PEWARNA (COLORANT)

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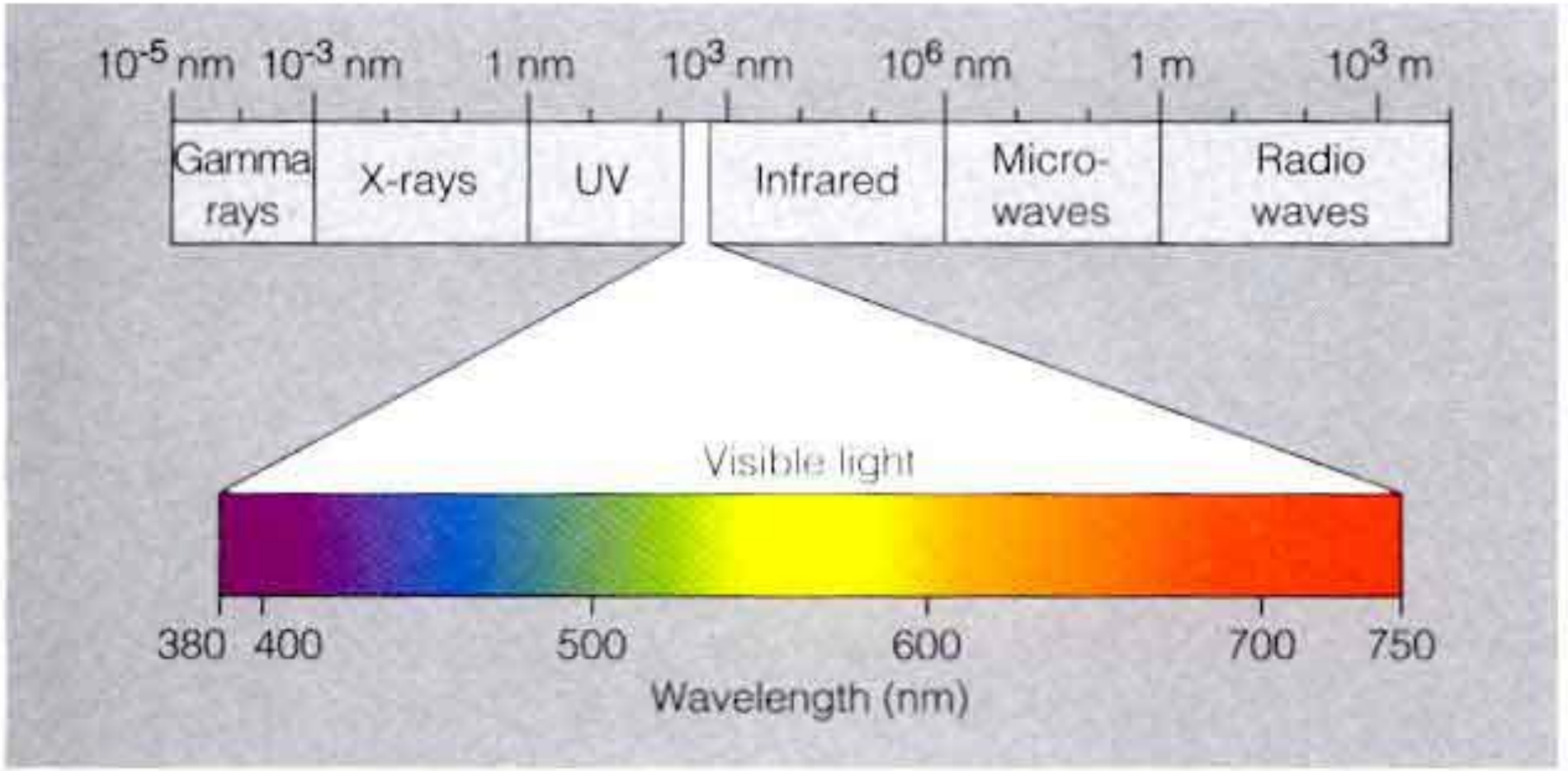
Teknologi Pangan UPGRIS

WHAT CAN A COLOR DO.....?

What is color??

Warna adalah suatu persepsi yang diterima sebagai respon dari suatu sumber cahaya yang memiliki range spectrum elektromagnetik tertentu

Cahaya memiliki panjang gelombang radiasi yang berbeda-beda dan cahaya tampak merupakan komponen penting yang terkait dengan penerimaan warna (memiliki panjang gelombang 380 -750nm)



Gambar : Spektrum elektromagnet. (Sumber : Campbell *et al.* 1999).

