Quality & Standard Control

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Quality

- What is quality?
- How's quality produce look like?
- Who designs good or bad quality ?

Low quality produce sold in wet market at low price.

Short shelf life due to yellowing, wilting and disease.

High quality means higher price!

High quality muskmelon as a pricey gift in Japan.

High quality pot plants sold in supermarket in Hawai'i.

Retail market in Japan

- Sweet Corn
  68 THB ea.

- Thai Mango
  157 THB ea.

- Durian
  1,750 THB ea

- Young aroma coconut
  245 THB ea

High quality fruits sold at the Suwannabhumi International airport at high price.


BABY CORN


ひわ
2800
とくらんぼ
5800
巨峰
3800
世界一
1680
2800

Standard

- **What is standard?**

Standard is a figure established for use as a rule or basis of comparison in measuring or judging capacity, quantity, content, value, **quality**, and etc.

It's used as a trading agreement to prevent misunderstanding between two companies.

USDA Quality Standards

http://www.ams.usda.gov/AMSv1.0/Standards

USDA Quality Standards are based on measurable attributes that describe the value and utility of the product.

For example, beef quality standards are based on attributes such as marbling (the amount of fat interspersed with lean meat), color, firmness, texture, and age of the animal, for each grade.

Standards for each product describe the entire range of quality for a product, and the number of grades varies by commodity.

Index

- **Maturity index**
  - color, age, dry weight, size
- **Harvesting index**
  - young/mature parts of plant depend on market demand
  - length, bud opening in flowers and asparagus
- **Quality index and standard**
  - size, color, dry weight of durian & avocado, SSC of papaya

Quality

- External characteristics or appearance
- Internal characteristics

Quality Evaluation

- Subjective or Sensory Evaluation
  - evaluate by tasting, seeing, touching, chewing and smelling
  - depend on customer preference

- Objective determination
  - using instrument
  - give exact value and trustfully

External characteristics

- Shape
- Size
- Color
- Gloss
- Defect
- Uniformity

Sorting, Sizing & Grading

Human sorting

Sizing by weight

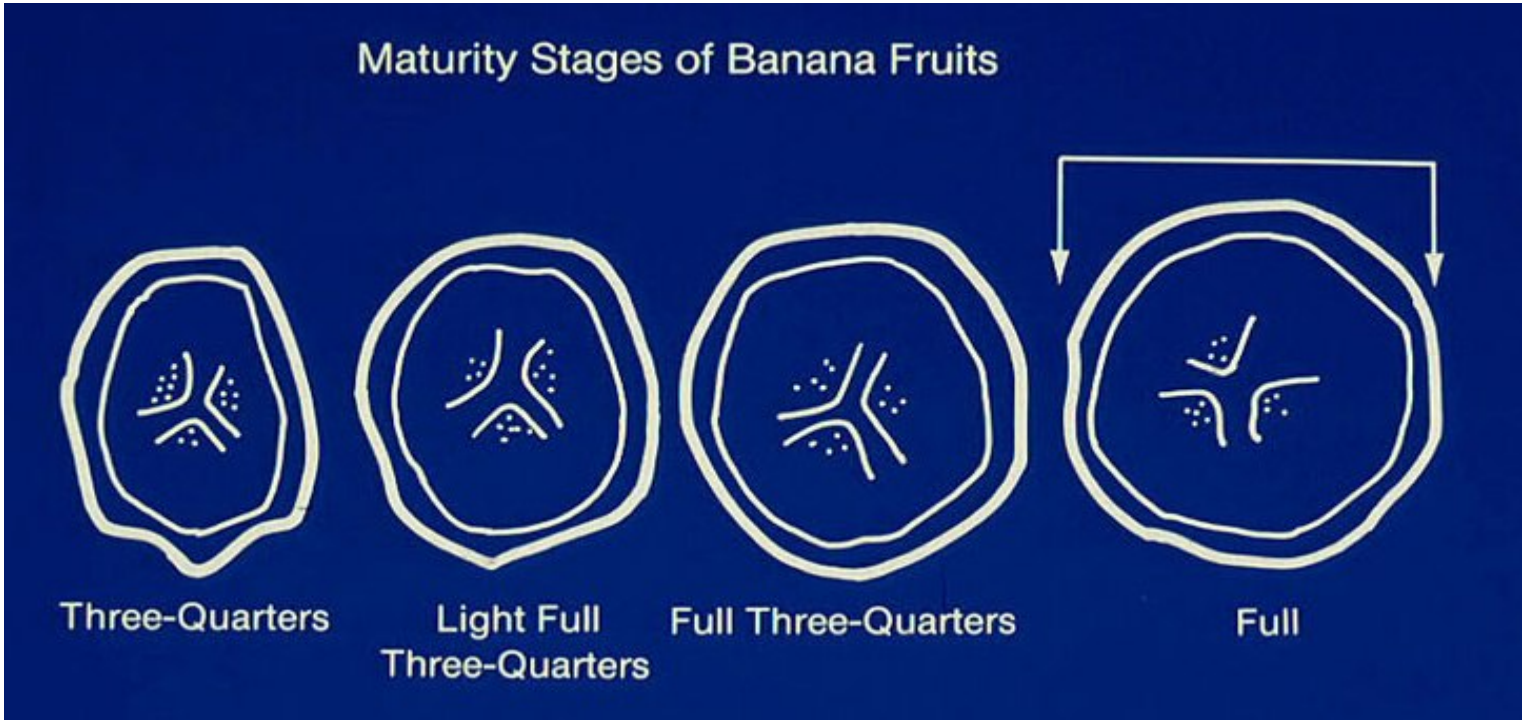
Sizing of round fruits by diameter

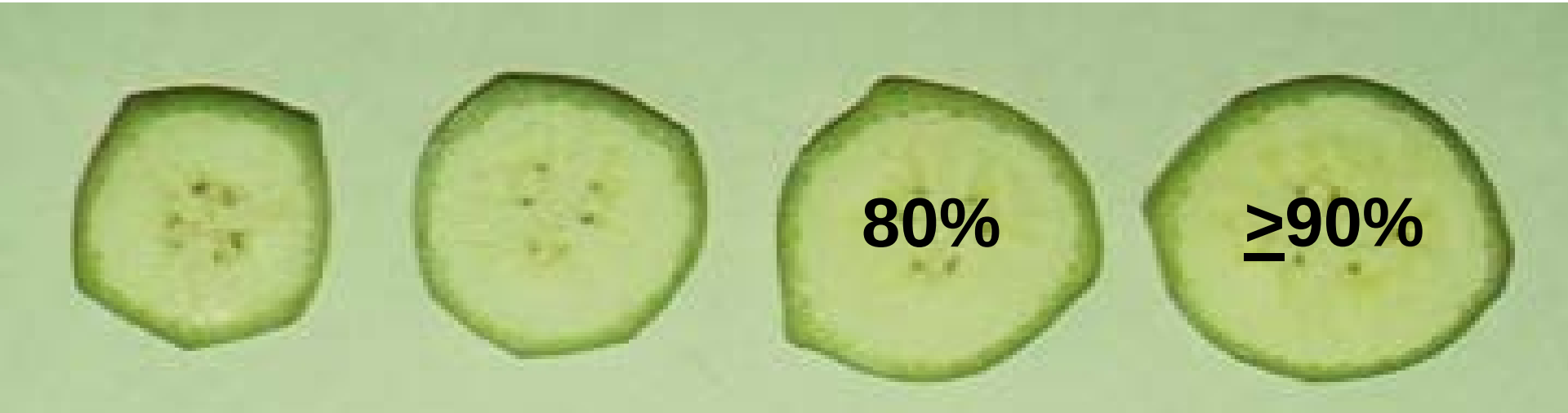
Small

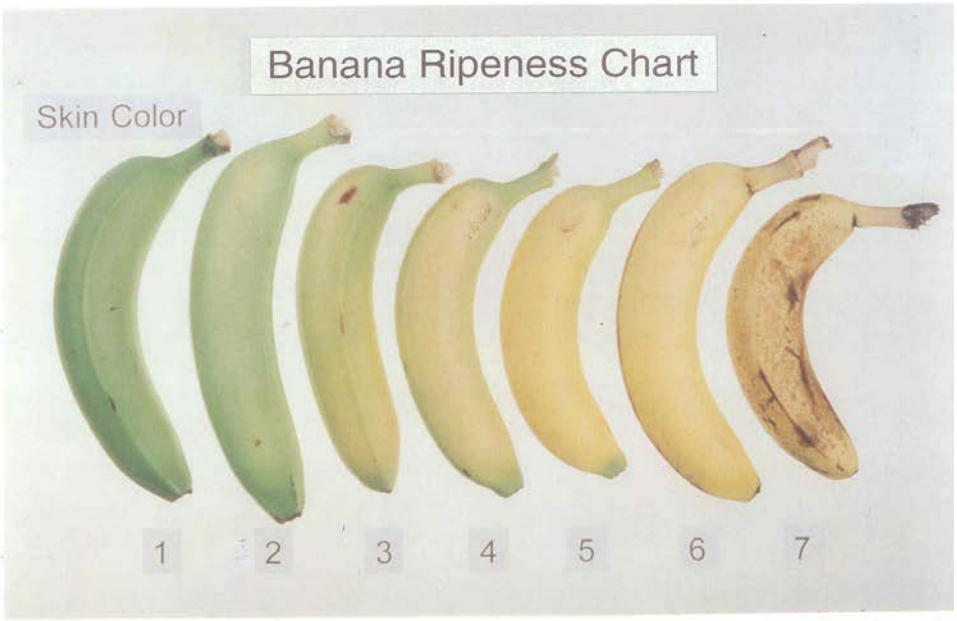
Big

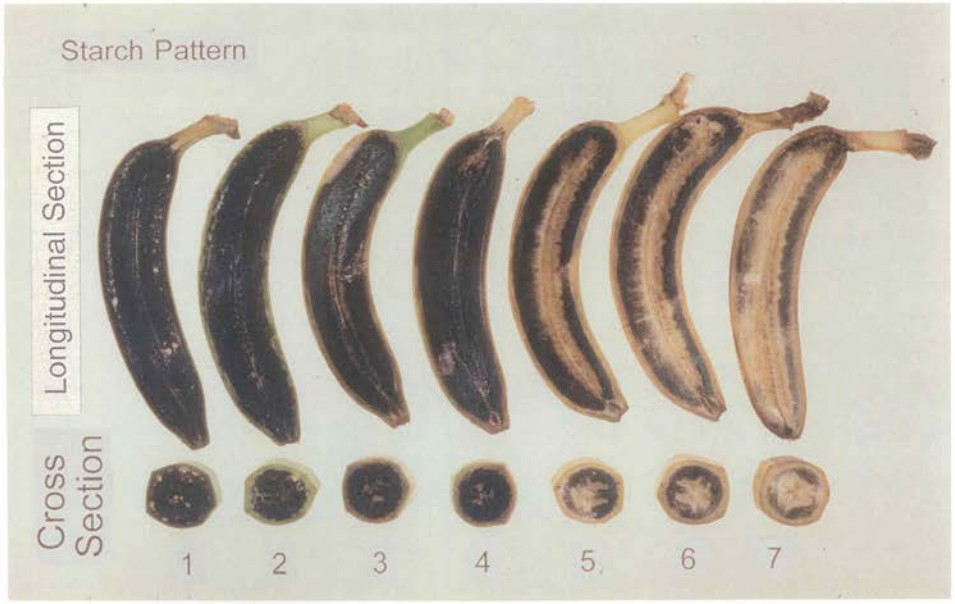
Citrus

Shape / dimension









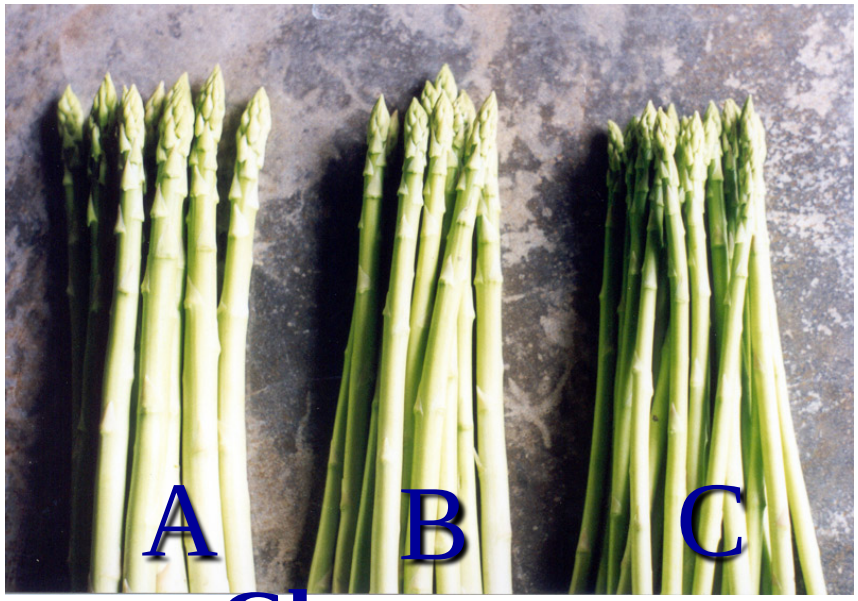
Israel Banana Growers Association A.M. Ltd.

Banana Ripening Chart

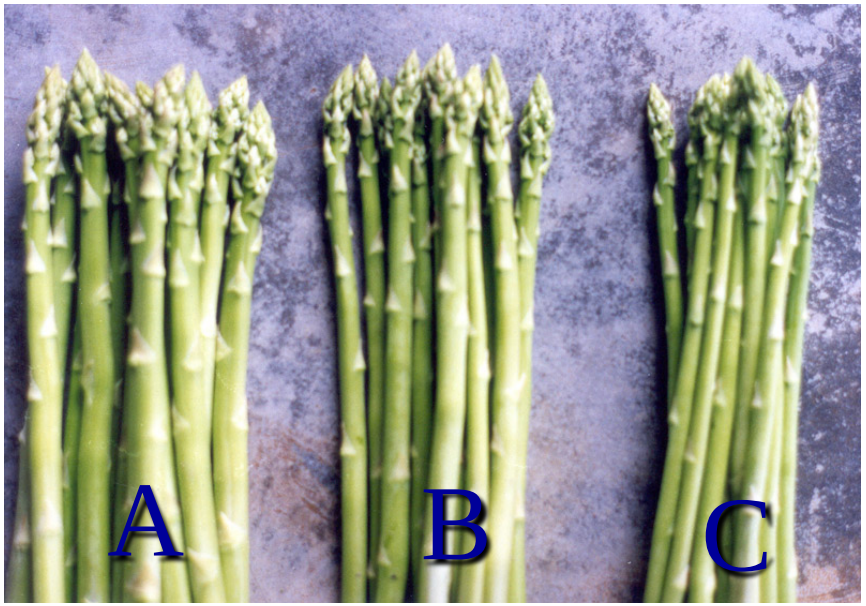
Temperature in 0° Celsius Ripening Period	Daily Ripening Chart							
4 Days	18°	18°	16½°	15½°	14½°			
5 Days	16½°	16½°	16½°	16½°	15½°	14½°		
6 Days	16½°	16½°	15½°	15½°	14½°	14½°	14½°	
7 Days	15½°	15½°	15½°	15½°	14½°	14½°	14½°	14½°
8 Days	14½°	14½°	14½°	14½°	14½°	14½°	14½°	14½°
	Day 1	Day2	Day3	Day4	Day5	Day6	Day7	Day8

1	2	3	4	5	6	7
Green	Light Green	Light Green with Light Yellow	Yellow with some Green	Yellow with Green at ends	Full Yellow	Yellow with Brown spots
Natural Green	First change in color as a result of ripening	Clear change in color - ready for market in hot weather	Ready for market in cold weather	Ideal color for retail sale	Ready for sale and for eating	Fully ripened with aroma

Postharvest Technology Center



Close spear



Open spear

Grading by size and bud opening

Off grade

Standard of Asparagus

Characteristics	Close spear	Open spear
Spear	- Tightly close - Straight stem	- Less open - Straight stem
Length	15 - 25 cm with 15 cm or longer of green part	
Defect	Clean, No insect & disease damage, Pesticide free	

Standard of Asparagus

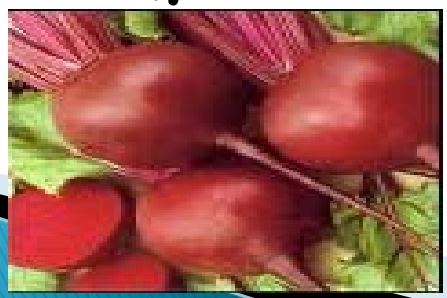
Spear size	Close spear	Open spear
Grade A	25 cm in length, 1cm or above in diameter 14 gram/spear in weight	
Grade B	25 cm in length, 0.8-1cm in diameter > 5 gram/spear in weight	

(Dept. of Agr. Ext., 2001)

Color and pigments

- Chlorophyll a & b
- Carotenoid: lycopene (tomato), β-carotene (mango), xanthophylls (marigold, egg yolks)
- Anthocyanin (lychee, mangosteen, grape)
  red<-- magenta<--pH-->purple-->blue

