Quality Assessment of Fresh and Dried Tropical Fruits

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Introduction to Department of Food Technology, Silpakorn University and my Expertise

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CONTENT I : Quality Assessment of Fresh and Dried Tropical Fruits

FOOD QUALITY ASSESSMENT

In General

QUALITY ASSESSMENT of FRESH MANGO

Physical properties

Chemical properties

Bioactive compound:

β-carotene

QUALITY ASSESSMENT of FRESH PAPAYA

Bioactive compound:

Lycopene

QUALITY ASSESSMENT of DRIED TROPICAL FRUITS

Production of dried tropical fruits

Quality assessment of dried tropical fruits

Banana

Mango leather

Osmotic dehydrated papaya

Osmotic dehydrated mango

CONTENT II : Dried “Thai Herb Tea” using a Solar Dryer

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Solar Dryer

Greenhouse Solar Dryer

call in Thailand

“Parabolar Dom”

PROCESSING of “Thai Herb Tea”

Lemongrass Tea

Bael Fruit Tea

Mixed Herbs Tea (Thai Tom yum tea)

Sensory Evaluation of

Thai Lemongrass Tea + Roselle

Ginger tea

Bael fruit tea

Thai Tom yum herbs tea

Food Quality Assessment:

In General

- Physical properties: size, shape, color, texture
- Chemical properties: starch, sugar, acids, pH, volatile compounds
- Microbiological properties: Bacteria, Yeast, Mold, Pathogenic microorganism (Salmonella, Clostridium, E. Coli)
- Nutrients: Carbohydrate, Protein, Fat, Dietary Fiber, Vitamins, Minerals etc.
- Functional properties:
  - Bioactive compounds
  - Antioxidant Capacity
- Sensory Evaluation

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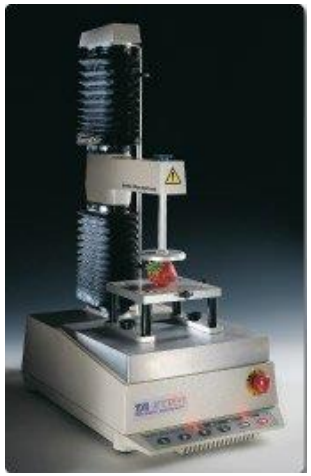
- Physical analyses
  - Specific gravity
  - Weight per fruit
  - Size (Length, Width, Diameter)
  - Peel color (Take a Picture or L*a*b* Hunter Lab)
  - Flesh color (Take a Picture or L*a*b* Hunter Lab)
  - Firmness, F



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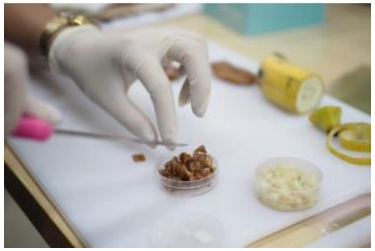
- Chemical analyses

  - Total soluble solids, TSS
  - Titratable acidity, TA
  - pH value
  - Sugar-acid ratio, TSS/TA
  - Glucose, fructose and sucrose contents
  - Individual organic acid content: citric, malic, tartaric acid etc.
  - Starch content
  - Phenolic contents, TPC
  - Volatile compounds
  - Moisture content, MC
  - Water activity, Aw



Quality Assessment of Fresh Tropical Fruits

- Functional Properties
  - Bioactive compounds
  - Antioxidant capacity

Carotenoids content, Anthocyanins content, Total phenolic content

Mango

Papaya

Rosella

Osmotic dehydrated fruits

Dried Tomato

Mulberry

Quality Assessment of Fresh Mango

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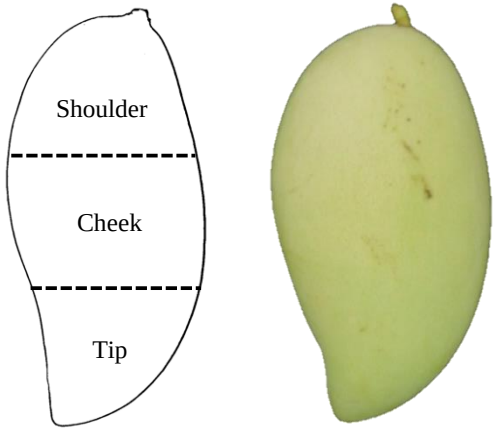
Physical Properties

Specific gravity of green mangoes is tested by immersing the fruits in water. The sinkers with a specific gravity exceeding 1 kg/dm^3 are matured for optimum ripening process.