Clasification

Bentuk :

- Granula
- Bubuk (powder)
- Pasta
- Cairan
- dispersi

Kelarutan :

- Larut air
- Larut minyak
- Larut dalam solvent tertentu

Sumber :

- natural
- synthetic

The importance of color

Used in most of food :

Image

Nutrition

Quality

Appeal

Taste

Role of Color on Foods

Color is associated with food safety :

- apples must be red or green
- meat should be red, etc

Inappropriate color is associated with spoilage, bad processing, or faulty transportation.

Functions of color

(1) restore the original food appearance

(2) ensure color uniformity

(3) intensify colors normally found in food

(4) obtain the best food appearance

(5) preserve characteristics associated with food

Food color must never be used to
cover up bad processing or manipulation
as strategies in food production.

How To Get The Right Color ?

- Select basic ingredient
- Process selection & control
- Use natural colorant
- Use synthetic colorant
- Don’t forget the packaging

1. Select Basic Ingredient

- Moisture
- Sugar content & types
- Protein
- Acidity
- Indigenous metal
- Indigenous antioxidant

2. Process Selection

- Drying → sundrying or oven drying (vacuum/non vacuum)
- Mixing → manual, mixer, homogenizer,
- Frying → wok frying, deep frying
- Sterilization → retort, high hydrostatic pressure, irradiation

2. Process Control

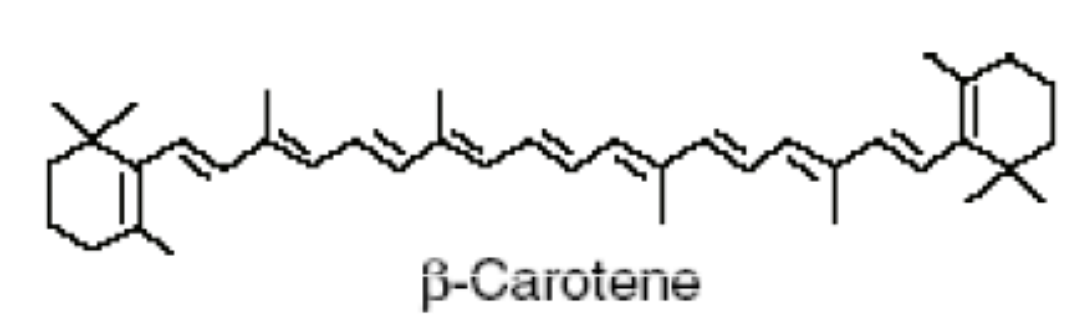
Biscuits :