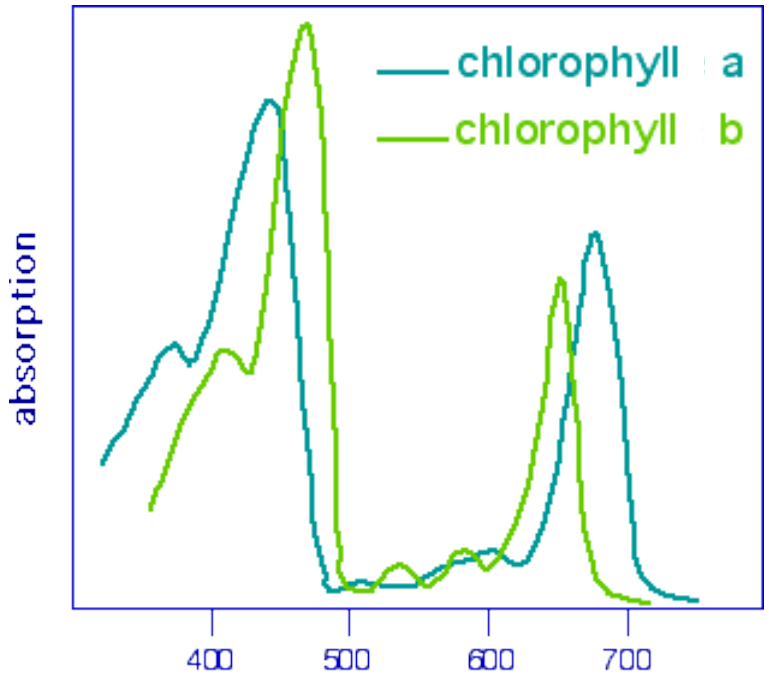
- Betalains:
  Betacyanins
  (red to violet; beets, bougainvillea, dragon fruit)
- Betaxanthins (yellow to orange; rhubarb, swiss chard)



Pigments

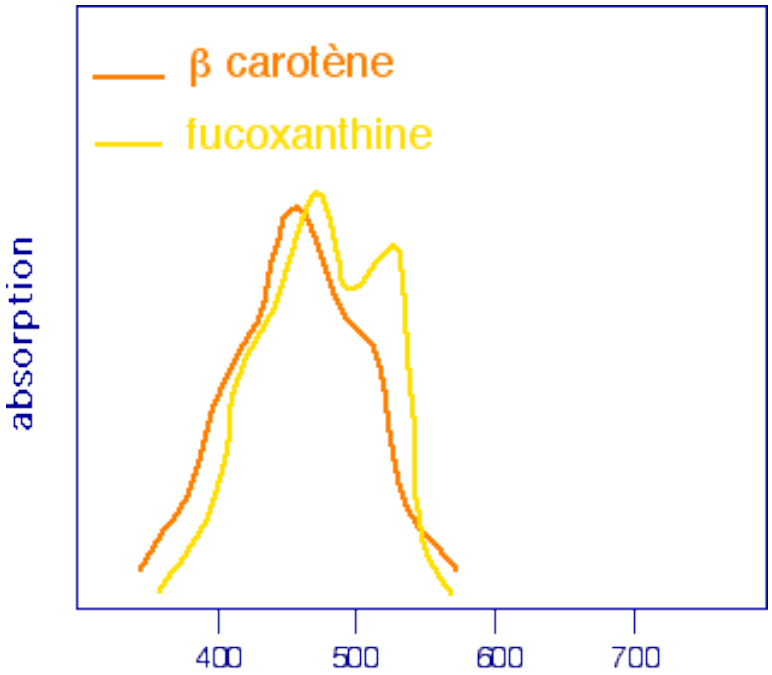
Lipid soluble pigments

Chlorophyll



wavelength (nm)

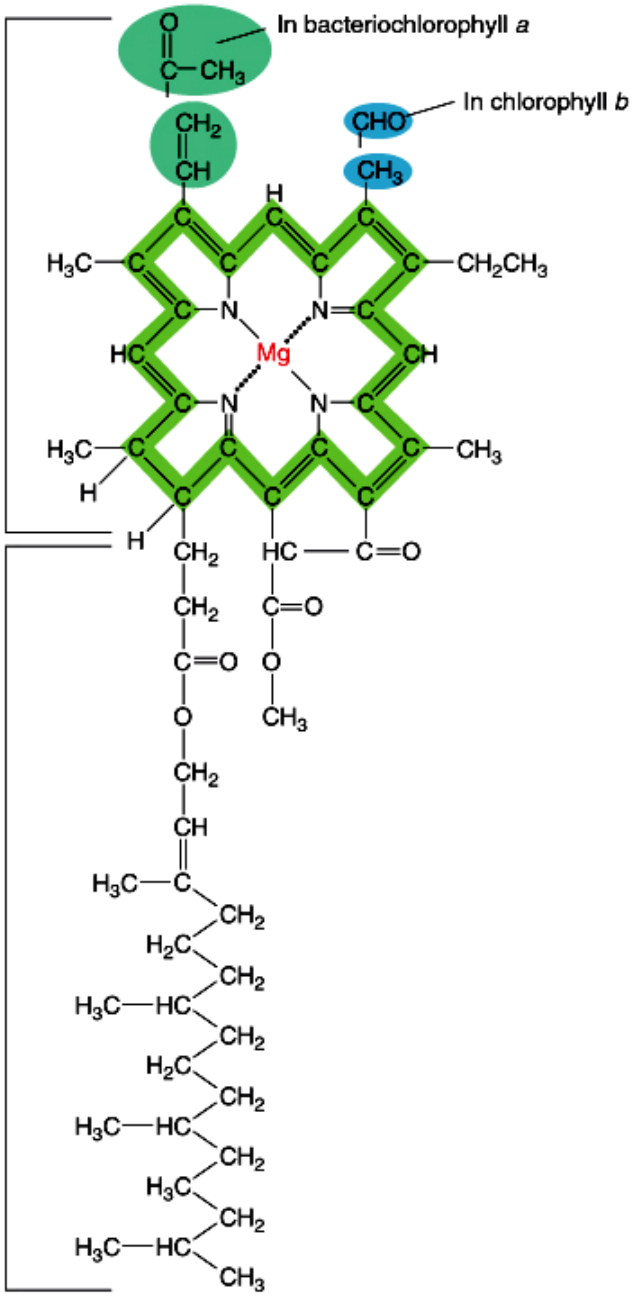
Carotenoids



wavelength (nm)