Quality Assessment of Fresh Mango

Physical Properties



Size and Shape
Weight per fruit

Quality Assessment of Fresh Mango

Physical Properties

Mango Grading by fruit weight (size)

Quality Assessment of Fresh Mango

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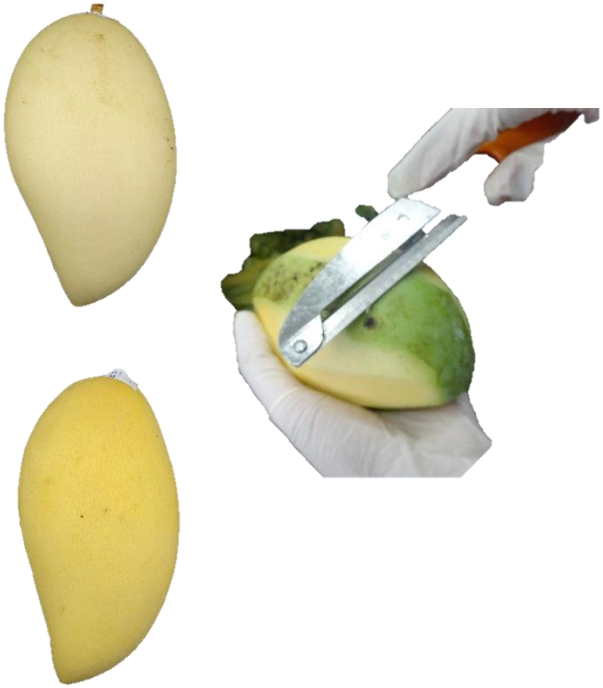
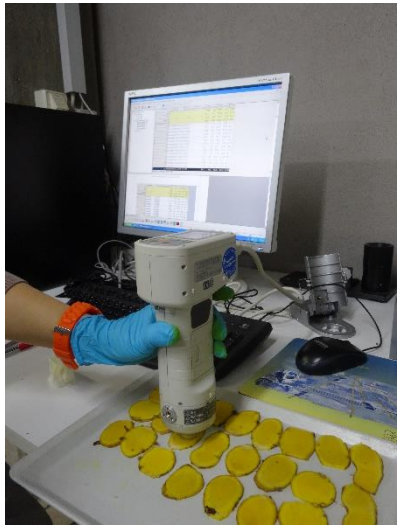
Physical Properties



Peel color

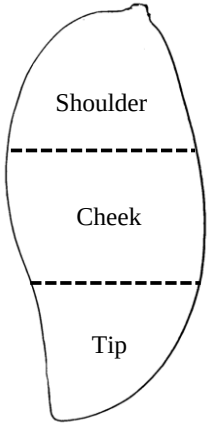
Flesh color

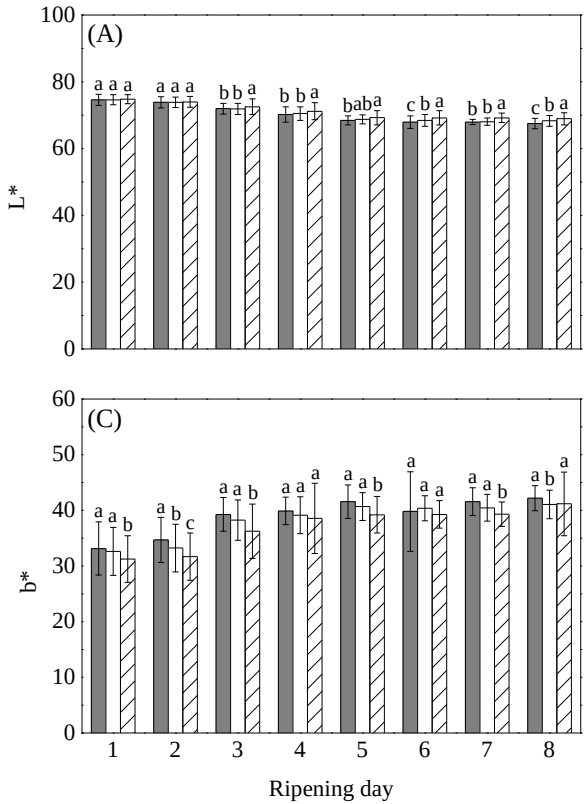


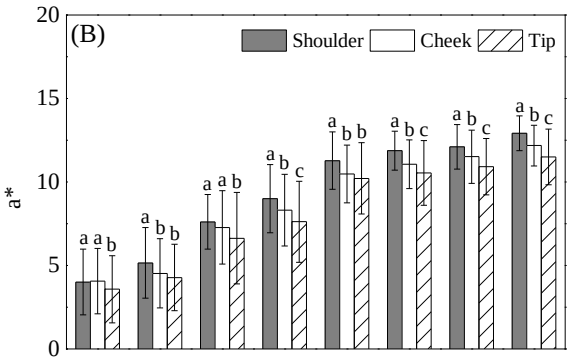
CIE L* a* b* values (L* for lightness, a* for redness and b* for yellowness)