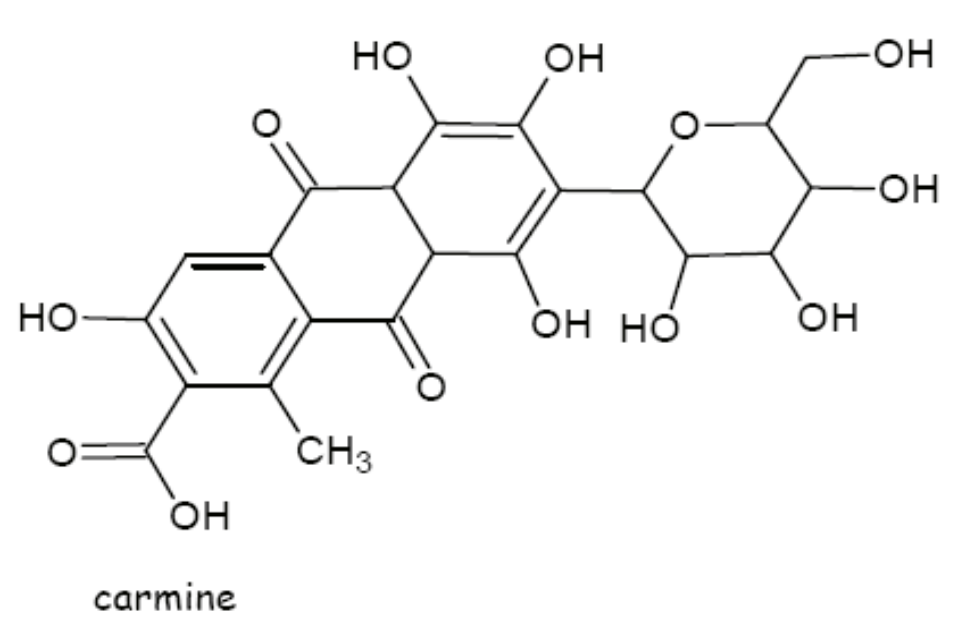
- Temperature
- Baking process, etc

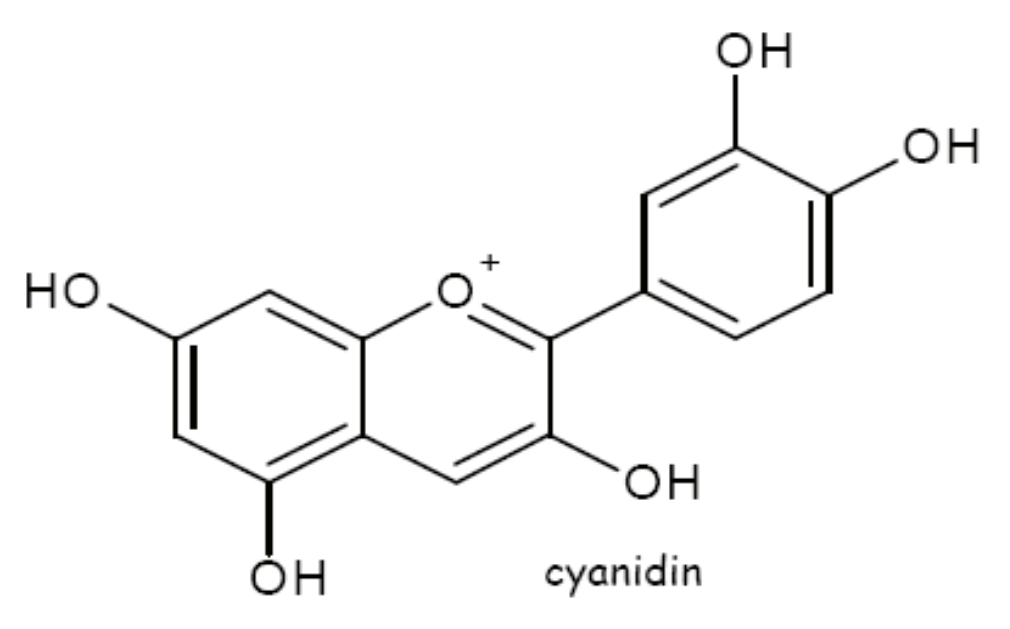
- Trained staff
- Responsible personality
- Equipment callibration