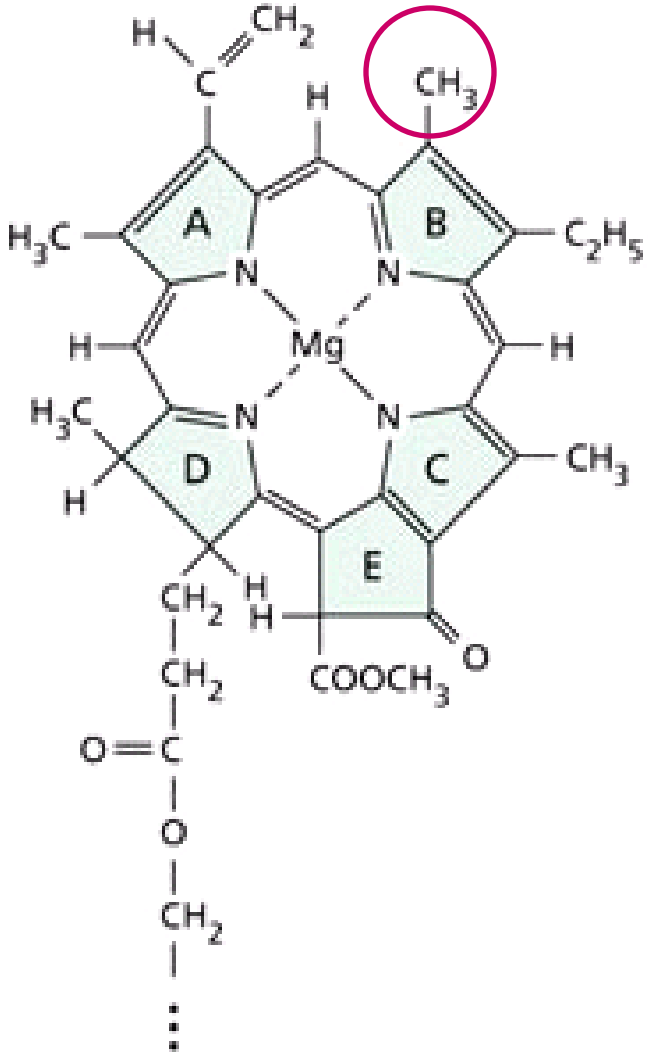
Porphyrin ring

Phytol tail

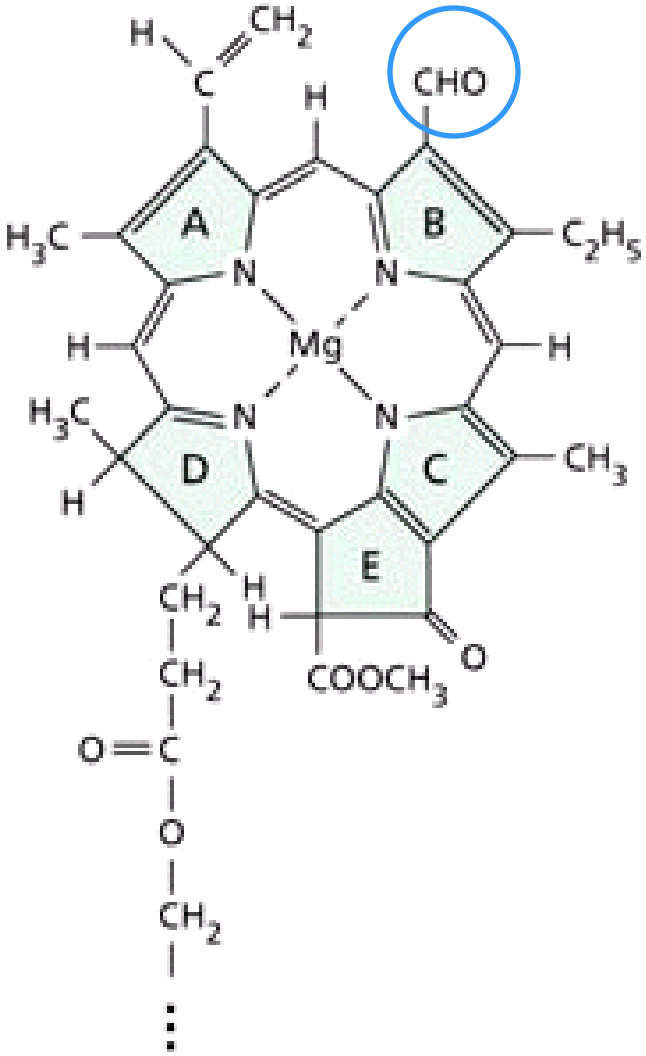


Chlorophyll

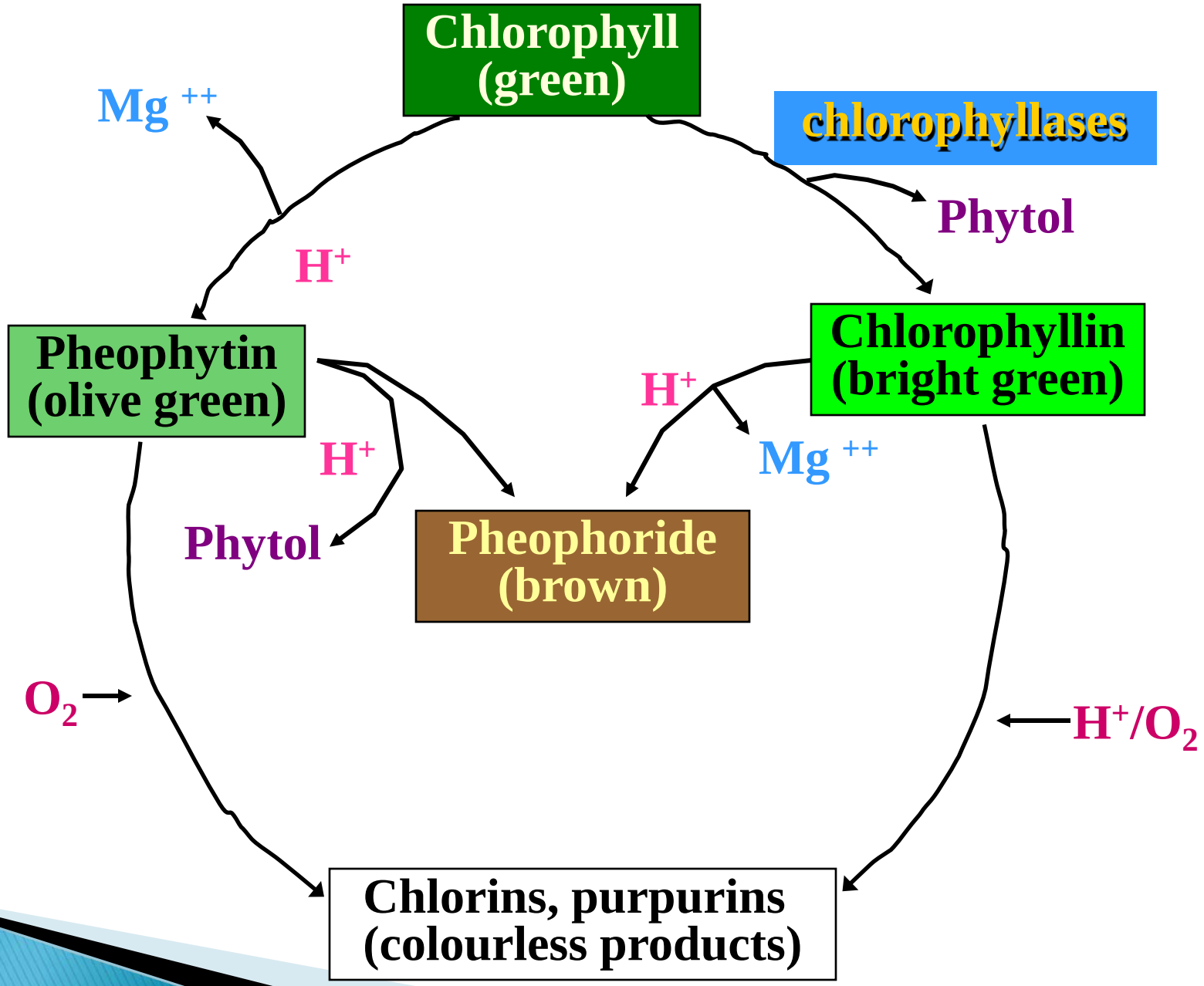
(A) Chlorophylls



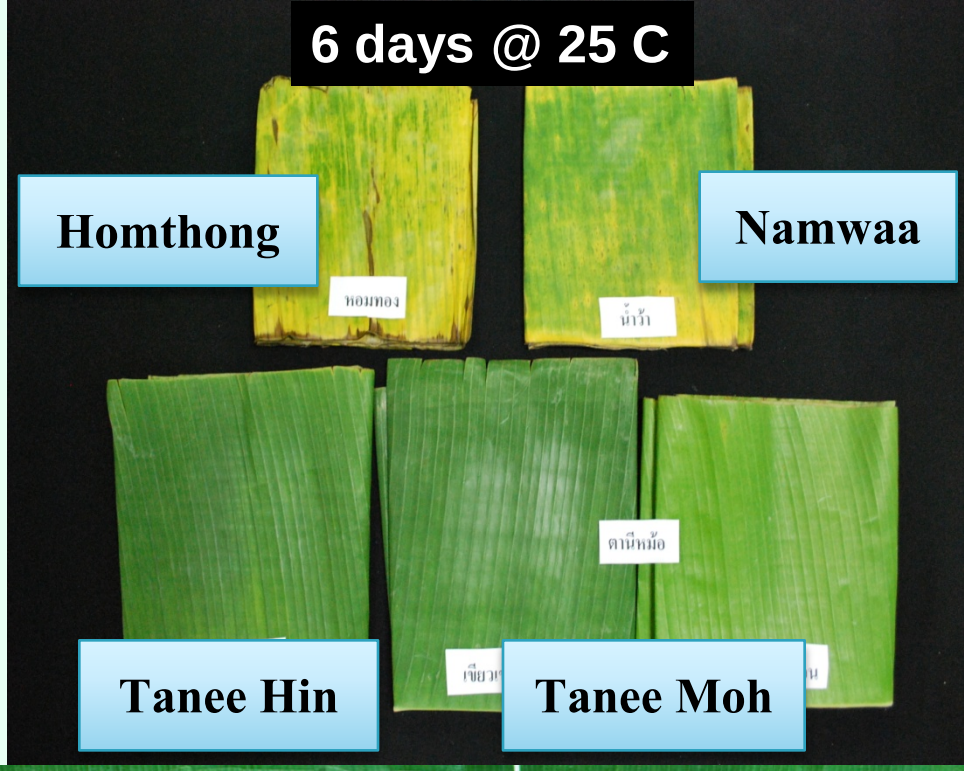
Chlorophyll *a*

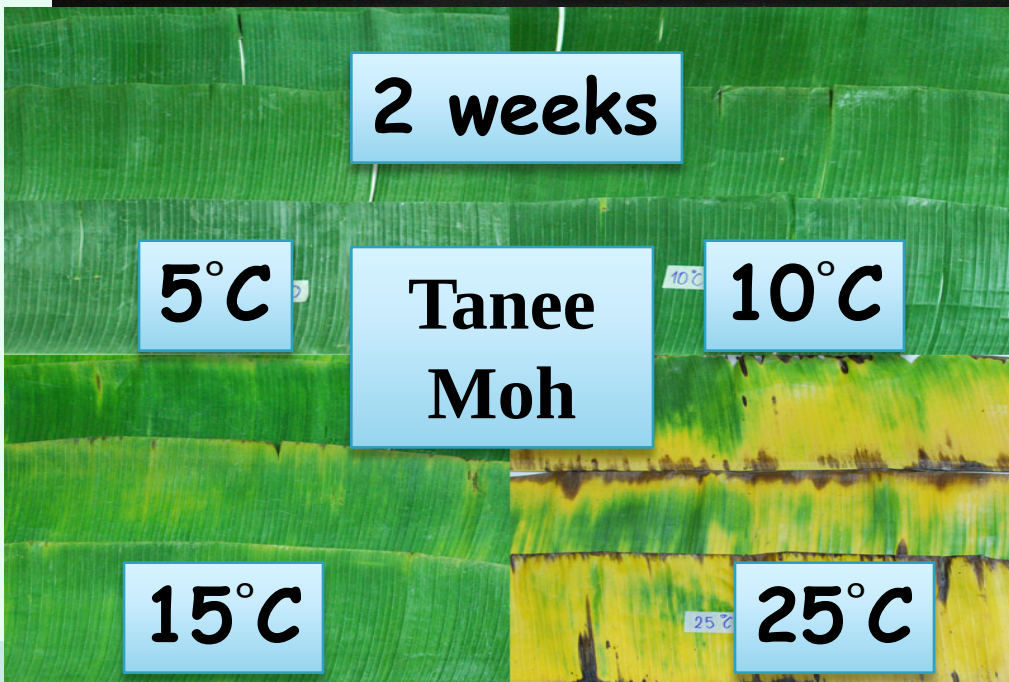


Chlorophyll *b*

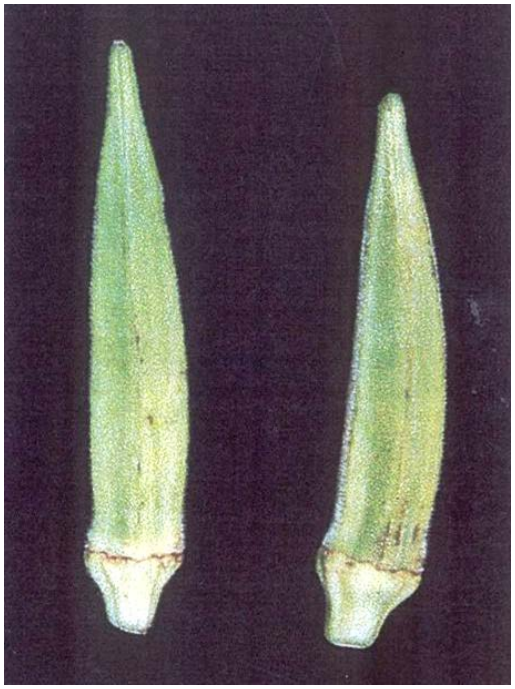

Chlorophyll (green)
Mg ++
chlorophyllases
Phytol
H+
Pheophytin (olive green)
Chlorophyllin (bright green)
H+
Mg ++
H+
Phytol
Pheophoride (brown)
O2
H+/O2
Chlorins, purpurins (colourless products)

Exported fresh banana leaves





No bag
6 days at 10C

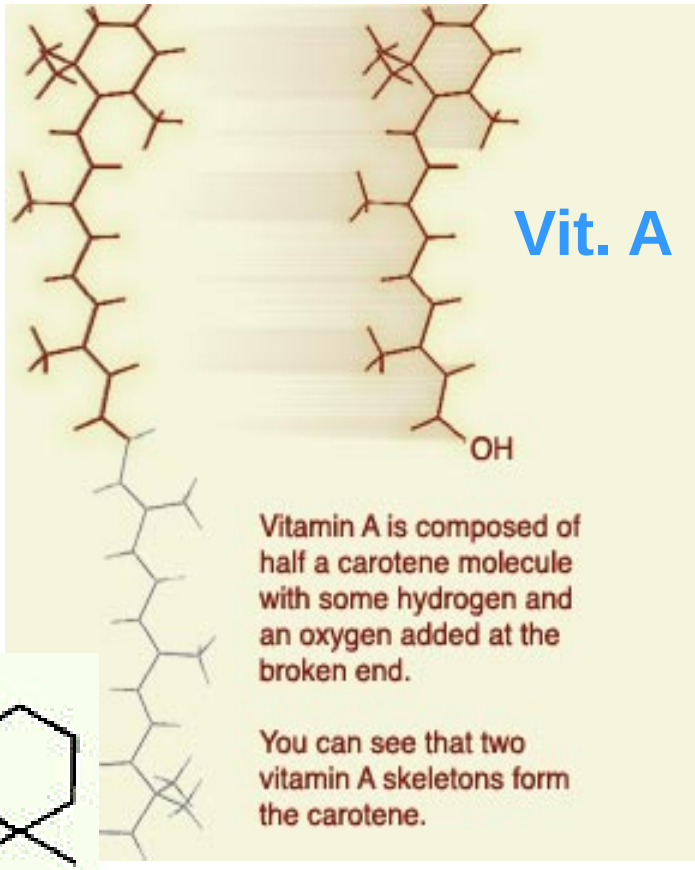


LDPE bag
12 days at 10C

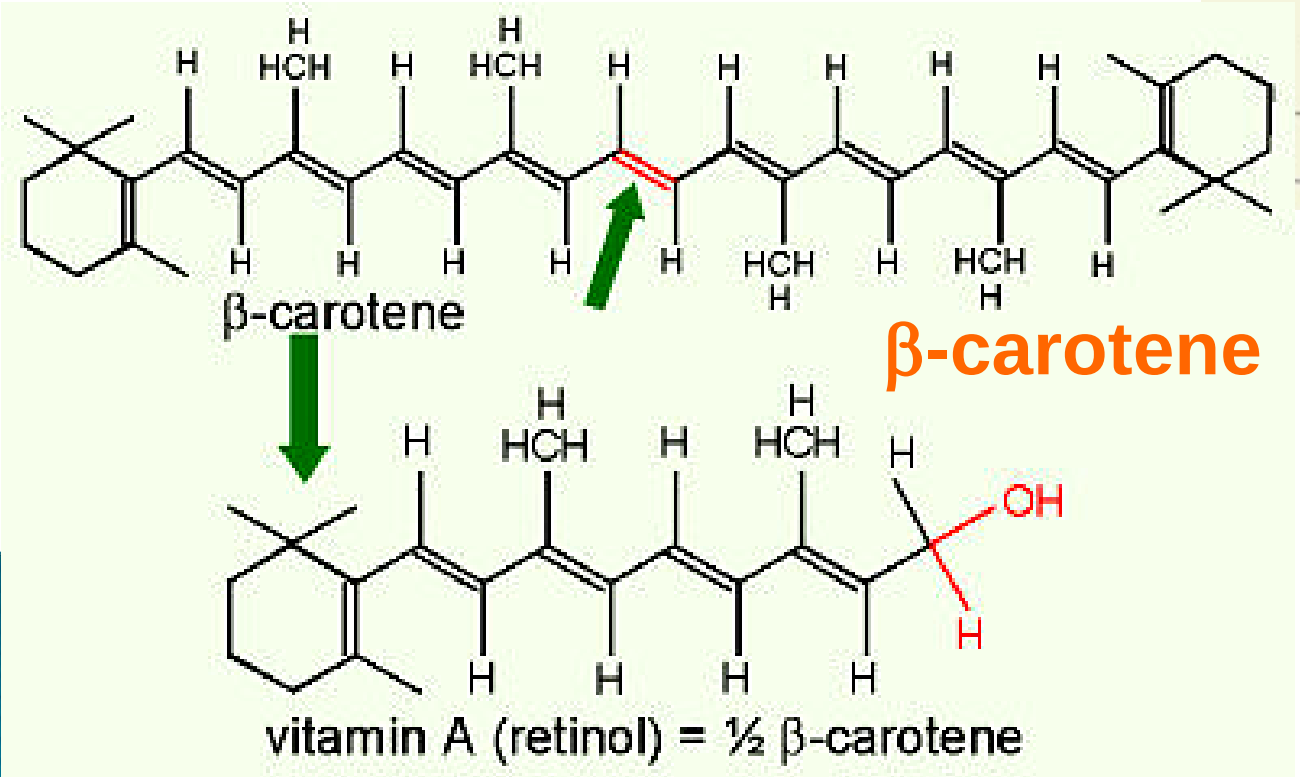
HDPE bag
12 days at 10-14C

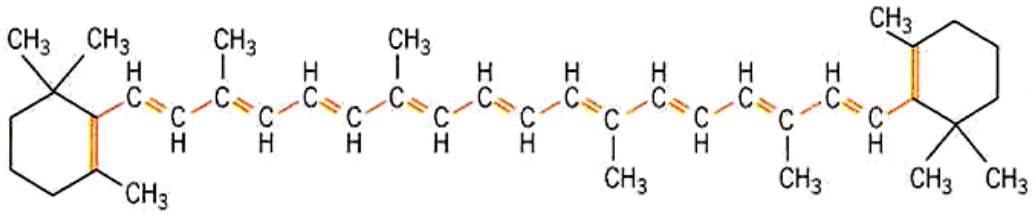
Okra could be stored in HDPE bag at 10 to 14 C for 12 days

Carotenoids

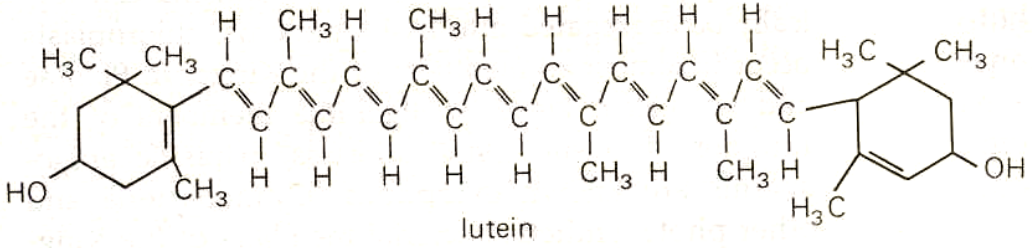


Vit. A

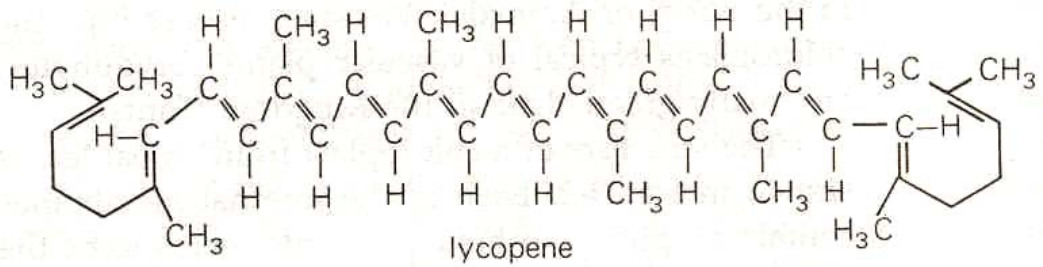




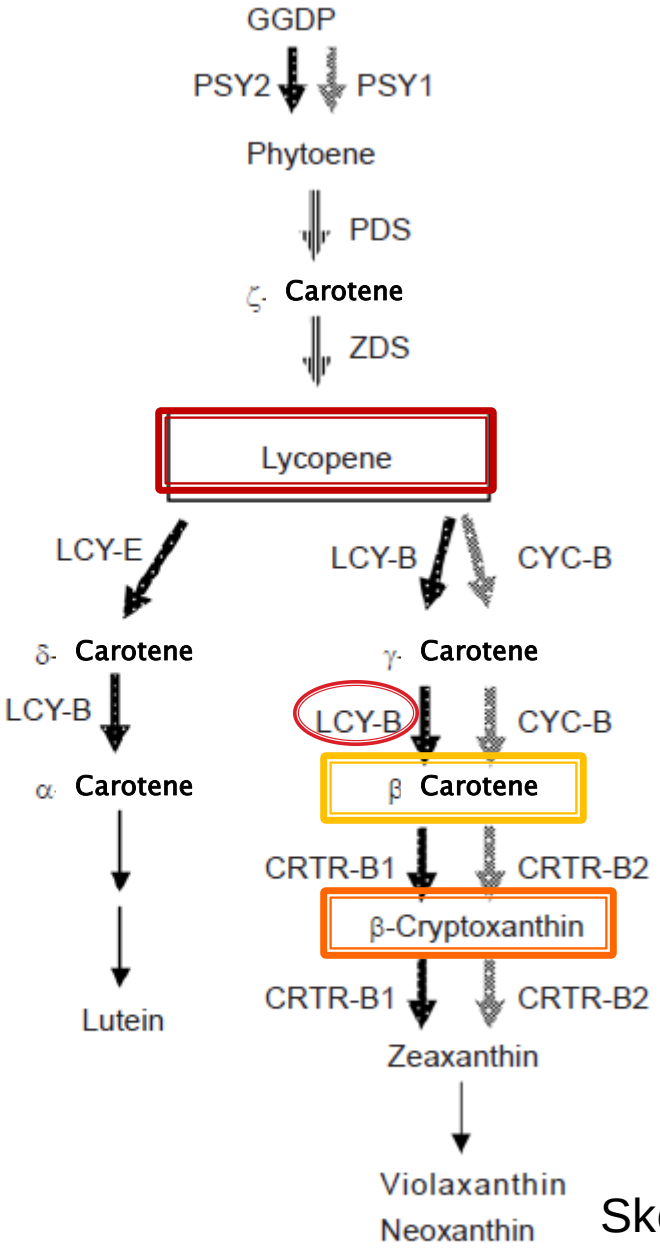
β-carotene

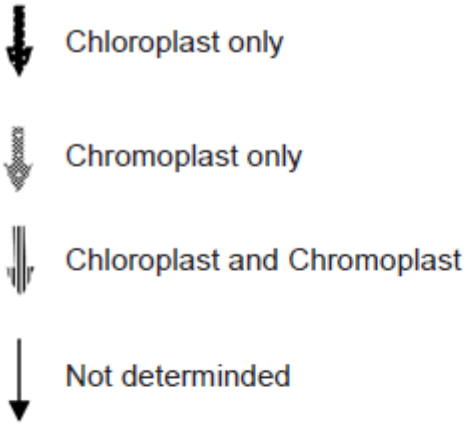


lutein



lycopene





Carotenoid Biosynthesis

Watermelon, papaya, tomato

Skelton *et al.* Cell Research (2006): 731-739

Figure 1 Pathway of carotenoid biosynthesis in plants [8, 22,23, 26]. PSY, phytoene synthase; PDS, phytoene desaturase; ZDS, ζ-carotene desaturase; LCY-B, lycopene β-cyclase; LCY-E, lycopene ε-cyclase; CYC-B, chromoplast-specific lycopene β-cyclase; and CRTR-B, β-ring hydroxylase.

Water soluble pigments

Anthocyanin (Flavonoid)

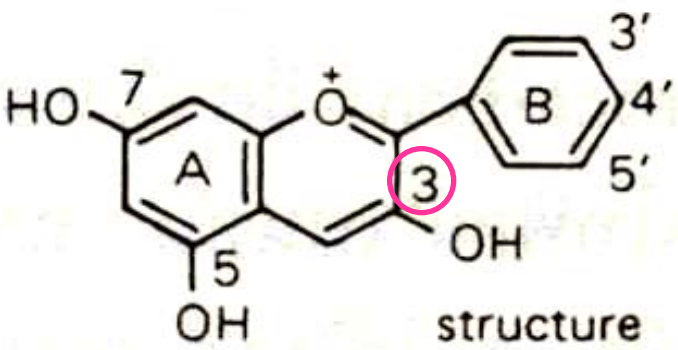
- red, violet and purple
- water soluble
- found in vacuole in the form of glycoside
- not stable depend upon pH

ex. Lychee, mangosteen, strawberry

anthocyanidin $\xrightarrow{O_2}$ Brown

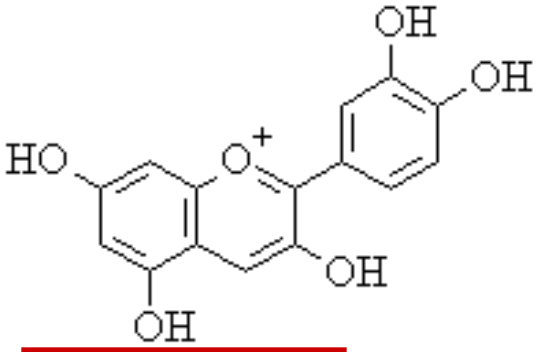
Polyphenol oxidase

(PPO)

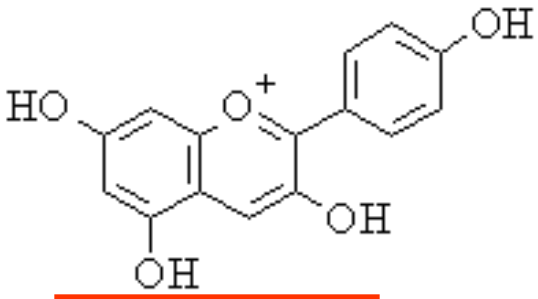


basic anthocyanidin structure
(flavynium ion)

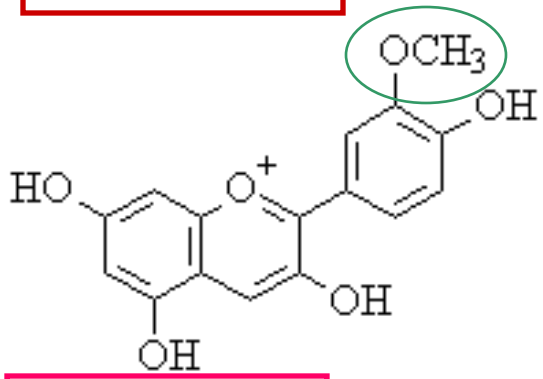
Position	Sugar Attached
3	this position is always glycosylated, commonly by glucose, galactose, rhamnose, xylose-glucose, rhamnose-glucose, or glucose-glucose
5	sometimes glycosylated; if so, by glucose
7	almost never glycosylated; if so, by glucose