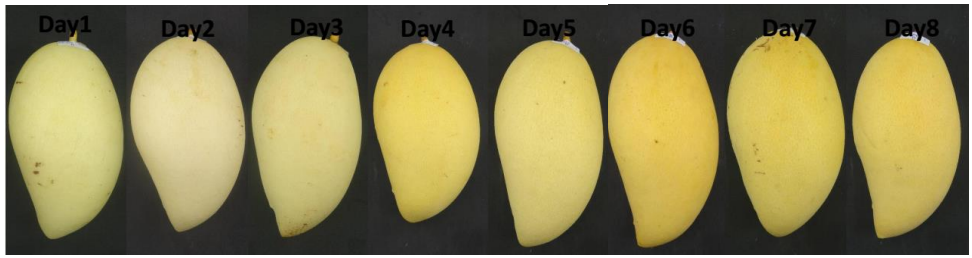
Quality Assessment of Fresh Mango

Physical Properties









D1 D2 D3 D4 D5 D6 D7 D8

Peel Color of Mango cv. Golden Nam DokMai during Ripening

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Physical Properties

sweet

Sweet &Sour

Peel Color of Mango cv. Golden Nam DokMai used as Criteria for Ripeness Recommendation

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Chemical Properties

- Total soluble solids (TSS) by digital refractometer
- Titratable acidity (TA) by sodium hydroxide (NaOH) titration
- pH value by pH meter
- Sugar-acid ratio (TSS/TA)

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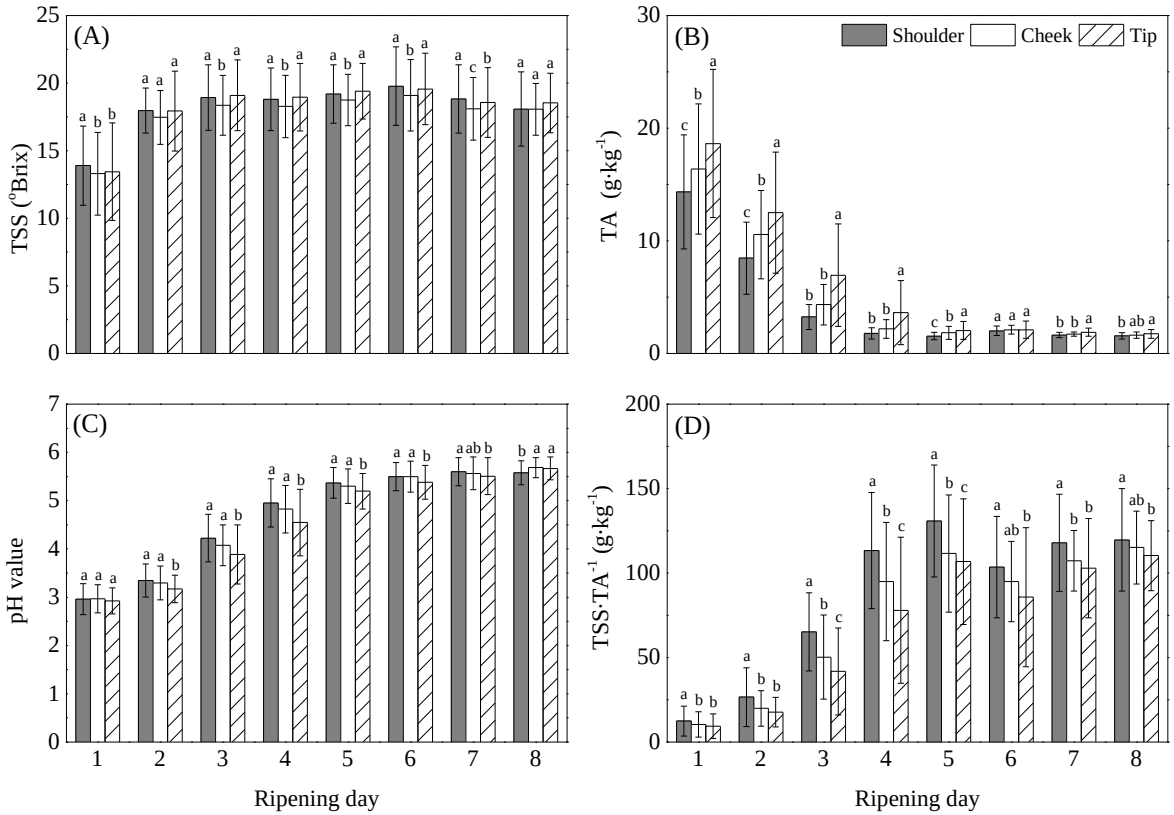
Chemical Properties



TSS, TA, pH and TSS/TA of Mango cv. Golden Nam DokMai during Ripening

Source: Rungpichayapichet et al.