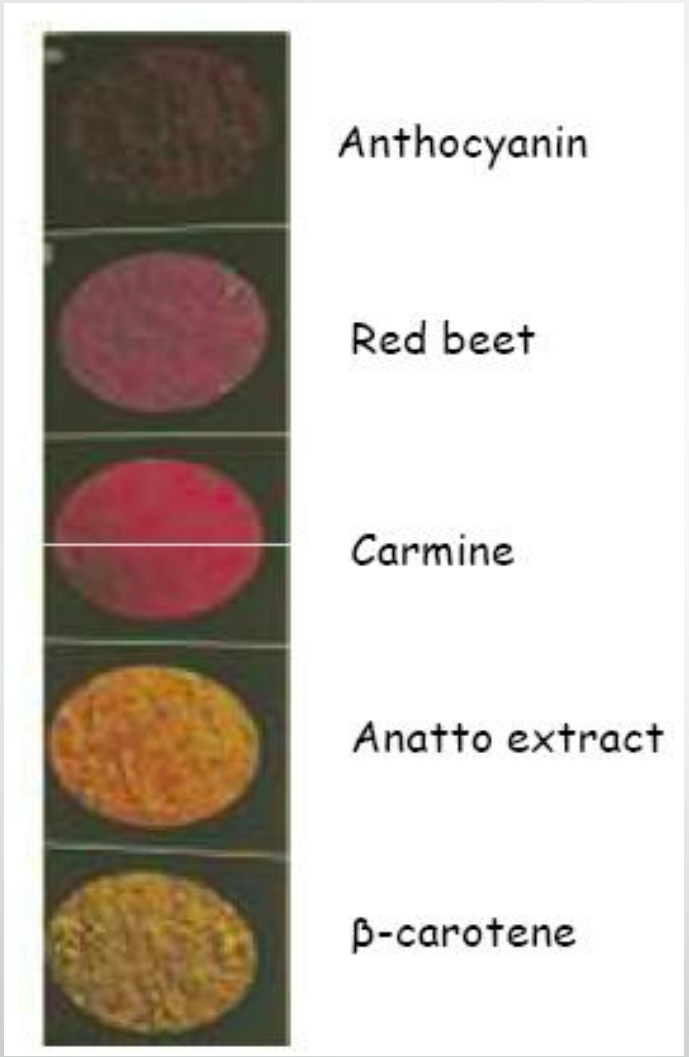
3. Natural Colorant

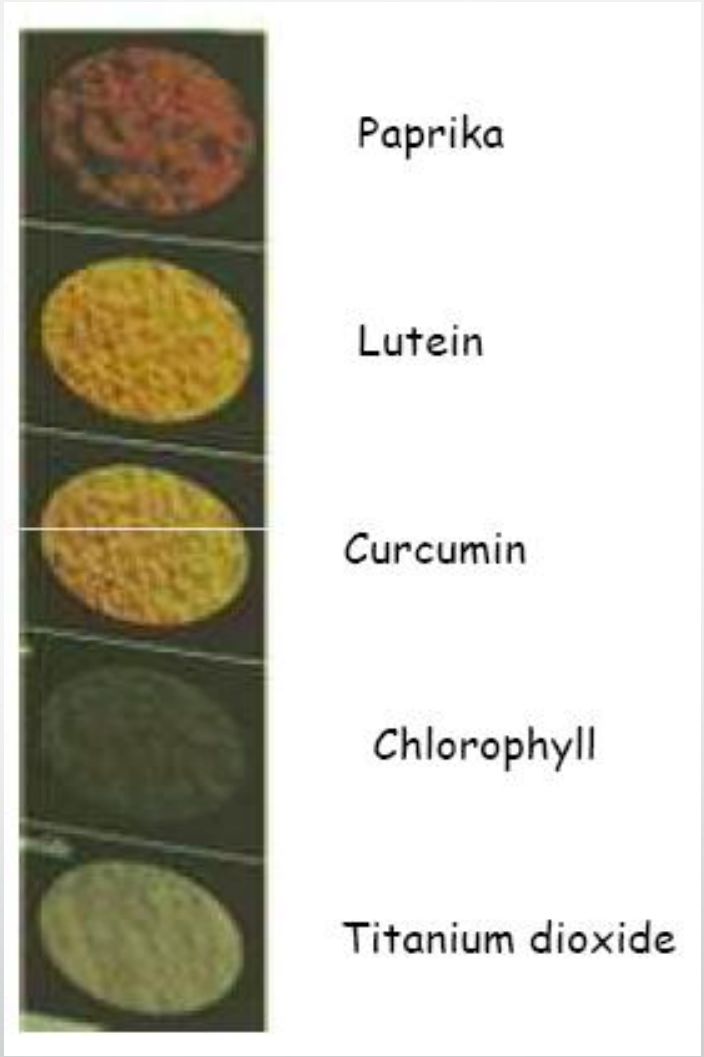
- Some have bioactivity: antiox, anticarsinogenic, supress LDL & VLDL, etc.
- No health concerns
- Produced by extraction or biotech.
- Some are uncompatible toward pH, sunlight,heat.
- Stability can be improved by microencapsulation, add antiox, etc.
- Four groups of natural pigments:
  - **tetrapyrrole compounds** : chlorophylls, hemes, and bilins
  - **isoprenoid derivatives** : carotenoids
  - **benzopyran derivatives** : anthocyanins and flavonoids
  - **Artefacts** : melanoidins, caramels


β-Carotene


HO
OH
OH
O
O
OH
HO
OH
HO
OH
O
O
CH3
OH
carmine


OH
OH
HO
O+
OH
OH
cyanidin


Anthocyanin
Red beet
Carmine
Anatto extract
β-carotene


Paprika
Lutein
Curcumin
Chlorophyll
Titanium dioxide

Method of obtaining natural color

Plant tissue

↓ Grinding/ Blending

Homogenized tissue

↓ Extraction

↓ Filtration/ Centrifugation

Extract

Sumber pewarna alami

- **Sayur** : bit, wortel, wortel hitam, seledri, dll
- **Buah** : strawberry, anggur, tomat, blueberry, dll
- **Hewan** : kuning telur, udang, kerang, dll
- **Biji** : beras merah, beras coklat, beras hitam, jagung, kacang hitam,
- **Daun** : daun pandan, daun suji
- **Bumbu** : cabe, lada, kunyit, dll

