Postharvest Quality Evaluation

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Methods for determining quality of fresh commodities

- Visual
- Color
- Gloss
- Shape and Size
- Absence of defects
- Firmness
- Soluble solids content (SSC)
- Titratable acidity (TA)
- Phenolic compound
- Starch

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Quality evaluation

- **Subjective**
  - Use eyes, hand feel, taste, noise to evaluate
- **Objective**
  - Based on measurement with number
  - Use an instrument to provide a specific value
  - Reliable

Color measurement

- **Visual assessment**
- **Matching of colors**
  - Color charts or models
- **Optical instrumentation**
  - Light reflected or transmitted by commodity
- **Chemical analysis for pigment content**

Yxy color space

- The CIE system characterizes colors by a luminance parameter Y and two color coordinates x and y

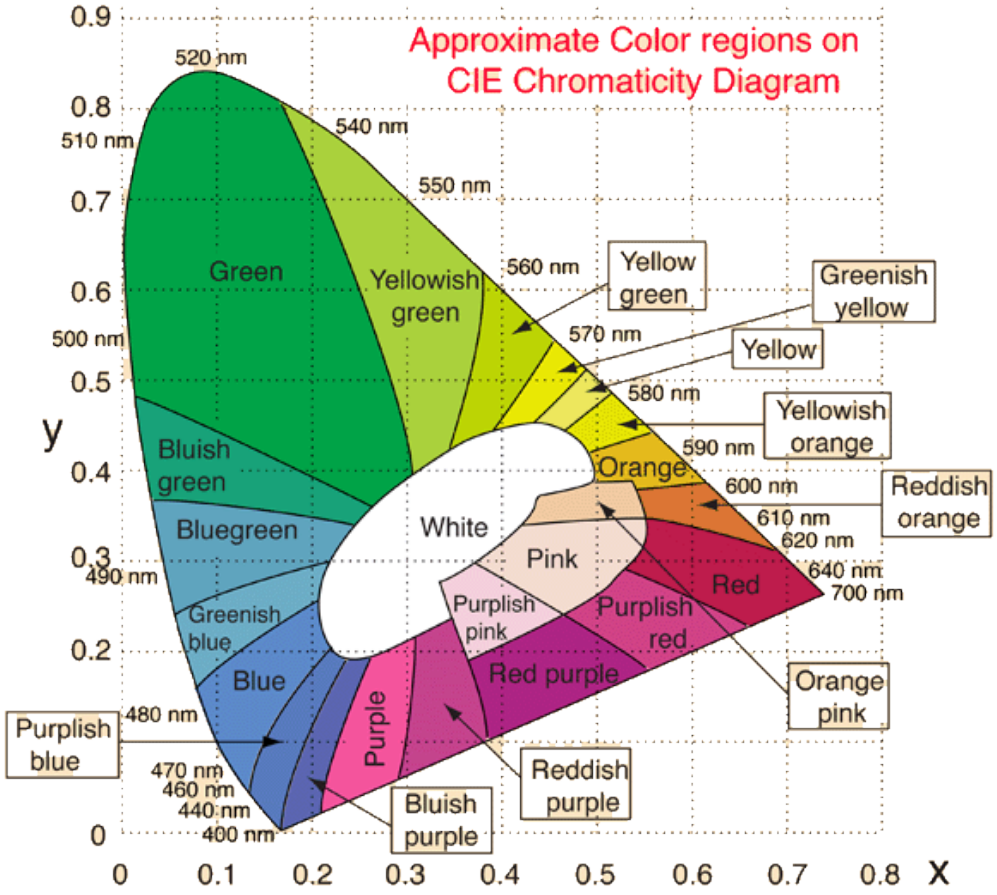
- Y = luminous intensity

  x = red light

  y = green light

  z = blue light

- That mixture may be specified by three numbers X,Y,Z called tristimulus values



Color chart
(The Royal Horticultural Society)

#1 No. 1-56 :

Yl, Or, Or/Yl, Or, Or/R, R

#2 No. 57-110 :