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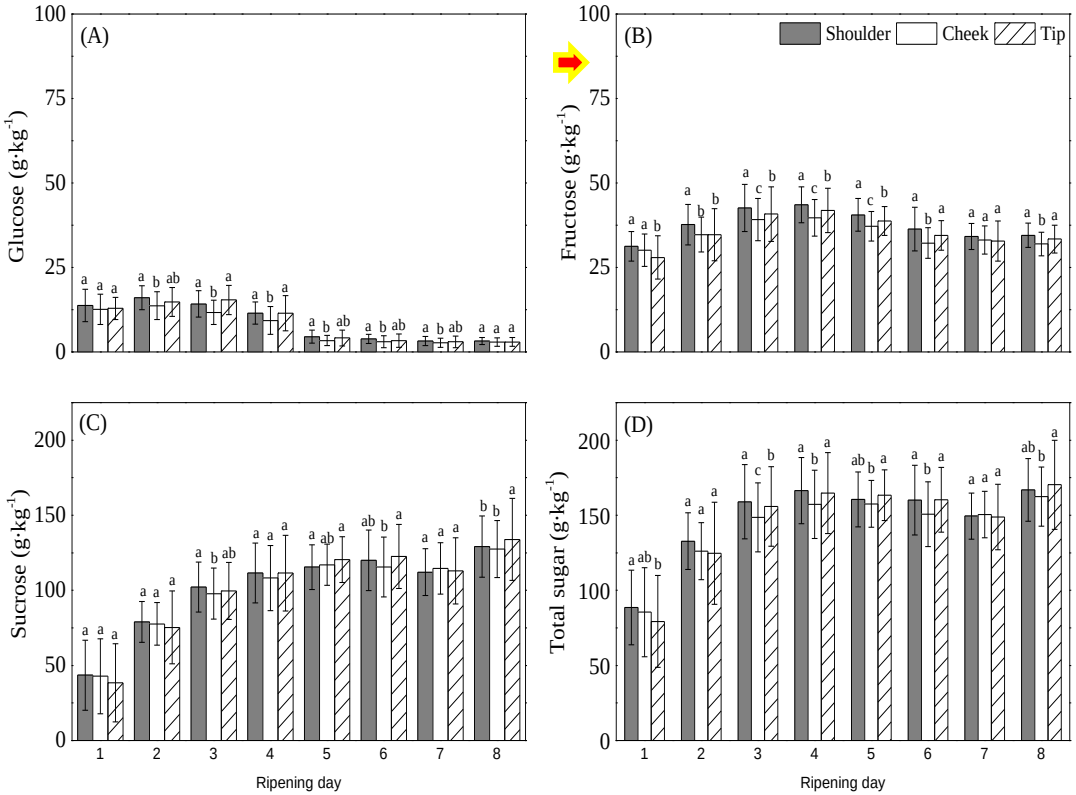
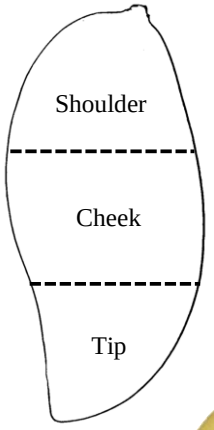
Individual Sugar





Glucose, Fructose, Sucrose of Mango cv. Golden Nam DokMai during Ripening

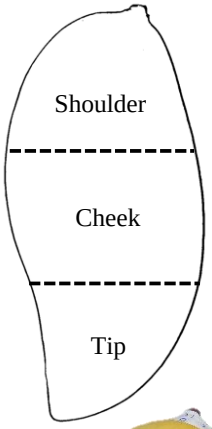
Source: Rungpichayapichet et al.

Quality Assessment of Fresh Mango

Individual sugars analysis

- Extraction

Each homogenized sample (2 g) was mixed with 8 mL of distilled water. The mixture was centrifuged at 9000 rpm during 15 min at 4 ºC. The supernatant was filtrated through 0.45 µm nylon syringe filter and kept at -18° for further HPLC analysis.