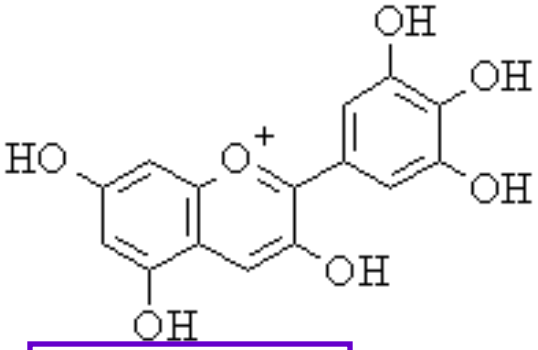
Cyanidin



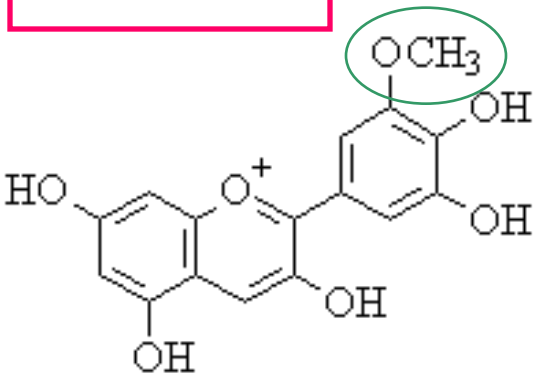
Pelargonidin



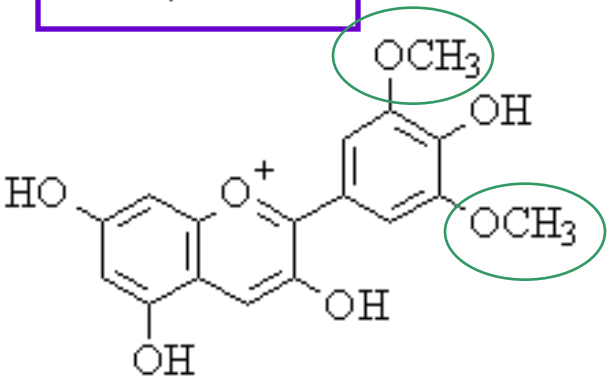
Peonidin



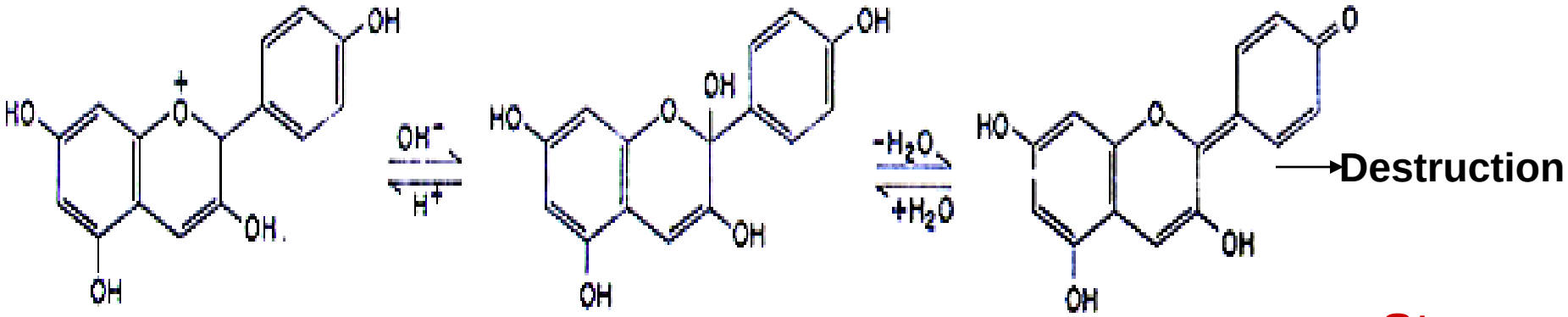
Delphinidin



Petunidin



Malvidin



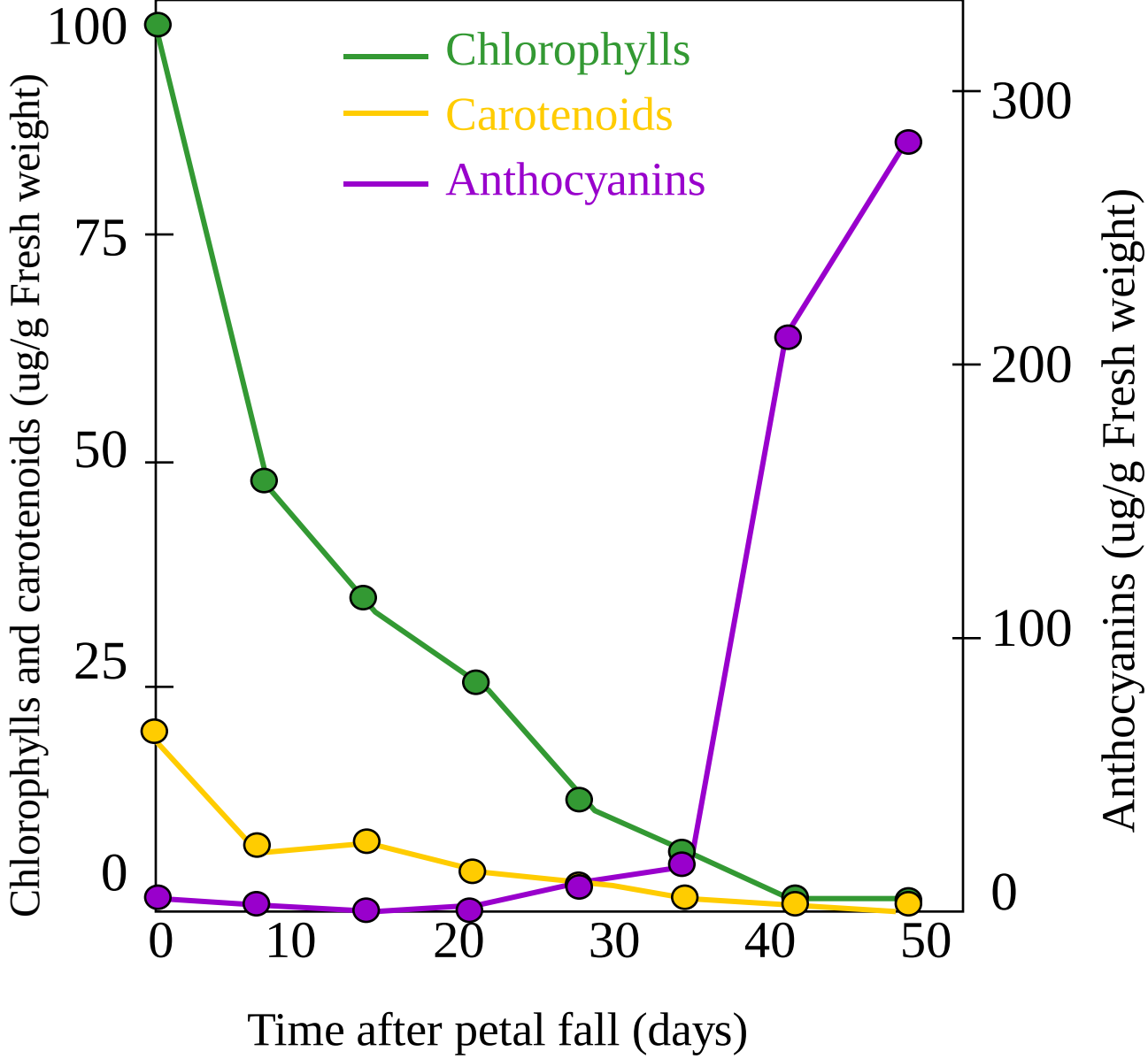
Orange red (pH1)

Colorless pseudo base (pH<6)

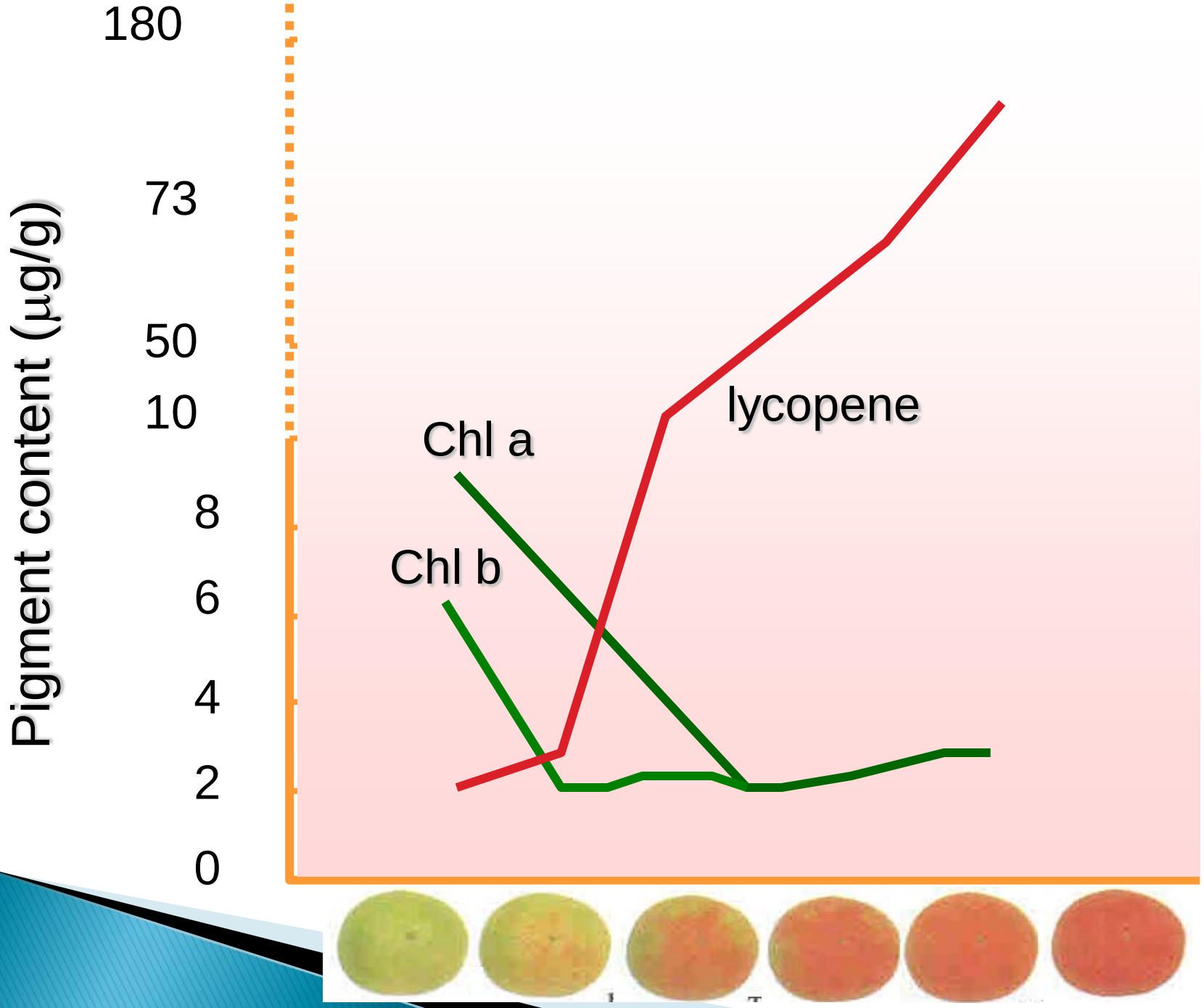
Blue hydrobase (mind alkali)

Strong alkali

Structural changes of anthocyanins with pH



Change in pigment concentration per unit fresh weight in developing strawberry fruits. (Woodward, 1972)


180
73
50
10
8
6
4
2
0
Pigment content (µg/g)
Chl a
Chl b
lycopene

CALIFORNIA TOMATOES

Ripening Stages

GREEN - STAGE 1

"Green" means that the surface of the tomato is completely green in color. The shade of green may vary from light to dark.

BREAKERS - STAGE 2

"Breakers" means there is a definite "break" in color from green to tannish-yellow, pink or red on not more than 10% of the surface.

TURNING - STAGE 3

"Turning" means that more than 10%, but not more than 30%, of the surface, in the aggregate, shows a definite change in color from green to tannish-yellow, pink, red, or a combination thereof.

PINK - STAGE 4

"Pink" means that more than 30%, but not more than 60%, of the surface, in the aggregate, shows pink or red in color.

LIGHT RED - STAGE 5

"Light red" means that more than 60% of the surface, in the aggregate, shows pinkish-red or red, provided that not more than 90% of the surface is red.

RED - STAGE 6

"Red" means that more than 90% of the surface, in the aggregate, is red.

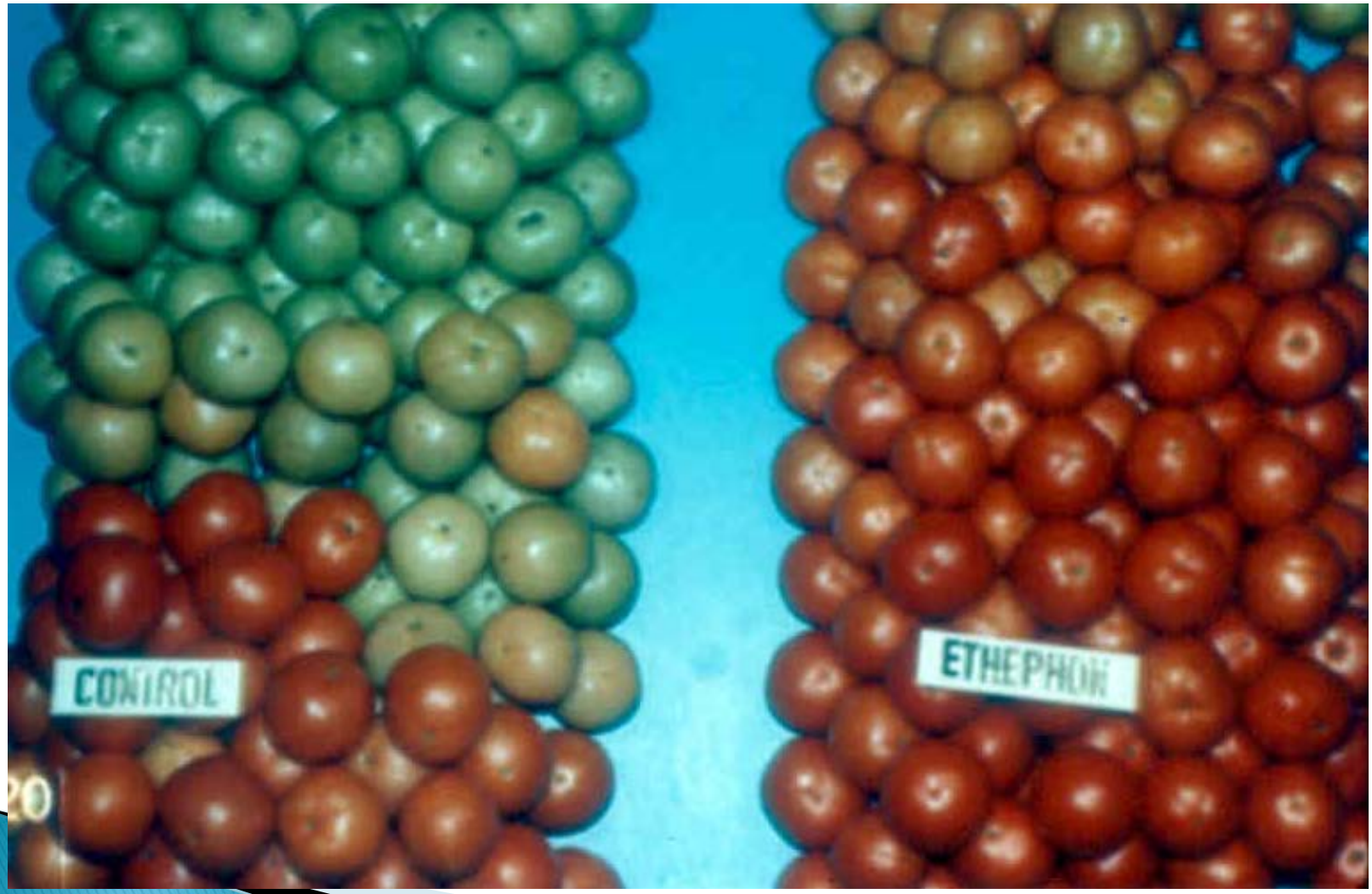
CALIFORNIA TOMATO COMMISSION 1625 E. SHAW AVENUE #106 FRESNO, CA 93710 P: (559) 230-0116 F: (559) 230-0635 www.tomato.org

CALIFORNIA TOMATOES

Postharvest Technology Center

“Ripe tomato on vine or with calyx attached” to guarantee fresh and tasty.