Pr/R, Pr, Pr/Bl, Bl

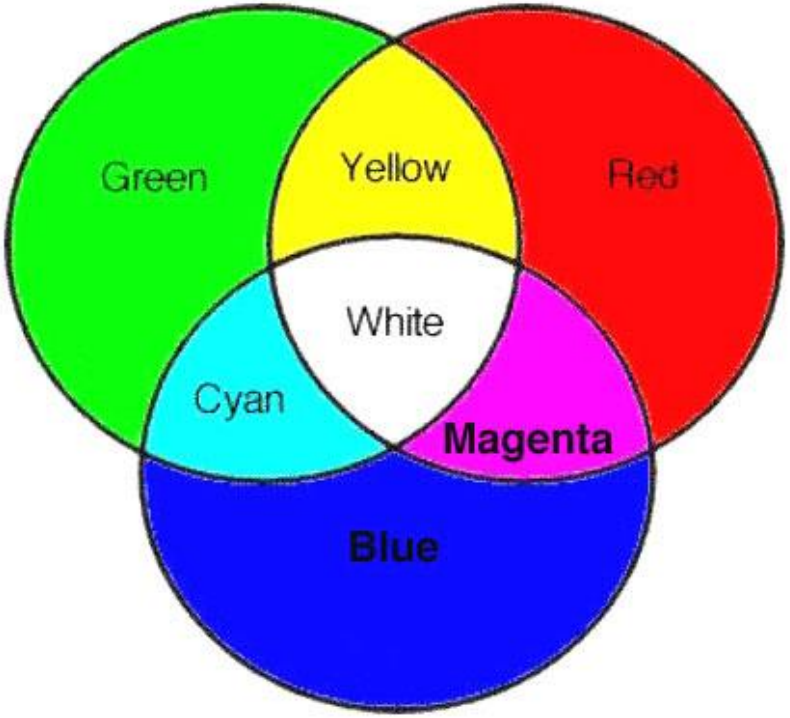
#3 No. 111-154 :

G/Bl, G, G/Yl

#4 No. 155-202 :

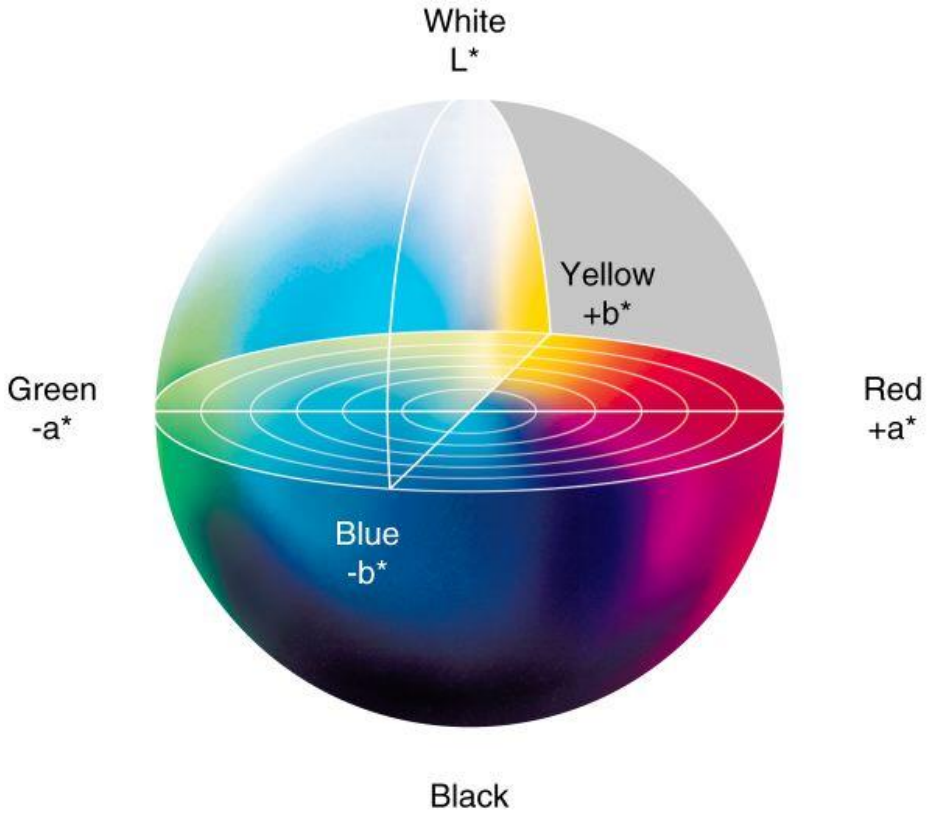
Yl/Gray, Or/Gray, R/Gray, Pr/Gray, Gr/Gray, Br/Gray, Gray, Black and White