Alga merah dan hijau

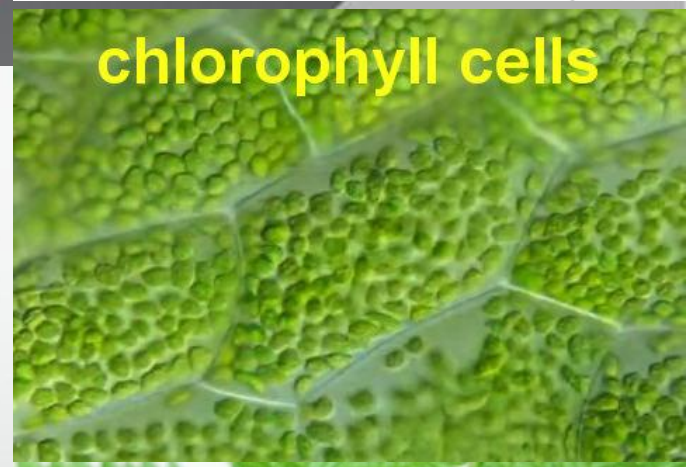
Chlorophyll

- Merupakan pigmen Hijau yang berperan dalam proses fotosintesis tanaman
- Mempunyai 2 jenis : klorofil a dan b
- Kestabilan :

  Panas : buruk

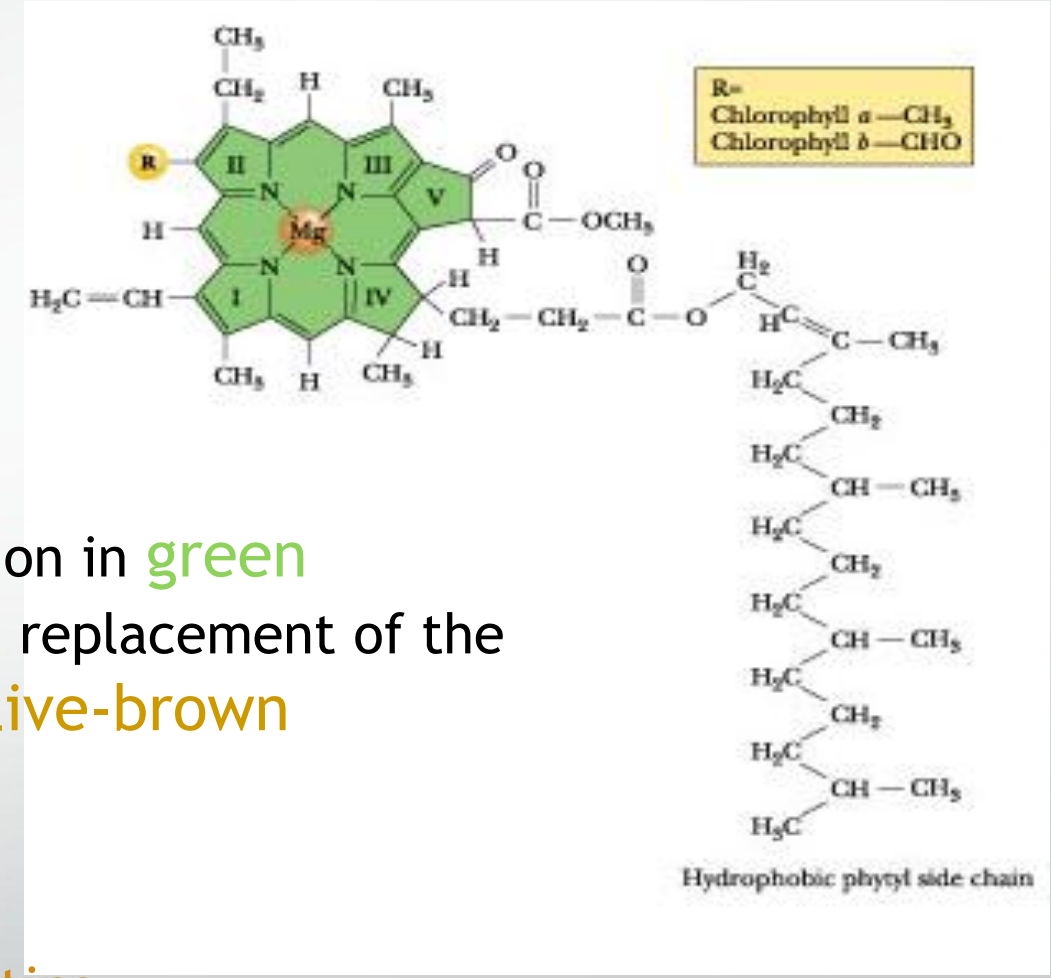
  Cahaya : buruk

  Asam : buruk
- Bentuk : bubuk & cairan
- Kelarutan : alcohol, ether, benzene & acetone, sedikit larut dalam petroleum ether, sulit larut dalam air



Chemical properties

In food processing, the most common alteration in green chlorophylls → PHEOPHYTINIZATION; the replacement of the central Mg by the hydrogen → form a dull olive-brown pheophytins.



