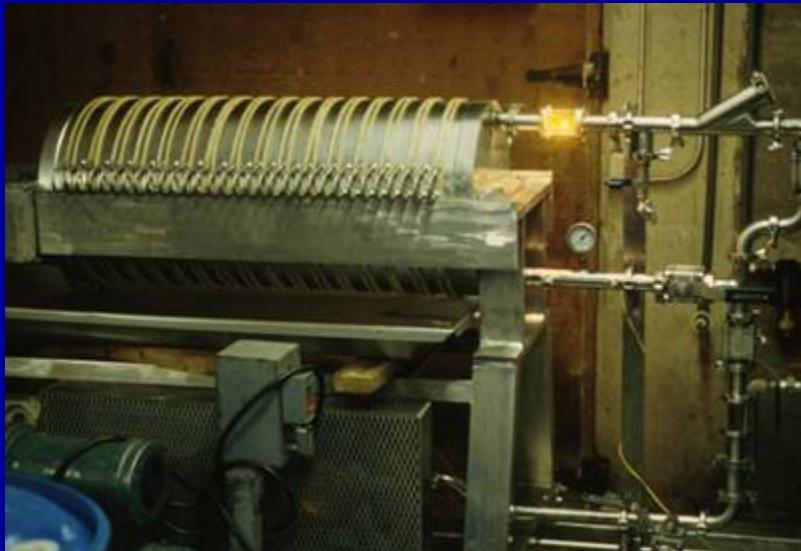
OIL STORAGE DEFECTS

- *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**



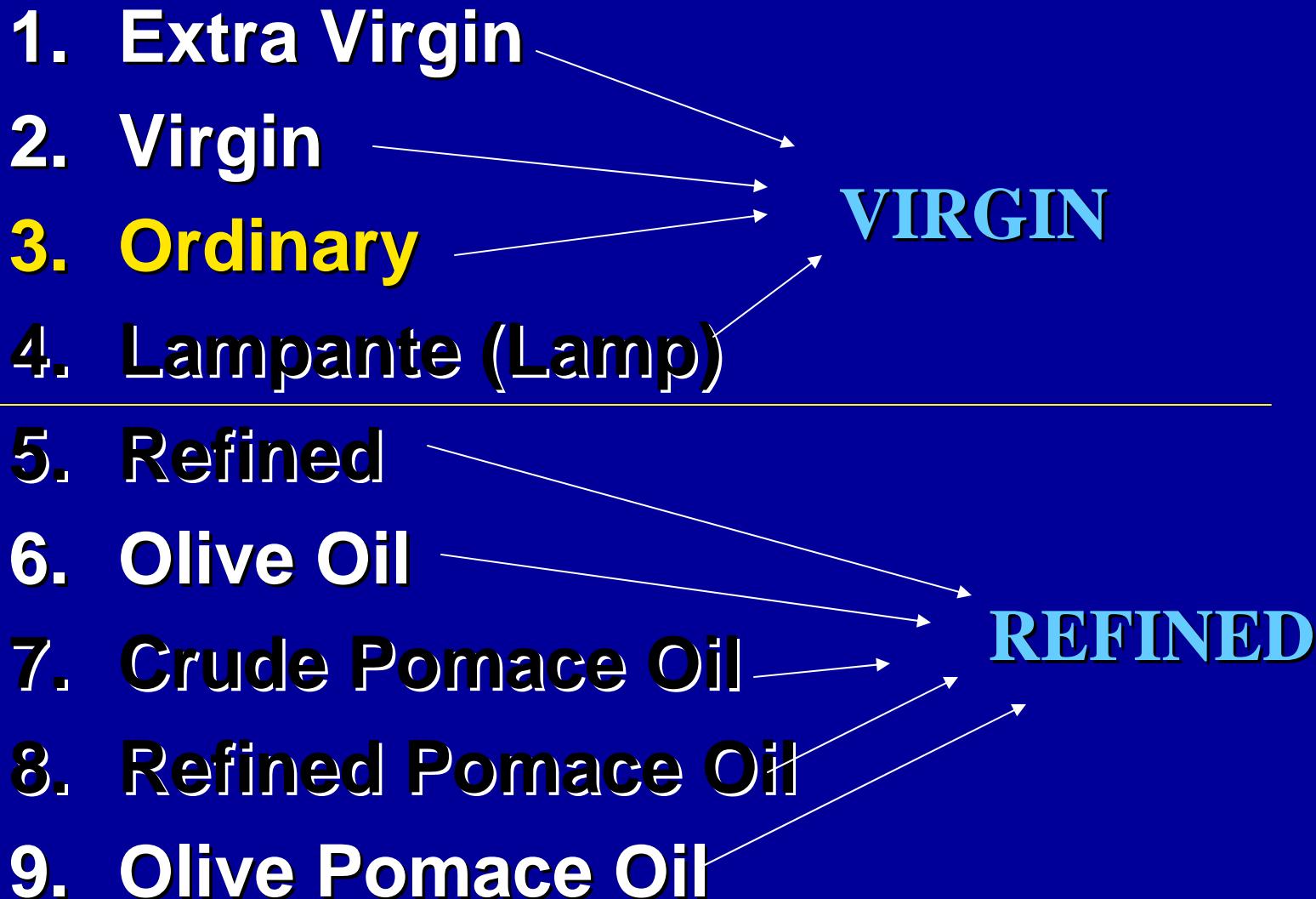
IOOC STANDARDS for authenticity & typicalness

- **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





OLIVE OILS ON THE MARKET

Tasting Oil



*Nancy Lilly
Taste Panel
Member*

Intensity of:

Olive fruitiness

Ripe fruit

Green “fruit”

Pungency

Bitterness

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