Difficulty of mixing the three lights to produce additional color

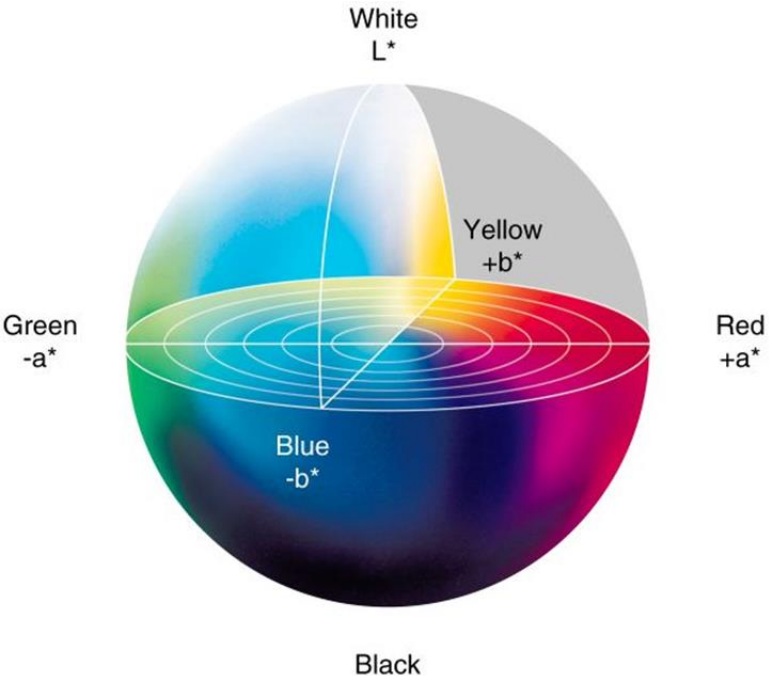


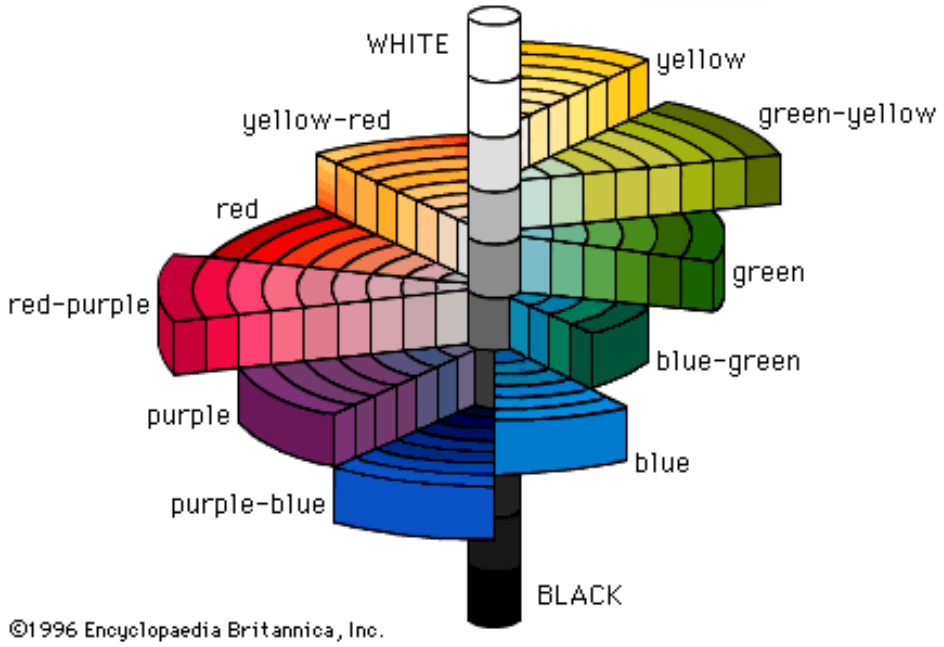
L*, a*, b* color system

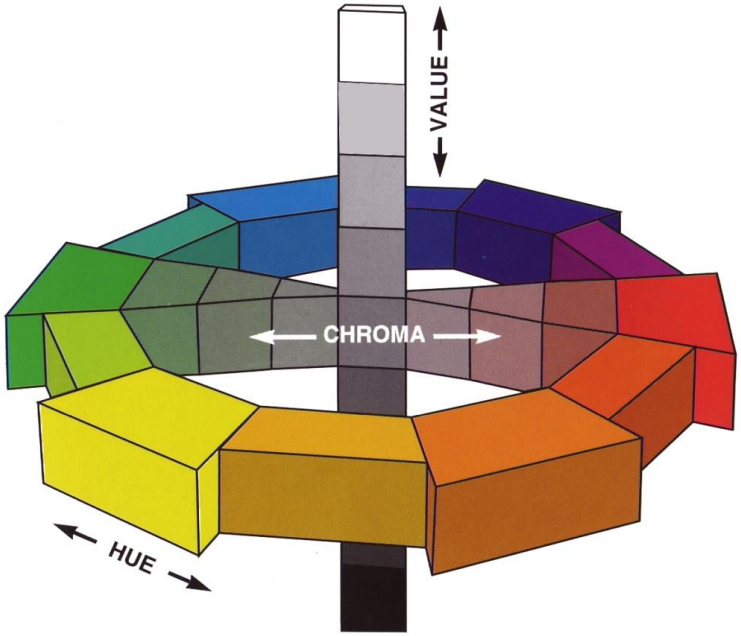
- Color can be used in many crops as in index of maturity or ripeness.
- Instruments to measure the peel color of fruits and vegetables are available from several manufactures.
- L* represents luminous intensity
- a* represents the red-green content
- b* represents the blue-yellow contebnt



Color







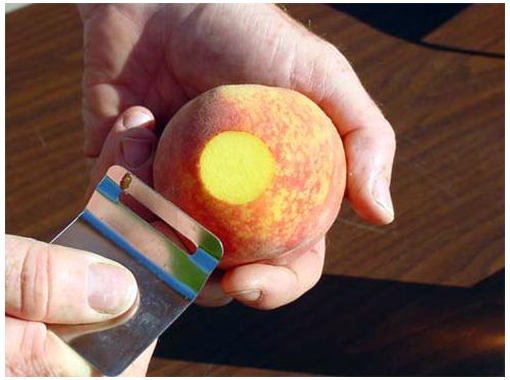
- Hue; red, purple, blue, green, yellow