Chlorophylls —(- Mg ↓)→ pheophytins

- Atom Mg pada klorofil mudah digantikan dengan 2 atom H, yang menghasilkan senyawa pheophytins.
- Pembentukan pheophytins pada klorofil a terjadi lebih cepat dibandingkan dengan klorofil b.
- Penambahan garam klorida dapat meminimalisasi reaksi feofitinisasi.
- Garam → electrostatic shielding effect ; penambahan kation akan menetralisasi muatan negative protein dan asam lemak yang terdapat pada permukaan membran kloroplas, sehingga mereduksi reaksi pengikatan hidrogen

Method of preserving chlorophyll

- **pH control** → In pH 9, chlorophyll is very stable toward heat, whereas in pH 3 it is unstable
- **use of salts** → electrostatic shielding effect
- control of the **thermal treatment** → The activity of enzyme chlorophyllase decreases when plant tissue is heated above 80°C, and it loses its activity if heated to 100°C
- use of **modified atmospheres** → Singlet oxygen and hydroxyl radicals are known to be produced during exposure of chlorophylls to light in the presence of oxygen
- their combinations

Anthocyanin

- A group of reddish water-soluble pigments in plants which exist in the cell sap/juice, i.e. flowers, fruits, vegetables,
- An anthocyanin pigment is composed of an aglycone (an anthocyanidin) esterified to 1 or more sugars. Only 5 type of sugars found in it, which are, in order of relative abundance : glucose, rhamnose, galactose, xylose, arabinose

Anthocyanin

Stability in Food

• Anthocyanins show a marked change in color with changed in pH → the higher the pH → the faster the rate of destruction

Chemical Reactions

• The addition of sulfite, sulfite oxide → rapid bleaching of the anthocyanins → yellowish colors.

i.e. in the making of jams, preserves such as dried fruits & vegetables

Betalain

- Plants containing betalaines have colors similar to plants containing anthocyanins.
- The presence of betalaines in plants is mutually exclusive of the occurrence of anthocyanins.
- They consist of **red-violet** betacyanins (λ_{max} ~540 nm) and yellow betaxanthins (λ_{max} ~480 nm).
- Their color is not affected by pH, contrary to the behavior of anthocyanins.

Beet

- Orange kemerahan – ungu kemerahan
- pH range 4.0 – 9.0
- Kestabilan :
  - Panas : cukup
  - Cahaya : cukup
  - Asam : kurang
- Bentuk : bubuk & cairan
- Kelarutan : air, etanol, propilen glikol

Saffron

- Spice and natural colorant
- Crocus sativa
- Termasuk bumbu yang cukup mahal harganya
- Berwarna kemerahan hingga ke warna kuning
- Warna ini didapatkan dari degradasi karotenoid (crocin dan crocetin)
- Biasanya digunakan di makanan yang dipanggang, sup, permen, dll

Annato

- kuning – orange
- pH range 2.0 -14.0
- Kestabilan :

  Panas : sangat bagus

  Cahaya : bagus

  Asam : cukup
- Bentuk : bubuk & cairan
- Kelarutan : oil soluble (bixin) and water soluble (norbixin)
- Penggunaan : confectionary, keju, bakery, sereal, dll

Karotenoid

- Kuning – orange
- pH range 2.0 – 14.0
- Kestabilan :
  - Panas : bagus
  - Cahaya : bagus
  - Asam : bagus
- Bentuk : bubuk & cairan
- Kelarutan : lebih mudah larut dalam minyak
- Provitamin A dan antioksidan
- Penggunaan : margarin, butter, minyak goreng, keju, es krim, yoghurt

- Most of produced carotenoids in nature is in form of fucoxanthin in various algae, in green leaves : lutein, violaxanthin, neoxanthin; ß-carotene; lycopene in tomatoes; capxanthin in red peppers

Provitamin A

• Beta carotene is precursor of vitamin A, which yields 2 molecules of vitamin A by cleavage at the center of the molecule.

• Alpha carotene is precursor of one molecule of vitamin A; which is half identical to beta carotene.

Oxidation reaction

• Stability of carotenoids depend on whether the pigment is in vivo or in vitro in environmental condition, i.e. lycopene in tomatoes is quite stable, but the extracted purified pigment is unstable.

• Enzyme degraded carotenoids rapidly, i.e. lypoxygenase.