Ripen tomato with ethephon (ethylene releasing compound)

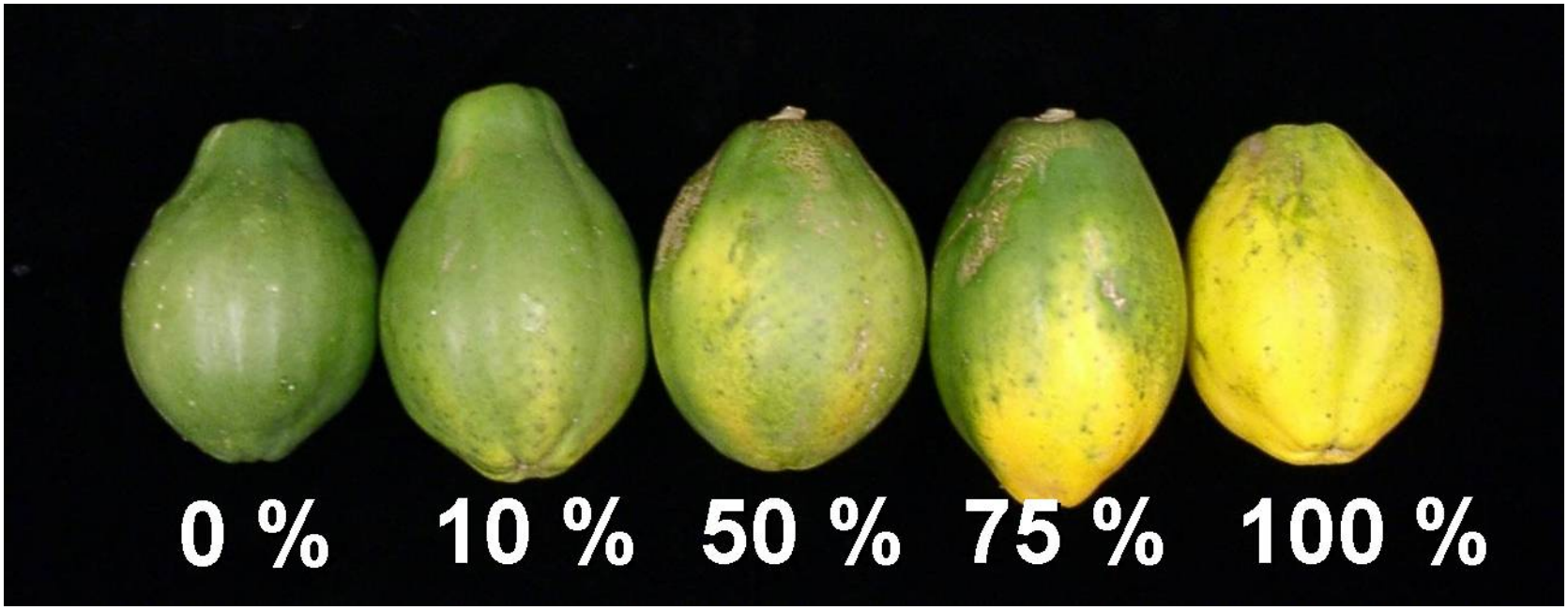


Skin color improvement of tangerine

4 days De-greening

Effect of 1-MCP on chlorophyll degradation

Color measurement



Evaluation of skin color development

Color chart

C.I.E. system: Y, x, y

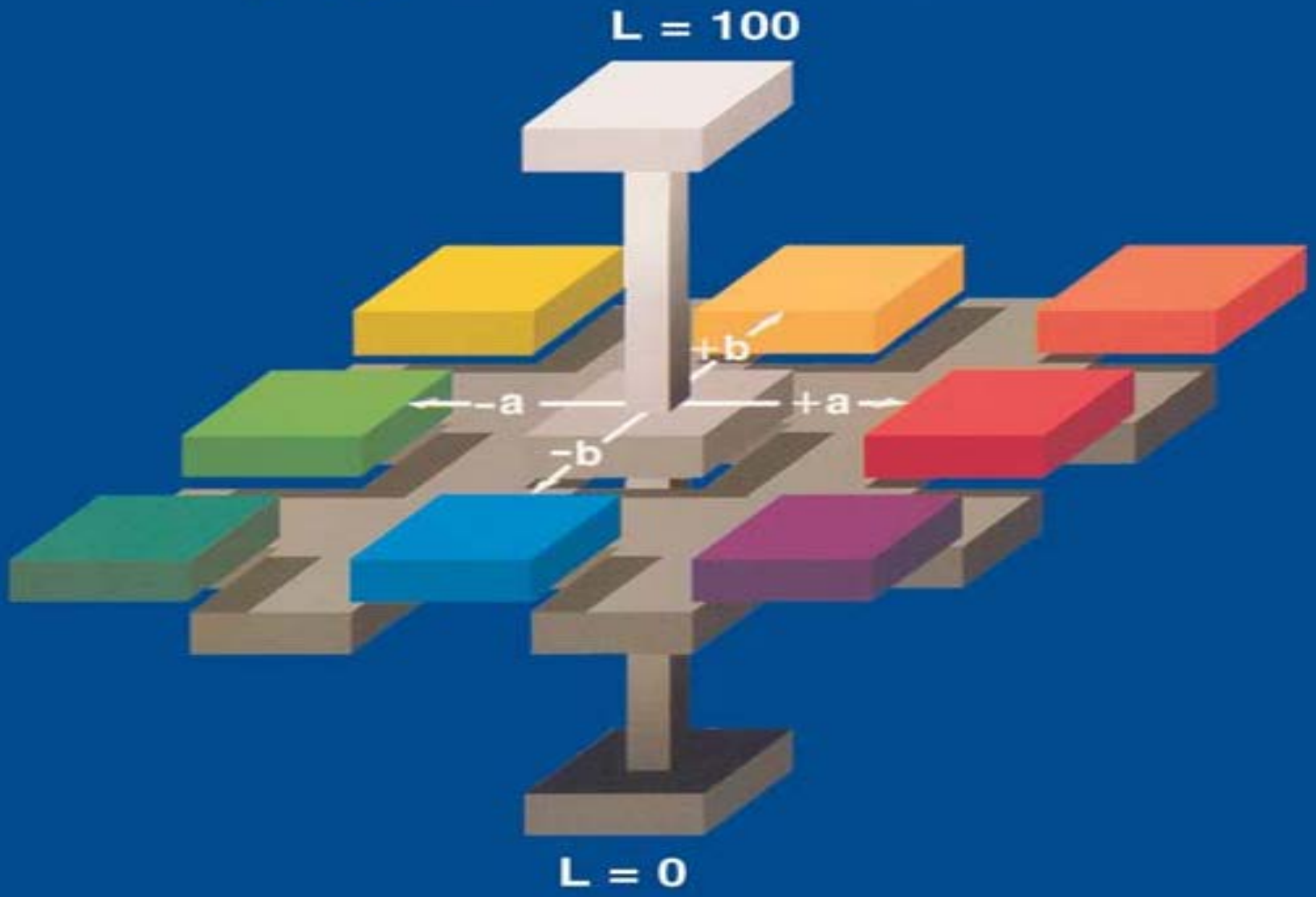
Y (brightness),

x (red),

y (green)

z (blue) = 1-x-y

Hunter's scale: L, a, b color space



http://www.hunterlab.com/appnotes/an08_96a.pdf

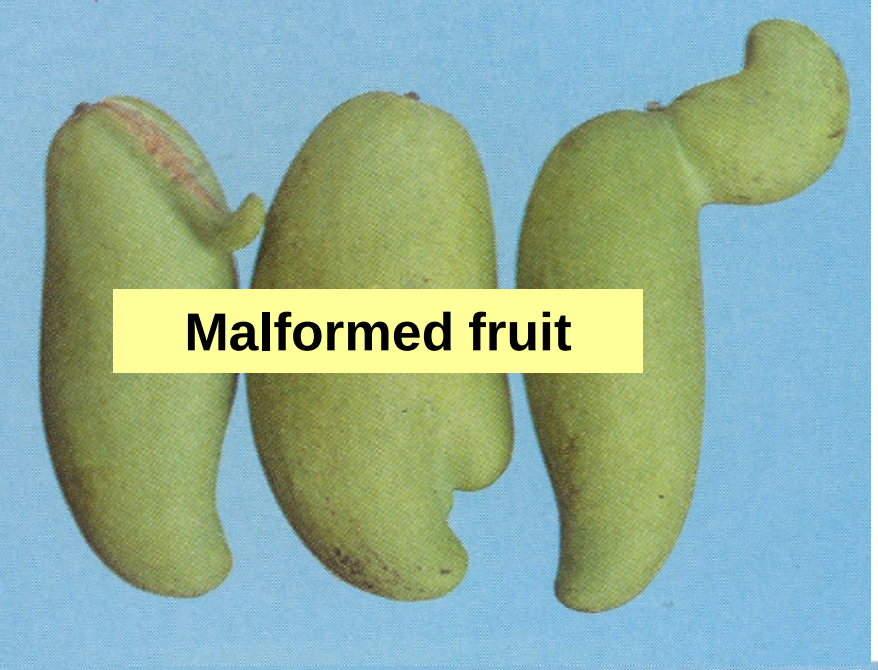
Defect

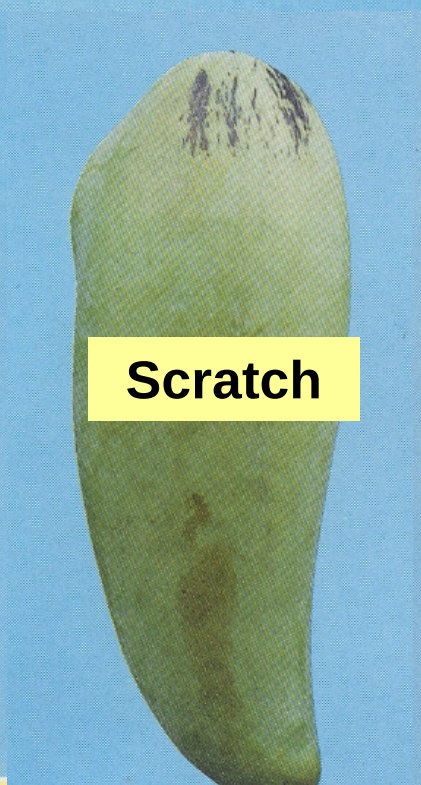
Standard Okra

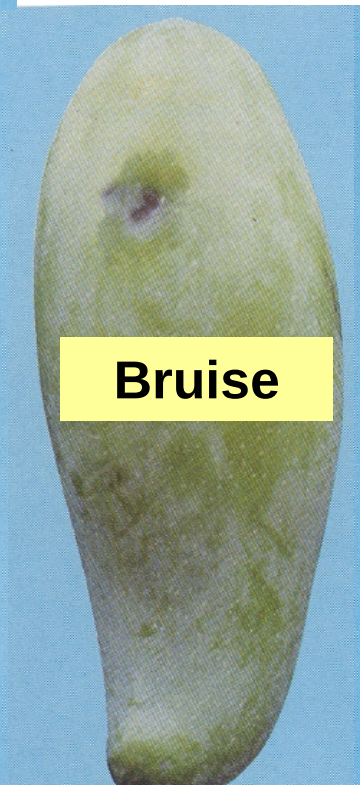
Insect Damage & Misshape pod

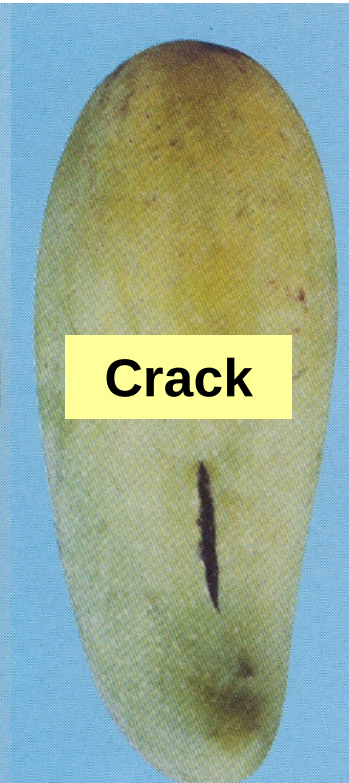
Miscolor pod

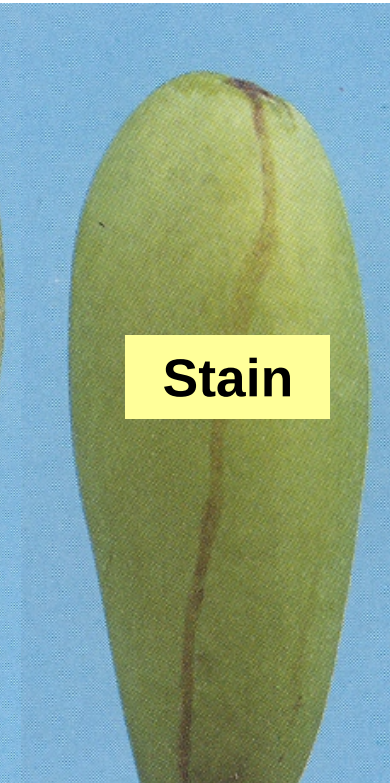
Defect











Prevention of defect formation

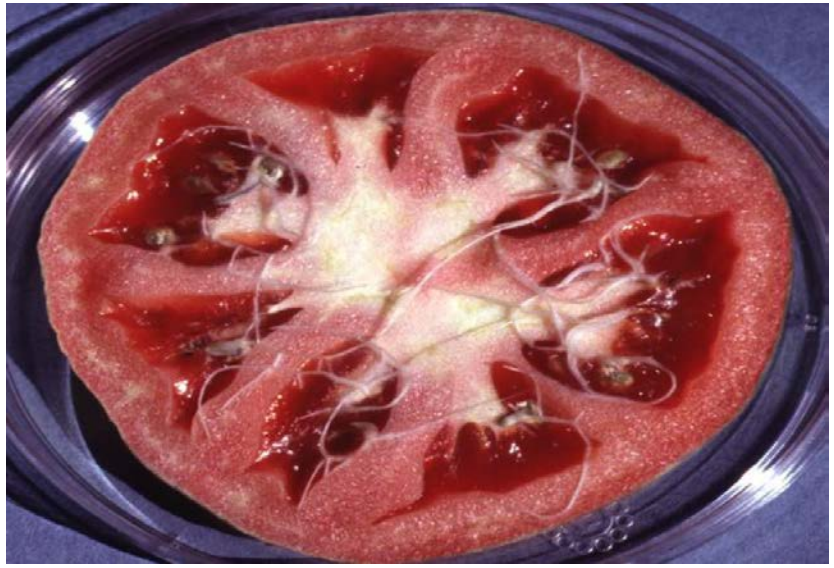
- Avoid sunshine.
- Well packaging & transportation.
- Immediate pre-cooling after harvest.
- Trimming & latex removal.


SELECTED
EXCELLENCE
Club Price
59¢
lb
SAVE 20¢ per lb
Postharvest Technology Center

Impacted banana

Having pictures is good for trading agreement.

GERMINATION



Telescoping of lemongrass

Growing of young leave sheath

Rooting

Internal characteristics

- Texture: firmness, softness & toughness
- Taste: flavor & aroma including sweetness, sourness, bitterness, and astringency
- Nutritional value: Vitamin C, antioxidant, etc.
- Food safety: pesticide residue, food borne disease and toxicant contamination.
- Uniformity
- Internal size: flesh and seed size

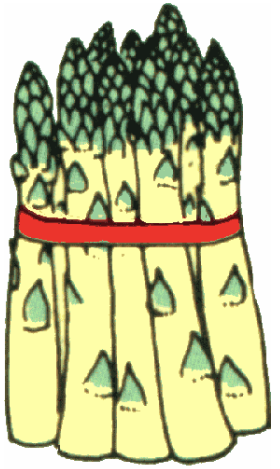
Texture

Firmness & Softness

- Water loss
- Starch degradation
- Cell wall loosening
  proto pectin (insoluble) → soluble pectin

Toughness

- fiber formation (lignification)