- Chroma; intensity of color
- Value (L); light to dark

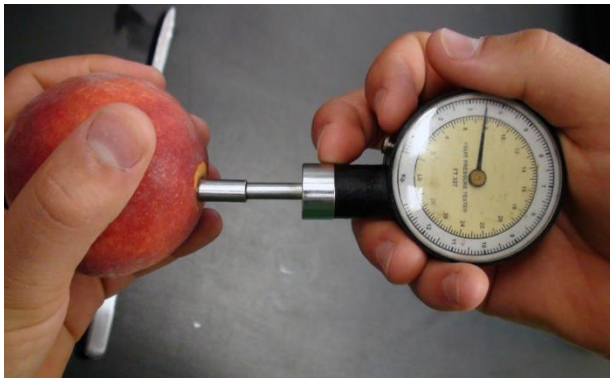
Texture-feel in hands or mouth

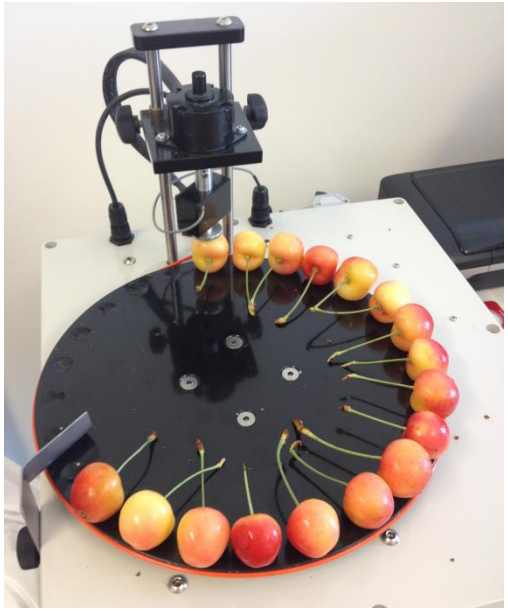
- Firmness
  - Hardness, softness
- Crispness
- Succulence, juiciness
- Mealiness, grittiness
- Toughness, fibrousness

Texture measurement

- Firmness or softness
  - Puncture (various sized tips)
    - Magness-Taylor pressure tester; Effegi penetrometer
    - May be mouthed in a stand or automated
  - Compression of Deformation
    - FirmTech, Instron
  - Acoustic measurement (non-destructive)