• In processed food → heat, light, presence of pro- and antioxidant influence carotenoids degradation.

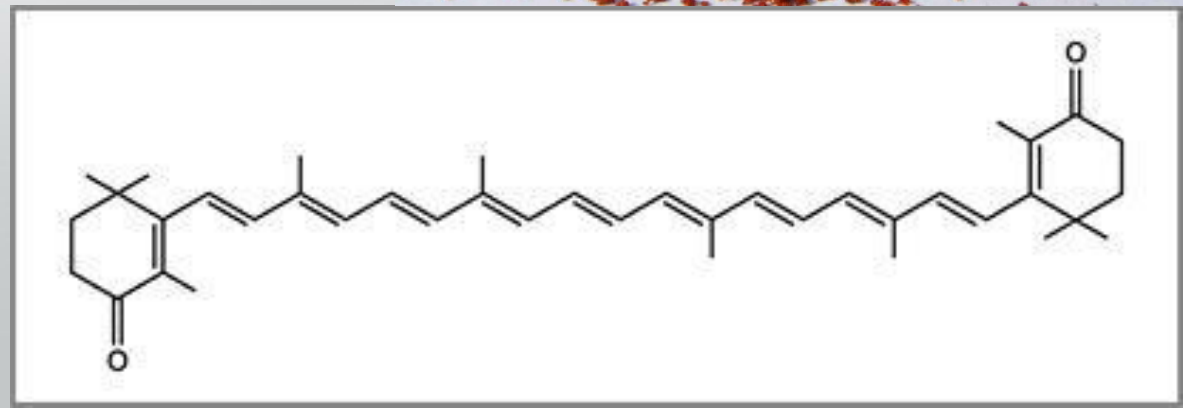
Canthaxanthin

- Orange kemerahan
- pH range 2.0 – 14.0
- Kestabilan :

  Panas : bagus

  Cahaya : bagus

  Asam : bagus
- Bentuk : bubuk & cairan
- Kelarutan : air, etanol, propilen glikol
- Sumber ; bioalga, crustacea



Carmine

- pH 3 : orange – merah/ungu
- pH 4 & 7 : merah/ungu
- Kestabilan :
  - Panas : sangat bagus
  - Cahaya : sangat bagus
  - Asam : kurang stabil
- Bentuk : bubuk & cairan
- Kelarutan : terdispersi di air
- Sumber : jenis serangga tertentu (cochineal dan *Porphyrophora*

Kubis ungu

- Biru – merah
- Kestabilan :