Firmness determination

Firmness tester

Remove skin before measuring

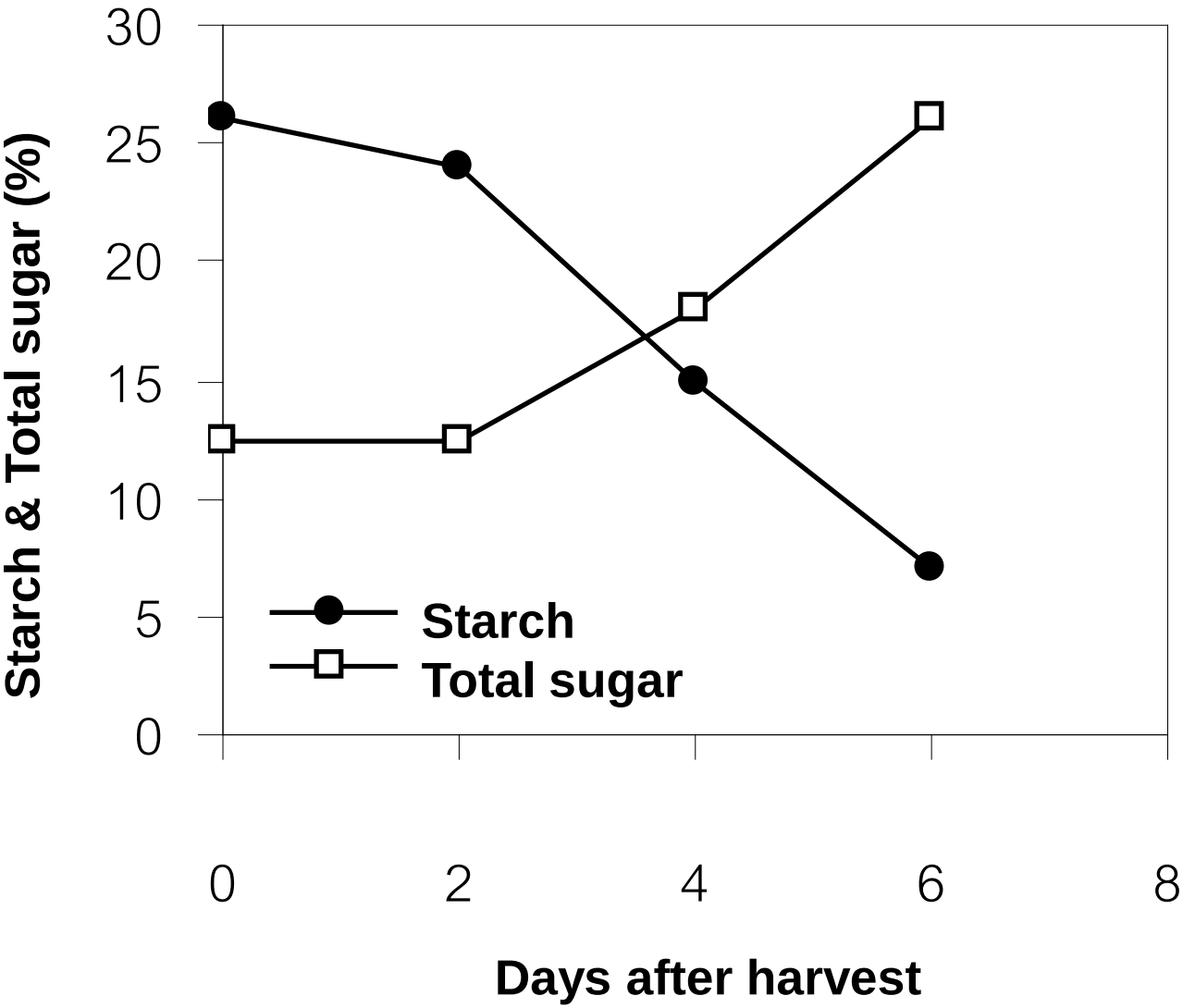
Deformation

Deformation by compression

Sweetness

- Starch degradation
- Sugar accumulation during growth & development
- Type of sugar

  sucrose = glucose + fructose



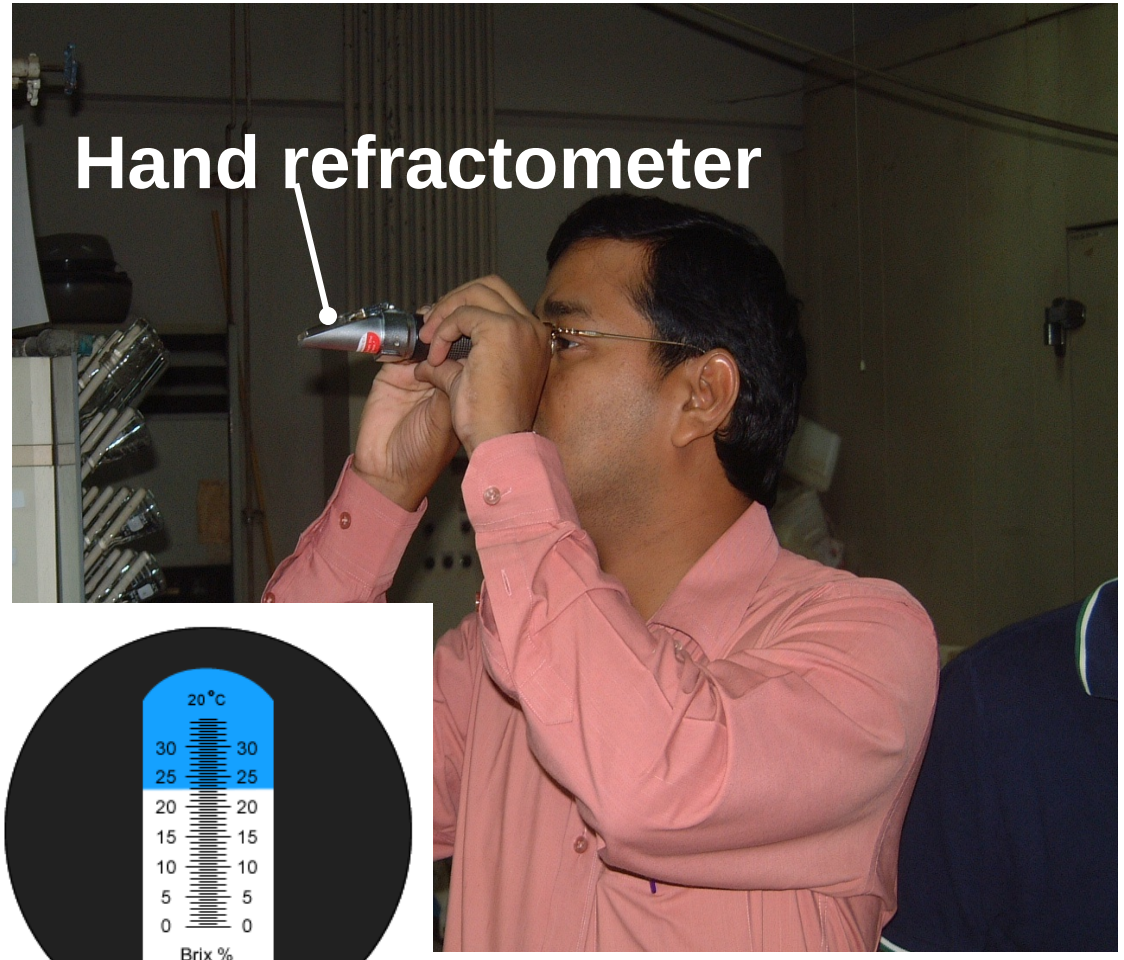
Starch and total sugar content in 'Monthong' durian fruit during ripening. [Thira, 1995]

Table Sugar 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**	0.0
Pomegranate	5.5	**6.1**	0.0
Tomato	1.6	1.2	0.0

(Whiting, 1970)

Soluble solids content (SSC) using hand refractometer



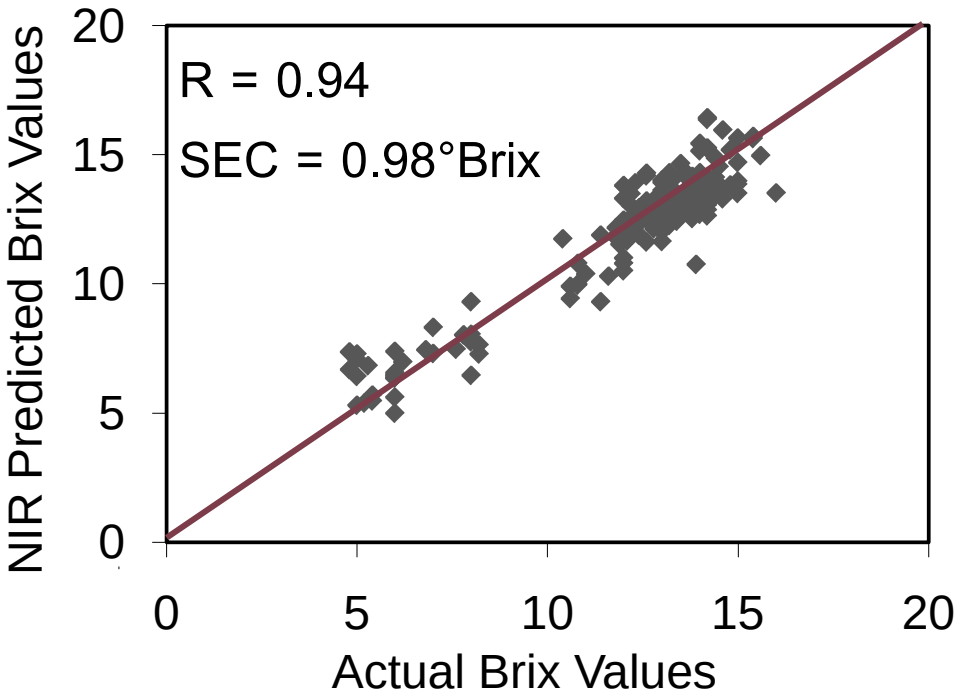
Nondestructive determination of SSC using Near Infrared Spectrometry (NIRs)

Standard for Hawai'i grown papaya is11.5 brix

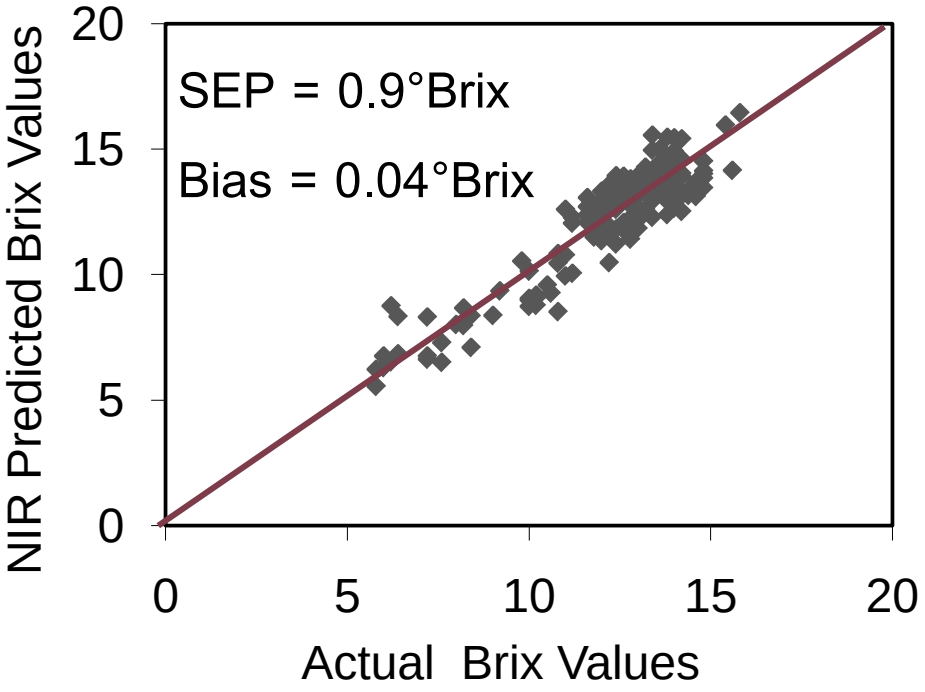
Sangwanangkul et al. (2011)

scatter plots of the predicted and actual SSC (Brix) showed estimated sugar content of papaya flesh

Calibration set



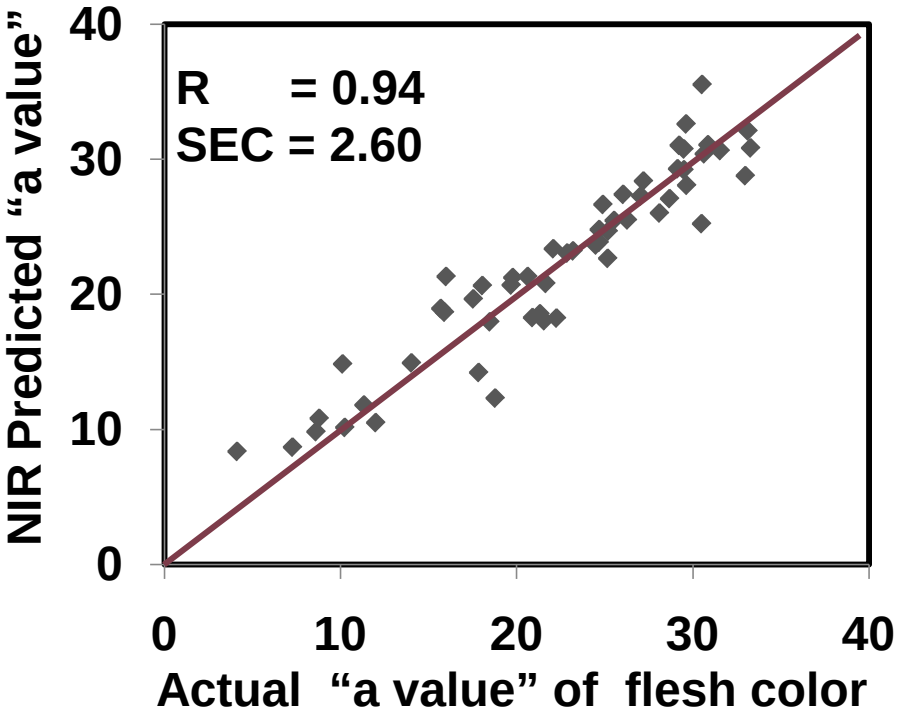
Validation set



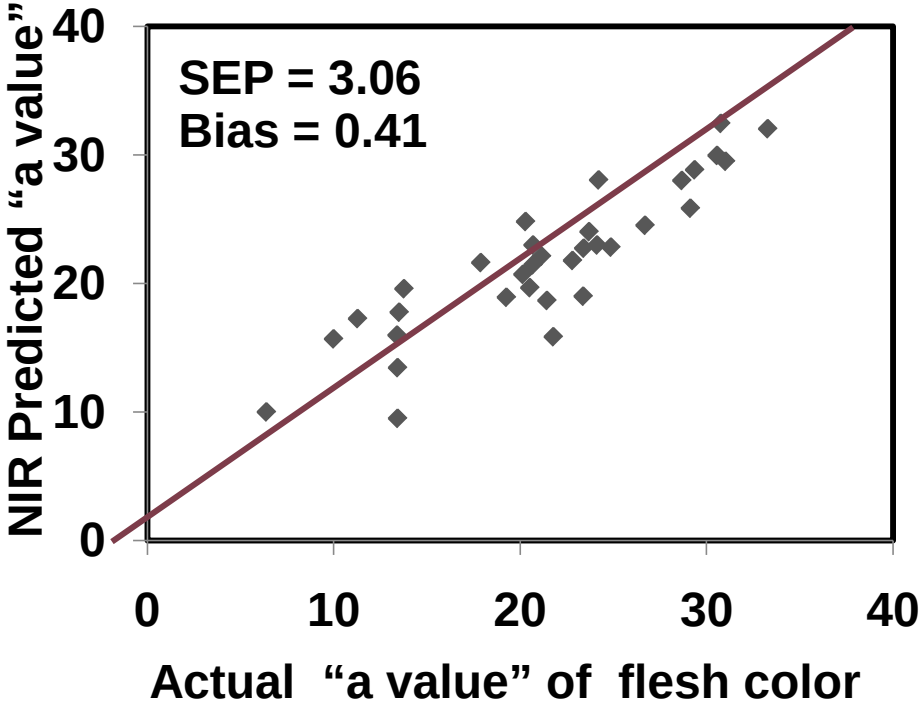
Sangwanangkul et al. (2011)

scatter plots of the predicted and actual value of a value showed red color of papaya flesh

Calibration set



Validation set



Sangwanangkul et al. (2011)

Carbohydrate content

1. Structural carbohydrate (cell wall, xylem, fiber)
2. Total non-structural carbohydrate (TNC)

- **Starch content** (biosynthesis & degradation)
- **Total sugar**
  - reducing sugar
  - non-reducing sugar

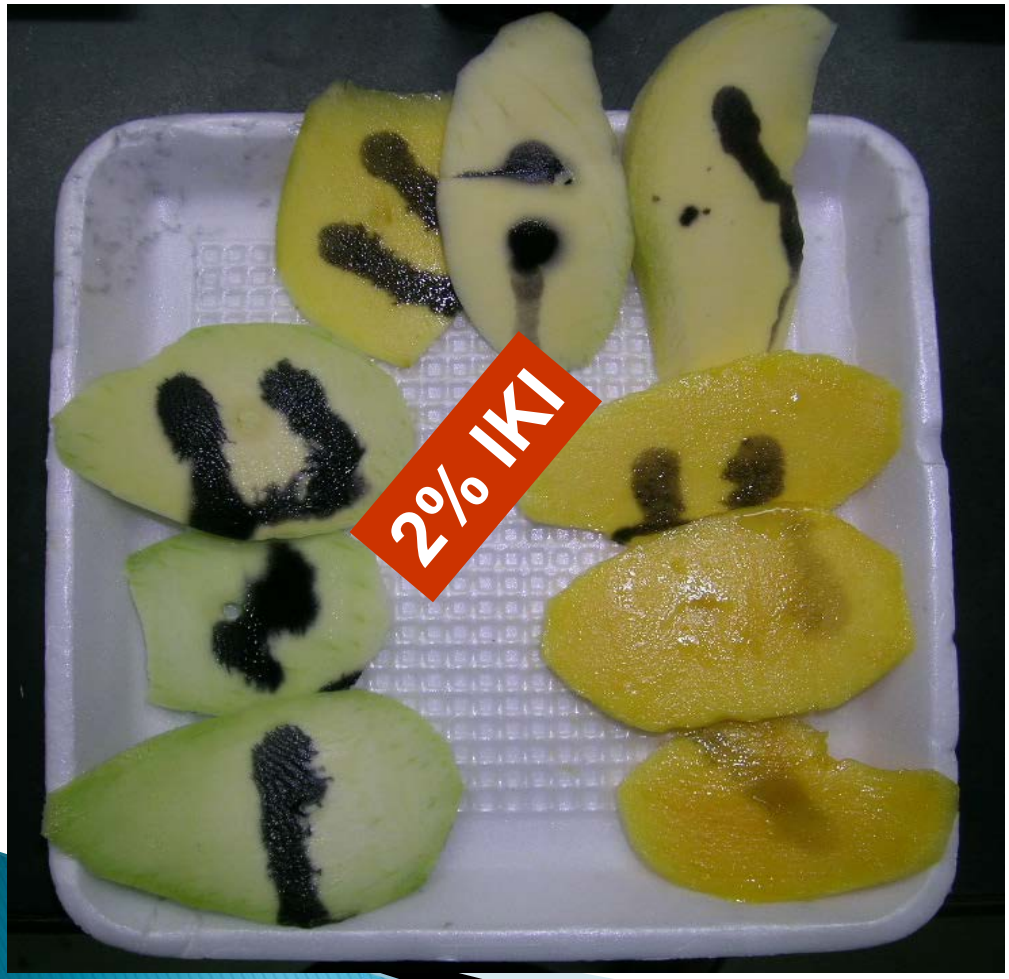
Analyzed by Spectrophot

& <u>Rapid methods</u>

maturity index

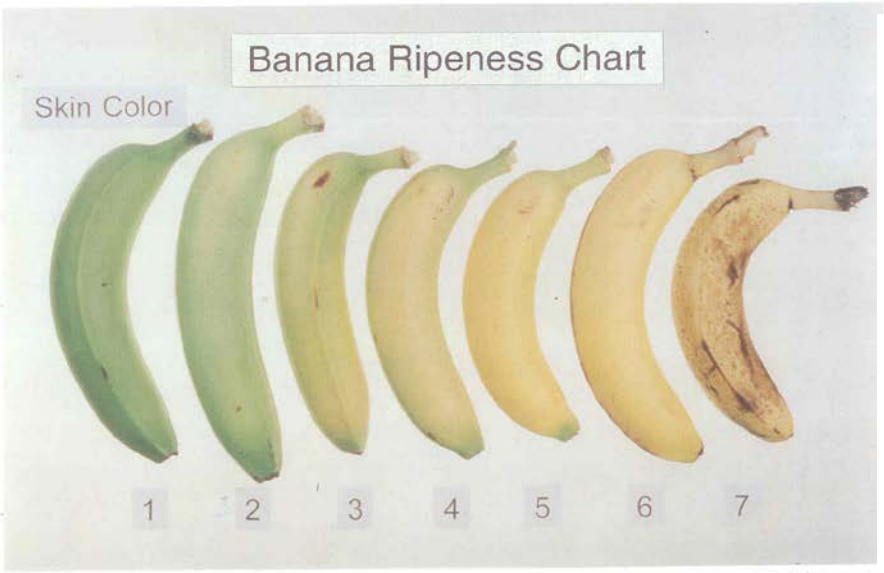
- In hawai'i grown papaya, 11.5 % SS is required.
- In Avocado, 30 % DW is used as maturity index.
- In durian, a minimum of 32 % DW is required for Monthong, 27 % for Kradum and 30 % for Chanee.