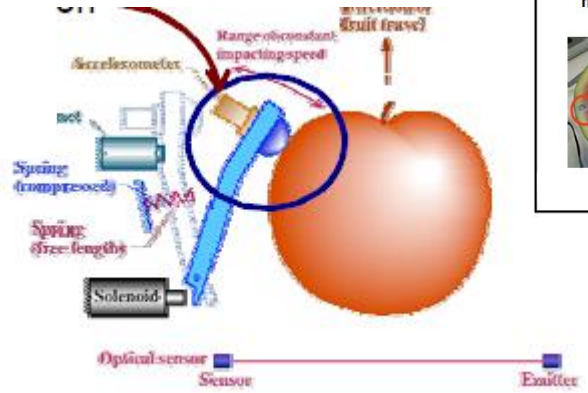
Texture Measurement

- Fibrousness or toughness
  - Shear force
  - Resistance to cutting (Fibrometer)
  - Chemical analysis of fiber or lignin content
- Succulence and juiciness
  - Water content or extractable juice
- Sensory textural quality
  - Grittiness, crispness, mealiness, chewiness, oiliness

Nondestructive Firmness

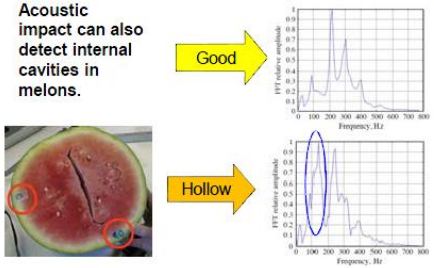
Nondestructive Firmness

- UC Davis handheld nondestructive firmness sensor for orchard use.



Acoustic Firmness sensor

Acoustic impact can also detect internal cavities in melons.



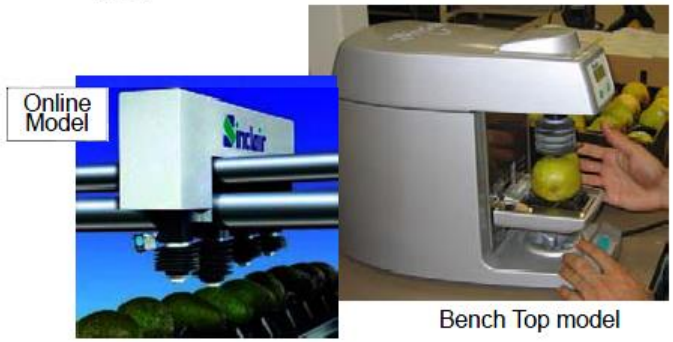
B. Diezma-Iglesias, M. Ruiz-Altisent, & P. Barreiro. 2004

Acoustic Firmness Measurement

- Aweta/Autoline on-line acoustic firmness sensor
  - "Gently" taps fruit and "listens" with a microphone.
  - Uses Fourier analysis to determine the natural frequency of the fruit.
  - Firmness = $f^2 * m^{2/3}$