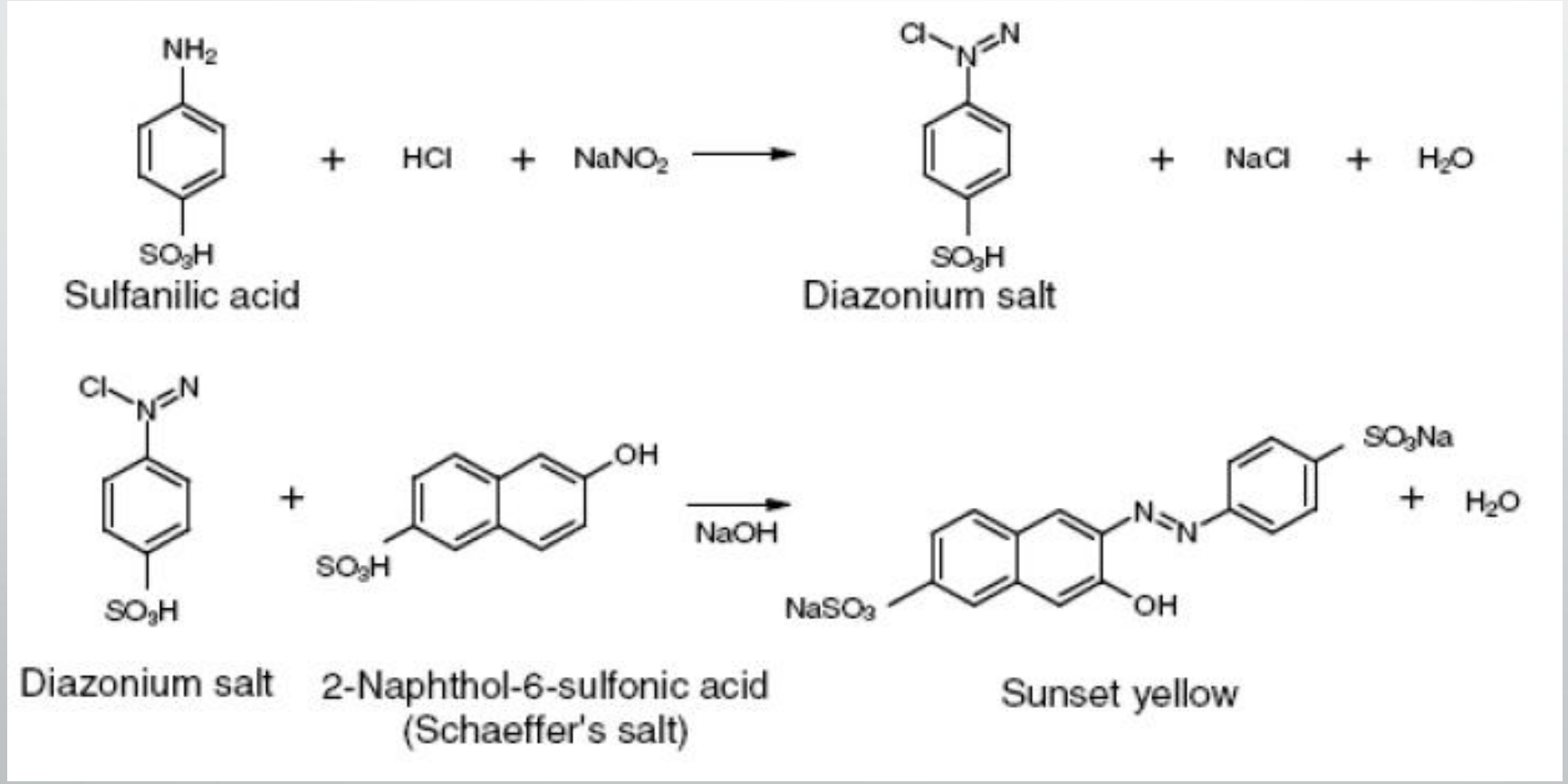
  Panas : bagus

  Cahaya : bagus

  Asam : bagus
- Bentuk : bubuk & cairan
- Penggunaan : permen, eskrim

Pewarna sintetis

- Organic reactions, such as nitration, sulfonation, halogenation, etc.
- Should be controlled carefully.



Pewarna sintetis

Nama	Warna
• Tartrazin	Kuning
• Sunset yellow FCF	Orange
• Allura Red AC	Merah (kekuningan)
• Ponceau 4R	Merah
• Red 2G	Merah
• Azorubine	Merah
• Amaranth	Merah (kebiruan)
• Briliant Black BN	Ungu
• Brown FK	Kuning coklat
• Briliant Blue FCF	Biru
• Green S	Biru Kehijauan
• Quinoline Yellow	Kuning kehijauan
• Erythrosine	Merah
• Indigotine	Biru kemerahan


Quinolline yellow
Tartrazine
Sunset yellow FCF
Erythrosine
Ponceau 4R
Allura Red
Carmoisine
Brown HT
Brilliant Blue FCF
Indigotine
Green S

Pewarna sintetis

Common Name	Color Index No.	EEC No.	Countries permitting
Allura red AC	16035	E129	Canada, US
Brilliant blue FCF	42090	E133	Can, EEC, Jpn, US
Erythrosine	45430	E127	Can, EEC, Jpn, US
Fast green FCF	42053	-	US
Indigotine	73015	E132	Can, EEC, Japan, US
Sunset yellow FCF	15985	E110	EEC, US
Tartrazine	19140	E102	Can, EEC, Jpn, US
Amaranth	16185	E123	Canada, EEC
Brilliant black BN	28440	E151	EEC
Brown FK	-	E154	EEC

Pewarna sintetis yang dilarang

- Citrus Red no.2
- Ponceau 3 R
- Rhodamine B
- Magenta
- Sudan I
- Methanil Yellow
- Auramine
- Oil Orange SS
- Oil Orange XO
- Oil Yellow AB
- Oil Yellow OB
- Guinea Green B
- Butter Yellow
- Chrysoidine

Warna yang terbentuk dari Proses Pengolahan

- Fermentasi : angkak, keju, teh, kopi, kakao
- Pemanasan : karamelisasi, maillard
- Pengemasan : daun pisang

Caramel

- Source:
  - Reaction products of carbohydrates during heating
  - Usually ammonium and sulfate are added
    - Negatively charged
    - Positively charged

- Stability
  - Light: very stable
  - Heat: very stable
  - Acid: use acid stable type

- Application:
  - Beverages
  - Bakery
  - Confectionery
  - Snacks, etc