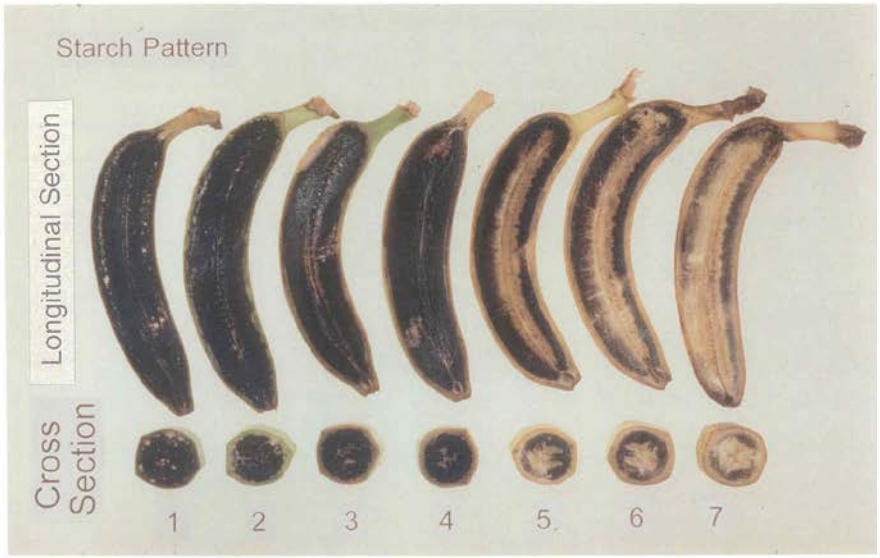
Rapid test for starch content



2% IKI
- brown solution

I_2 react with amylose
- show blue stain

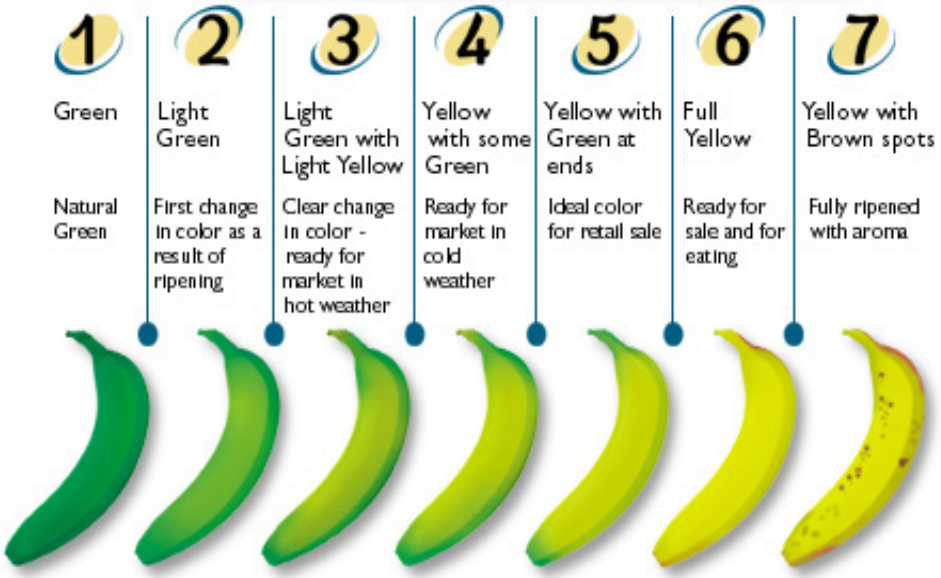




Israel Banana Growers Association A.M. Ltd.

Banana Ripening Chart

Temperature in 0° Celsius Ripening Period	Daily Ripening Chart							
4 Days	18°	18°	16½°	15½°	14½°			
5 Days	16½°	16½°	16½°	16½°	15½°	14½°		
6 Days	16½°	16½°	15½°	15½°	14½°	14½°	14½°	
7 Days	15½°	15½°	15½°	15½°	14½°	14½°	14½°	14½°
8 Days	14½°	14½°	14½°	14½°	14½°	14½°	14½°	14½°
	Day 1	Day2	Day3	Day4	Day5	Day6	Day7	Day8



Sourness

- Acid accumulation during growth & development
- Different fruits contain different types & quantities of acids.
- Can be determine by titration of fruit juice with alkali solution (NaOH), but not by pH value.
- Mangosteen contains 0.5-1% acid but it's pH is about 3-3.3 as low as lime and pineapple.

Organic acids

Major acids	Fruits	Other acids
Citric acid	Pomegranate	Malic
	Guava	Malic
	Orange, Lime	Malic, Quinic
	Pineapple	Malic
Malic acid	Banana	---
	Grape	Tartaric
	Apple	Quinic

(Ulrich, 1970)

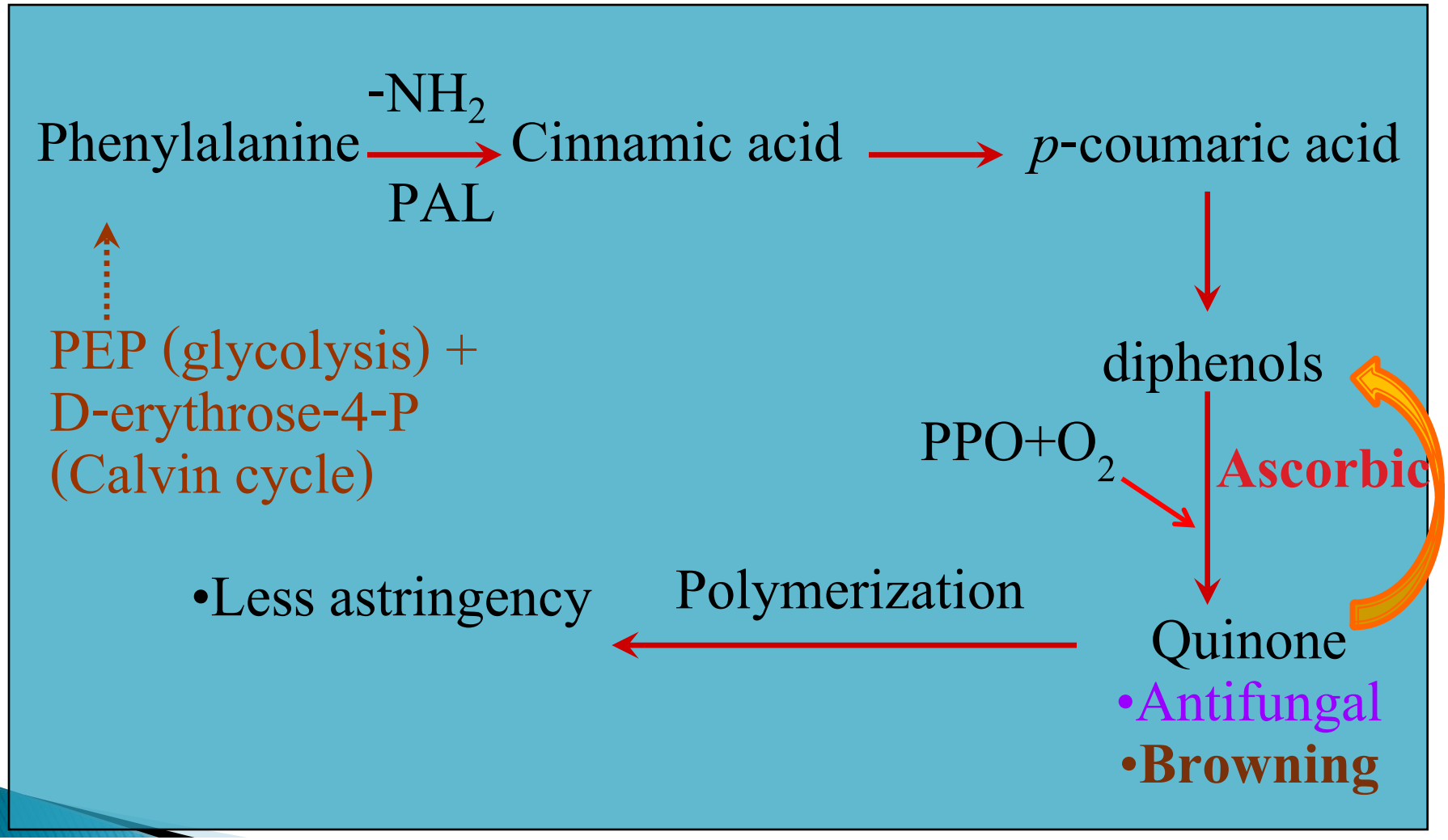
Titratable acidity (TA)

Titrate 1 - 5 ml juice with 0.1N NaOH using 1% phenolphthalein as indicator (1-2 drops)

Astringency

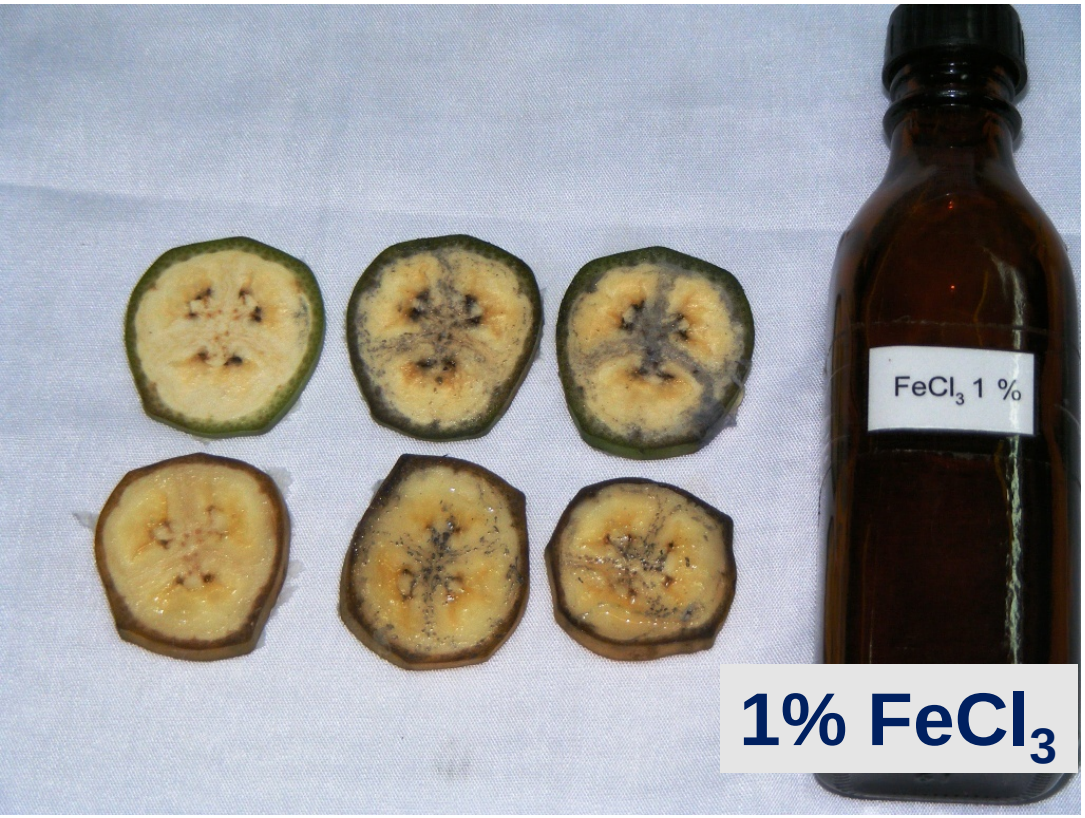
- Accumulation of phenolic compound
- Found in some green/immature fruits; banana, plum, jujube, etc.
- High CO_2 packaging can reduce this astringency taste.

Phenolic compound



PAL= phenylalanine ammonialyase, PPO = polyphenol oxidase

Rapid test for phenol content



1% $FeCl_3$ solution

Fe^{++} will react with phenol & show brown stain.

Bitterness

- Caused by flavonoid accumulation such as limonoid in orange peel and naringin in grapefruit. However, Naringin has antioxidant, anti-carcinogenic and cholesterol lowering activity.

- Bitter taste in most produces is not acceptable. However, in some fruits such as bitter melon, it's preferable.

Aroma

- Volatile compound biosynthesis during fruit ripening.
- Fruit aroma is preferable in one group of customers, might not acceptable in another group, for example, ripe durian, papaya and mango.
- Preference is depend on nationality, age, familiarity and popularity of various customers.

Ripening of banana (*Musa sapientum* L.)

Food safety

1. **Pesticide residue**
   -need to know MRL (Maximum Residue Limit)

2. **Microbial contamination:** *E coli., Salmonella spp.*

3. **Mycotoxins**
   - Aflatoxin in dry seed and grain can be destroyed at 237-306 ◦C (Semarajeewa et al.,1990)

4. **Plant toxin**
   - Solanin in potato

Thai agriculture commodity and food standard (TAS 9002-2008)

Ethephon (Maximum Residue Limit ; MRT) in Durian

		Sugar cane	0.2
Ethephon	ethephon	Banana	2
		Cherries	3
		Durian	2
		Mango	2
		Pineapple	2
		Grapes	1

CODEX alimentarius commission

- Maximum Residue Limit (MRL) for Ethephon in peeled fruit (papaya, pineapple, durian) = 2 mg/kg

Review of the existing maximum residue levels (MRLs) for ethephon[1]

European Food Safety Authority[2]

European Food Safety Authority (EFSA), Parma, Italy

Commodity	Existing EC MRL (mg/kg)	
Residue definition for enforcement: *ethephon*		
Walnuts	0.1	
Blueberries	0.05*	
Pineapples	0.5	
Barley grain	0.5	
Rye grain	0.5	
Wheat grain	0.2	
Apples	0.5	
Cherries	3	
Table grapes	0.05*	
Tomatoes	1	

Ethephon Residues in Samples from the Germany Market (2008)

Anastassiades M., Mack D., Tasdelen B., Sigalova I., Kostelac, D., Scherbaum E.

Commodity	Country of Origin	No. of findings	Minimum Value (mg/kg)	Maximum Value (mg/kg)	Remarks
Pineapple	Africa	6	0.1	0.73	1 organic
	South / Central America	3	0.03	0.4	
	unknown	1	0.17		
Pineapple Juice	unknown	6	<0.01	0.22	3 organic
Apples	Germany	3	<0.01	0.1	
Pears	Italy	1	0.01		
Durian	Thailand	2	0.31	10.1	2 > MRL
Sweet Pepper	Spain	4	0.049	1.2	
Kaki/Sharon	Italy	1	0.12		1 > MRL
	Spain	4	0.024	0.61	1 > MRL
Tomatoes	Belgium	1	0.12		
Grapes	Italy	7	0.28	0.78	
	South Africa	2	>0.01	0.13	1 organic

Ethephon: 472 samples (40 different commodities) from 28 countries were tested for this compound. 41 samples (9 commodities) from 12 countries were found to contain ethephon residues with 4 samples (kaki and durian) exhibiting MRL-violations. The concentrations in the positive samples ranged between <0.01 and 10.1 mg/kg (median 0.13 mg/kg).

Europe supermarket magazine

- 2011, The German discount supermarket Lidl has recalled a contaminated batch of peppers from its stores in Europe.