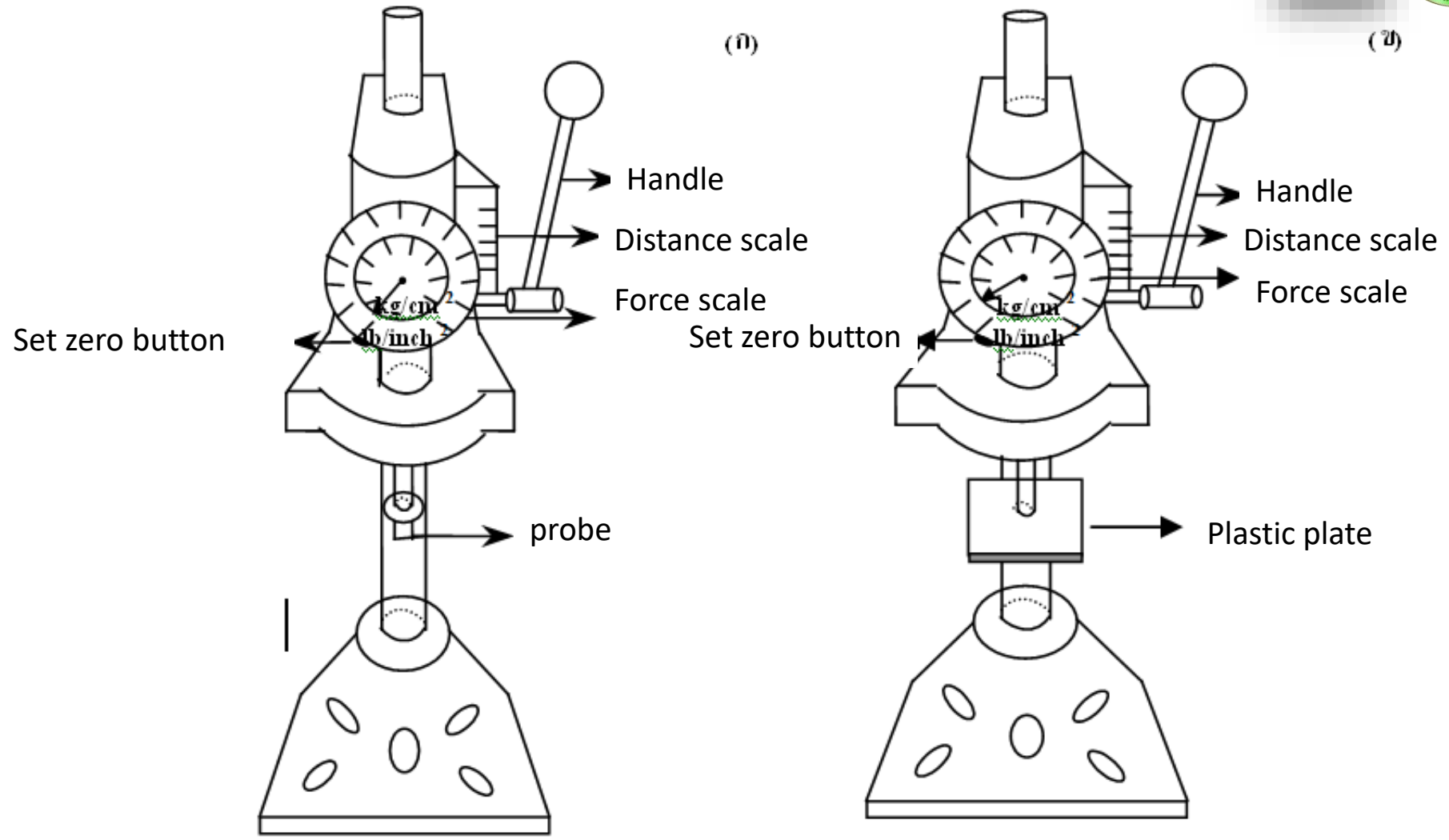
Nondestructive Firmness

- Sinclair Nondestructive firmness tester.
  - "Gently" taps the fruit and provides a Sinclair iQ firmness value.



Texture or firmness

- How texture/firmness change?
  - Transpiration
  - Starch breaks to glucose (banana, mango)
  - Cell membrane breakdown
  - Fiber synthesis


(ก)
Handle
Distance scale
Force scale
Set zero button
kg/cm 2
lb/inch 2
probe
(ข)
Handle
Distance scale
Force scale
Set zero button
kg/cm 2
lb/inch 2
Plastic plate

Sweetness

- Starch break down to glucose e.g. mango, banana
- Sugar accumulated during growth and development e.g. orange, grape, papaya

Sugars contents of different types of fruit

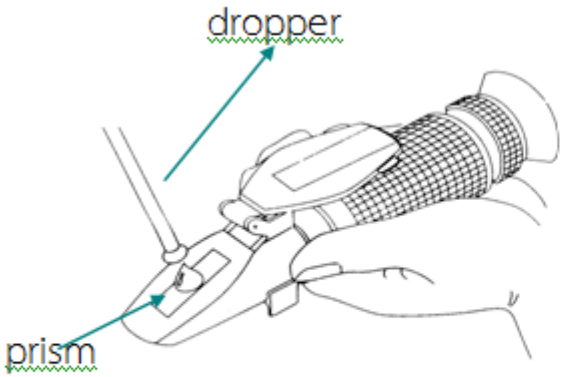
Fruits	Sugar contents (%)		
	Glucose	Fructose	Sucrose
Banana	5.8	3.8	**6.6**
Orange	2.4	2.4	**4.7**
Pineapple	2.3	1.4	**7.9**
Grape	8.1	8.0	**0**
Pomegranate	5.5	6.1	**0**
Tomato	1.6	1.2	**0**

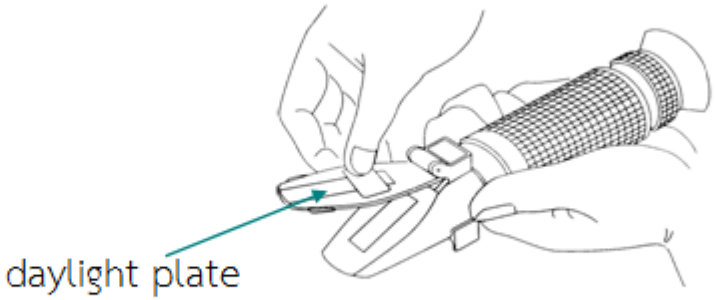
Whiting, 1970

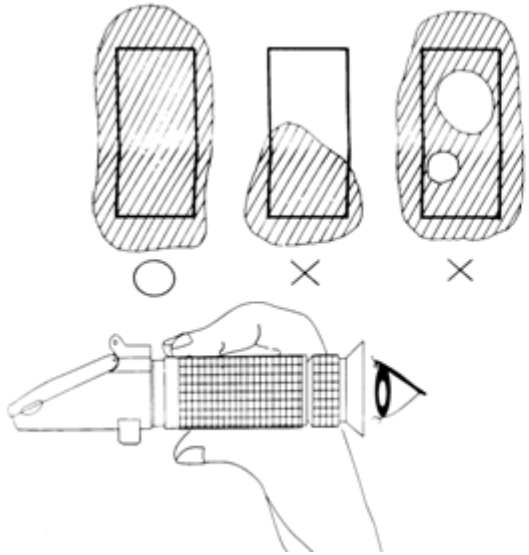
Relative Sweetness Index

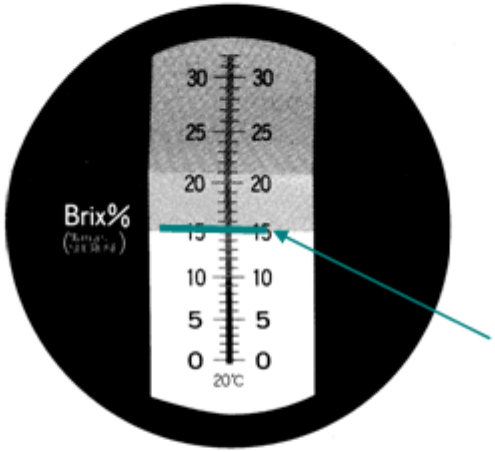
Compound	Rating
Sucrose	1.00
Fructose	1.40-1.75
Glucose	0.60-0.75
Galactose	0.35
Maltose	0.30-0.50
Lactose	0.20

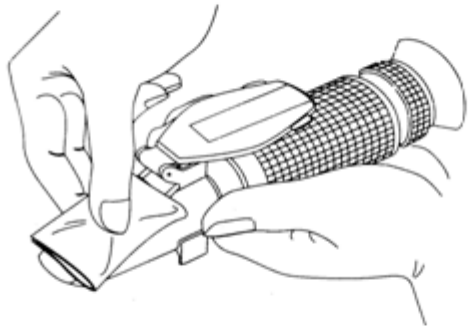
Soluble solids content








Brix%
30
25
20
15
10
5
0
20°C



Sourness

- Organic acids accumulation
- Different fruits and development stages, different organic acids
- Determined by titrate with NaOH
- Can not use pH to determine sourness e.g. mangosteen

$$\% \text{ Titratable acidity} = \frac{(\text{ml NaOH})(\text{N NaOH})(\text{meq. wt. acid})}{\text{ml sample}} \times 100$$

ml NaOH = vol of NaOH
N NaOH = normality of NaOH
ml sample = vol of sample

meq.wt. citric acid	= 0.064
meq.wt. malic acid	= 0.067
meq. Wt. tartaric acid	= 0.075

Major organic acids in fruit and vegetables

Citric acid	Malic acid	Tartaric acid
citrus	tomato	grape
guava	potato	
pineapple	sweet potato	
pomegranate	leaf vegetable	**Succinic acid**
cucumber	banana	mango
carrot	peach	sala
okra	grape	
cabbage	bean	
onion		