- The three – color peppers contain levels of a growth regulator called ethephon residue in excess (found 1.65 mg/kg) of the legal limit (0.05 mg/kg).

Health assessment of ethephon residues in bell peppers

- BfR Opinion Nr. 001/2011, 19 January 2011
- ethephon residues at a concentration of 1.65 mg/kg constitute a possible health hazard for children, but not adult.
- at a concentration of 4 mg/kg constitute an acute health hazard for the whole population
- increased urination and diarrhea

To prevent microbial contamination

Control of insect, disease and microbial contamination

Wearing gloves

Avoid soil contact

Disease control using pesticide in orchid.

Insect control using methyl bromide fumigation in orchid.

Insect & disease control using high CO_2 fumigation in strawberry

Nutritional value

- Most customers care of flavor rather than nutrition.
- Modern customers tend to concern more about healthy/functional food.
- "5 Colors a day" and "Eat the rainbow" campaign is promoted.

"5 Colors a day" / "Eat the Rainbow"

1. Blue/Purple: purple cabbage, Japanese egg plant

- High in vitamin C, folate , anthocyanin, polyphenol (antioxidant)
- Against heart attack, high blood pressure, diabetes, Alzheimer's

2. Green: most vegetables, kale, broccoli, etc.

- High in Phytochemical (lutein, zeaxanthin, indoles), folate, mineral & fiber
- Promote eye vision and against cancer

3.White: onion, garlic, mushroom, cauliflower

- High in allicin & phytonutrients
- Reduce cholesterols and blood pressure, increases immunity and against cancer

"5 Colors a day" / "Eat the Rainbow"

4.Yellow/Orange: carrot, corn, orange

- High in beta-carotene, vitamin C & E, folate, bioflavonoid
- Promote eye vision, bone, teeth and skin health
- increases immunity, prevent cancer and heart attack

5. Red: tomato, beet root, apple, red grape

- High in lycopene & anthocyanin (antioxidant)
- Promote eye vision, against heart attack, high blood pressure, diabetes, Alzheimer's

Kalihi-Palama Health Center

Eat the Rainbow!

Different colored fruits & vegetables are full of nutrients. Eating a variety of these helps your body stay healthy.

zest

Adapted from Healthy Hawaii Initiative's Eat a Rainbow Handout

GREEN





Helps your body...

- Lower your chance of getting cancer
- Keep your eyes healthy
- Keep your bones & teeth strong

You should try:

spinach, green peas, green beans, broccoli, cabbage, bok choy, cucumbers, asparagus, cauliflower, watercress, honeydew, green grapes, green apples, limes, avocados

RED




Helps your body...

- Keep your heart healthy
- Keep your bladder healthy
- Keep your memory strong
- Lower your chance of getting cancer

You should try:

tomatoes, red peppers, red cabbage, strawberries, cherries, watermelon, red onion, red apples

YELLOW & ORANGE



Helps your body...

- Keep your heart healthy
- Keep your eyes healthy
- Lower your chance of getting cancer
- Keep you from catching colds

You should try:

carrots, sweet potatoes, yellow peppers, pumpkins, pineapple, papayas, cantaloupes, tangerines, mangoes, oranges, lemons

BLUE & PURPLE



Helps your body...

- Stay healthy when you get old
- Keep your memory strong
- Keep your bladder healthy
- Lower your chance of getting cancer

You should try:

eggplant, purple cabbage, raisins, blueberries, purple grapes, Okinawan sweet potato (purple potato)

WHITE



Helps your body...

- Keep your heart healthy
- Have good cholesterol levels
- Lower your chance of getting cancer

You should try:

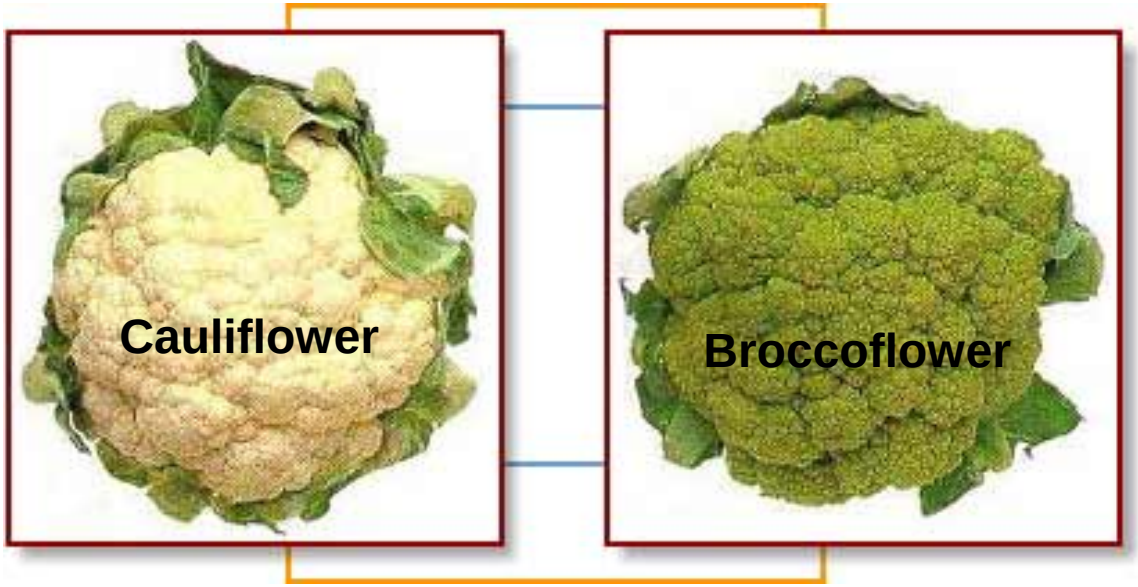
onion, green onion, chives, ginger, mushrooms, jicama

 This material was funded by USDA's Food Stamp Program. The Food Stamp Program provides nutrition assistance to people with low income. It can help you buy nutritious foods for a better diet. To find out more, contact 1-800-352-8401


Eat a Rainbow
How many colours can you eat today?

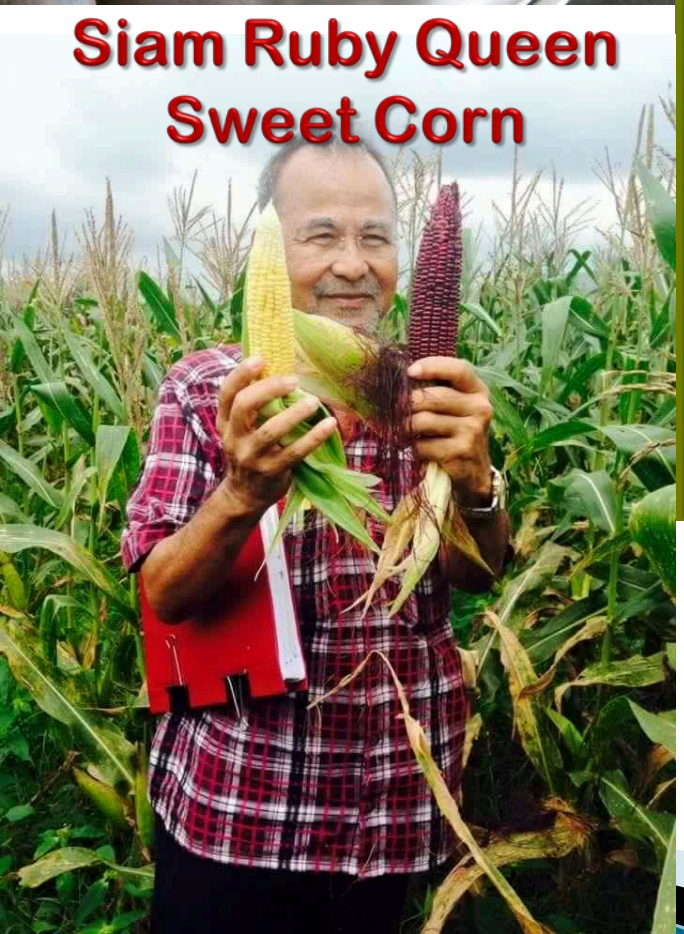

I DONUT CARE ABOUT U


RED
To improve heart & blood health & support joints
ORANGE
To prevent cancer & promote collagen growth
YELLOW
Helps your heart, vision digestion & immune system
GREEN
Powerful detoxers, fight free radicals, improve immune system
BLUE/ PURPLE
Improve mineral absorption, powerful anti-oxidants
WHITE
Activate our natural killer cells & reduce cancer risk

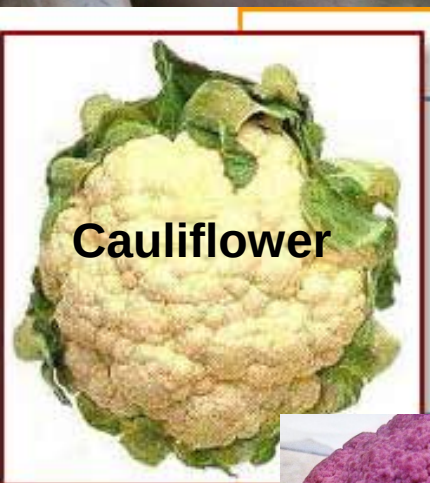

Cauliflower
Broccoflower


9.88€ KG

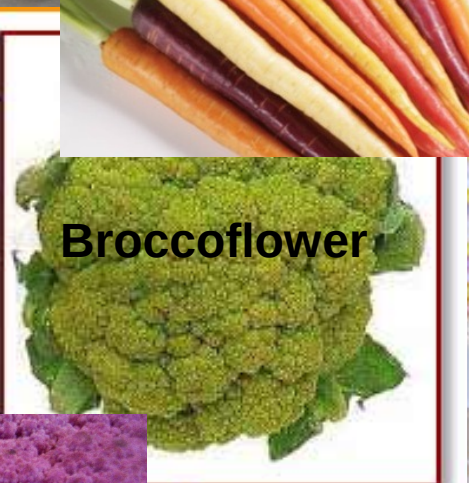

Red Waxy Corn


Siam Ruby Queen
Sweet Corn


Glass Gem Corn



Cauliflower



Broccoflower

Glass Gem Corn

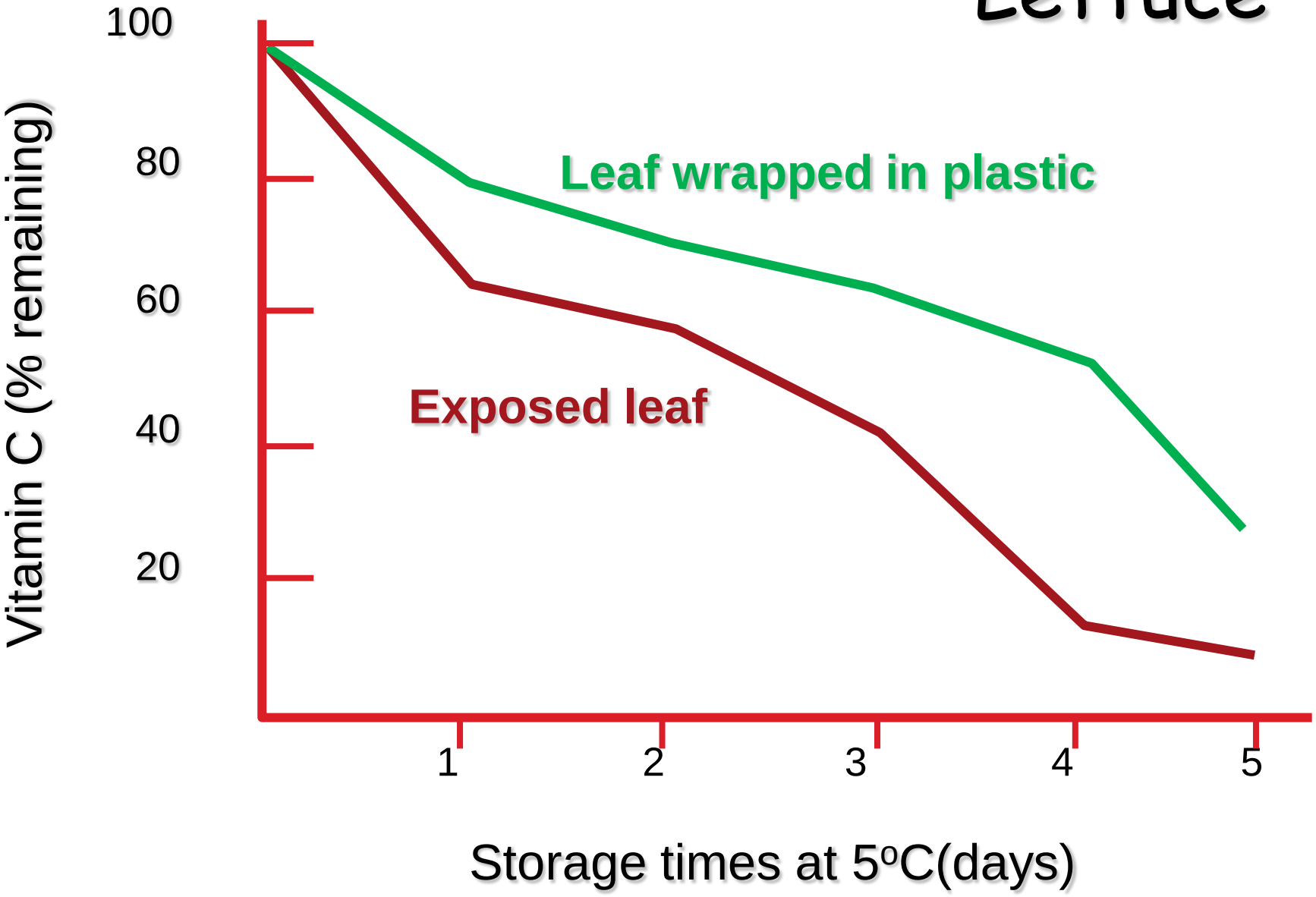
VITAMIN A and C in some vegetables

	Vitamin A (I.U.) / 100 g	Vitamin C mg / 100 g
cabbage	520	31
kale	10,000	186
tomato	900	23
potato	trace	20
sweet potato	8,800	21
onion	40	10

VITAMIN A and C in some fruits

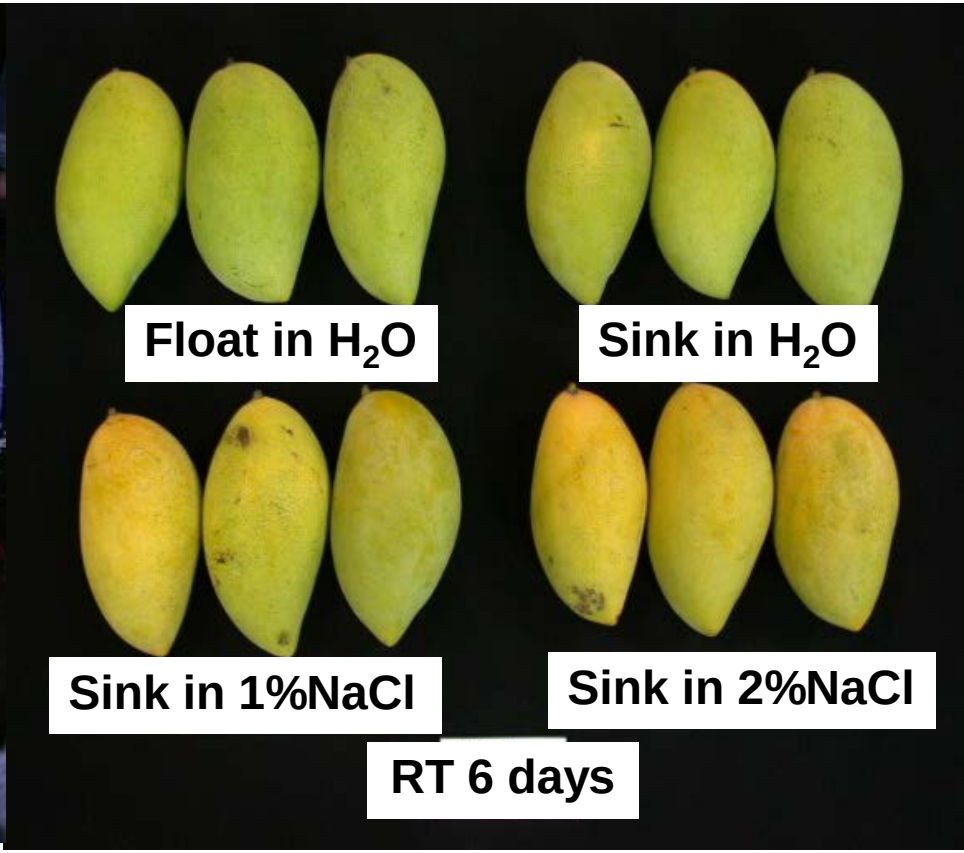
	Vitamin A (I.U.) / 100 g	Vitamin C mg / 100 g
banana	190	10
guava	280	242
mango	4,800	35
papaya	1,750	56
pineapple	4,450	204
(tangerine)orange	420	31
RDA (U.S.)	5,000	60

Lettuce


100
80
60
40
20
Vitamin C (% remaining)
Leaf wrapped in plastic
Exposed leaf
1
2
3
4
5
Storage times at 5°C(days)

Uniformity


2%Salt solution


Float in H_2O
Sink in H_2O
Sink in 1%NaCl
Sink in 2%NaCl
RT 6 days

More information

- http://postharvest.ucdavis.edu/

USDA Standard can be found in

- http://www.ams.usda.gov/AMSv1.0/Standards


Question?
16/10/2012