Organic aids declines during ripening

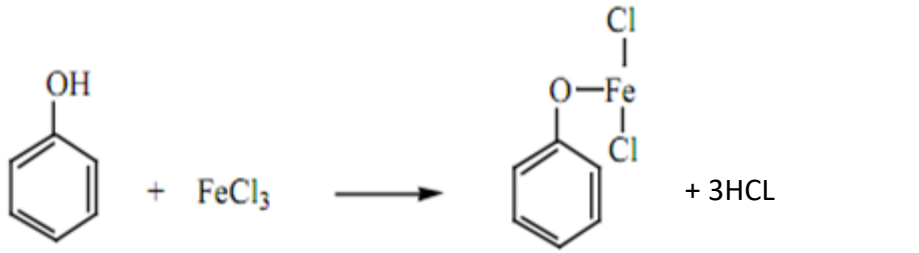
- Respiration
- Reduce translocation from source tissue
- Sugar conversion
- Reduce the biosynthesis

Astringency

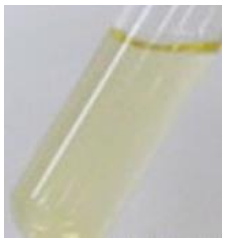
- Phenolic compound accumulation
- Found in some unripe fruits e.g. banana, persimmon
- Eliminated by high CO_2 treatment (or alcohol)
- Test by $FeCl_3$ solution

Astringency

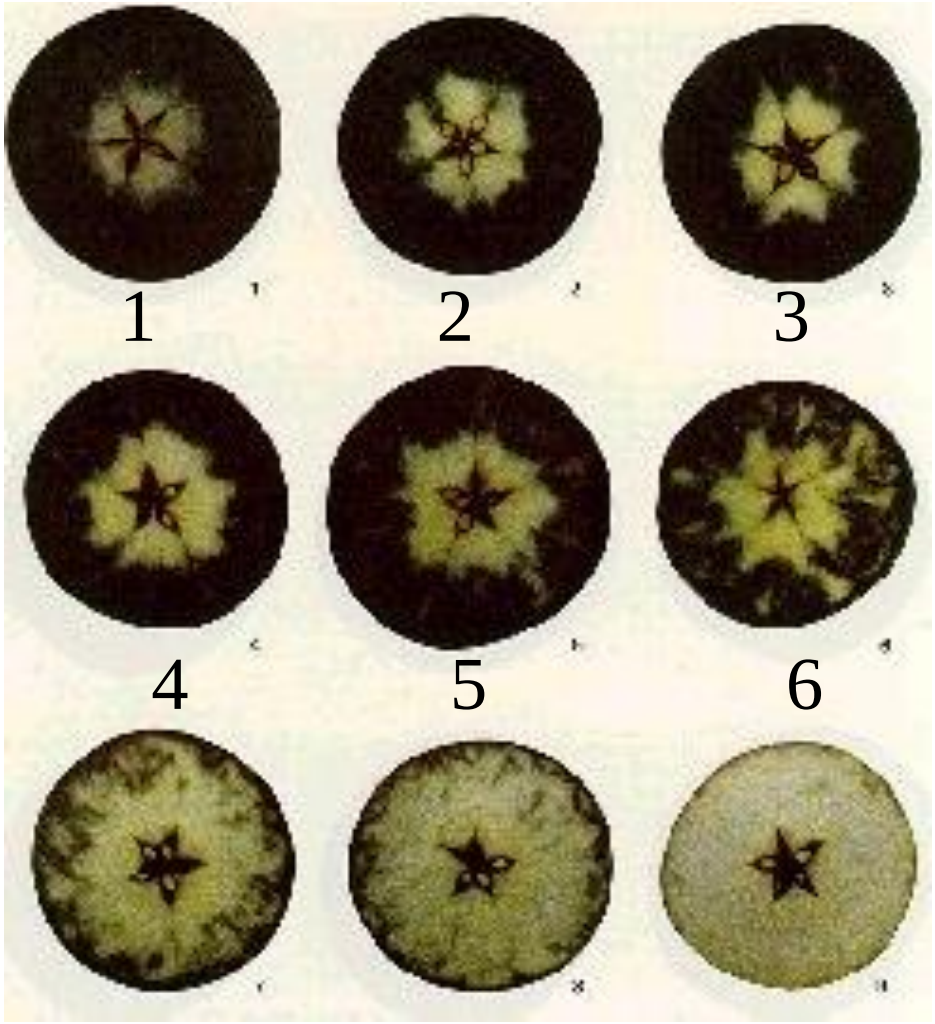
- When 2-3 drops of iron (III) chloride solution is added to a dilute solution of phenol, a violet-blue coloration is produced.



Clear Yellow Purple (or red, blue, green)



Starch



Measurement of transpiration rate

A. Weight loss

B. Direct measurement

C. Diffusion porometer