Source: Rungpichayapichet et al.

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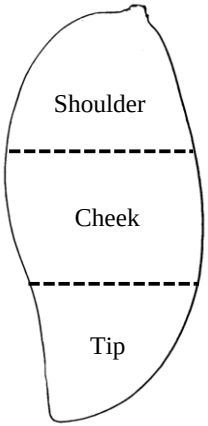
Individual sugars analysis



- Glucose, Fructose and Sucrose determination using a High Performance Liquid Chromatrography (HPLC)
  - Mobile phase: deionized water
  - The HPLC system consists of a LC20AD pump, a CTO-10Asvp column oven, a CBM-20A system controller, and a refractive index detector (RDI-10A, Shimadzu, Kyoto, Japan). Quantification using certified standards (Sigma Aldrich)

Source: Rungpichayapichet et al.

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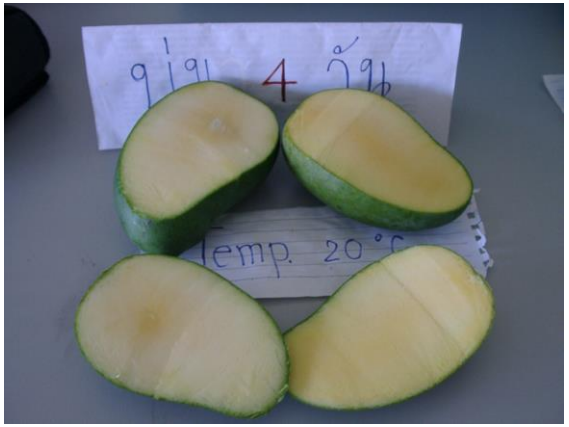
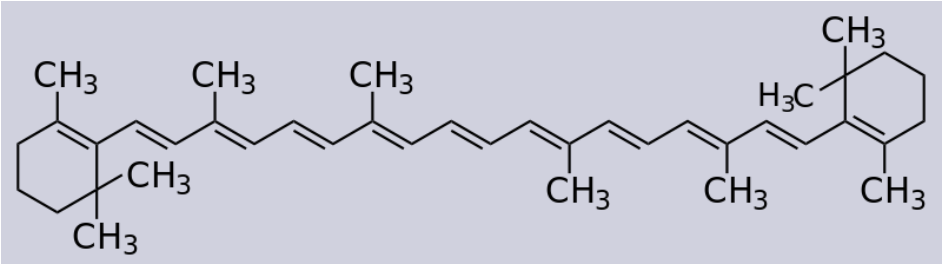
Determination of Bioactive Compounds

β-carotene content (Pro-vitamin A or Vitamin A precursor)





Source: Rungpichayapichet et al. 2015

Quality Assessment of Mango

Bioactive Compounds

β-carotene content

Cultivars	Carotenoids	Contents	Reference
Tommy atkin	Total carotenoids	1400 µg/100g FW	Sogi et al., 2012
Irwin	β-carotene	3700 µg/100g FW	Liu et al., 2013
Keitt	β-carotene	6100 µg/100g FW	Liu et al., 2013
Kaew	All trans β-carotene	8200 µg/100g DW	Vásquez-caicedo et al., 2005
Nam Dokmai#4	All trans β-carotene	11000 µg/100g DW	Vásquez-caicedo et al., 2005

Quality Assessment of Fresh Mango

β-carotene analysis

- Extraction
  - Using methanol and mixture of acetone and hexane as solvent extraction
  - Acetone was removed by washing with water and sodium sulfate was added to remove water
  - Hexane was evaporated at 25°C 150 mbar
  - Extract were dissolved in isopropanol

Source: Rungpichayapichet et al. 2015

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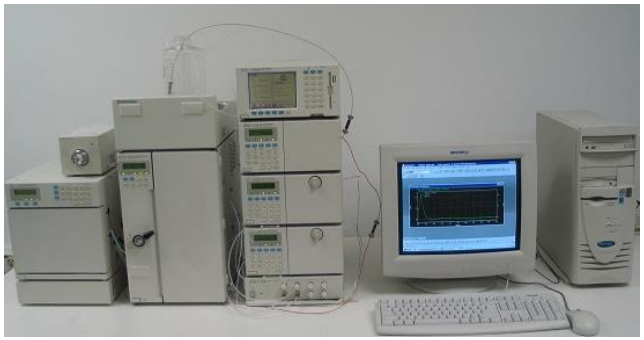
β-carotene analysis

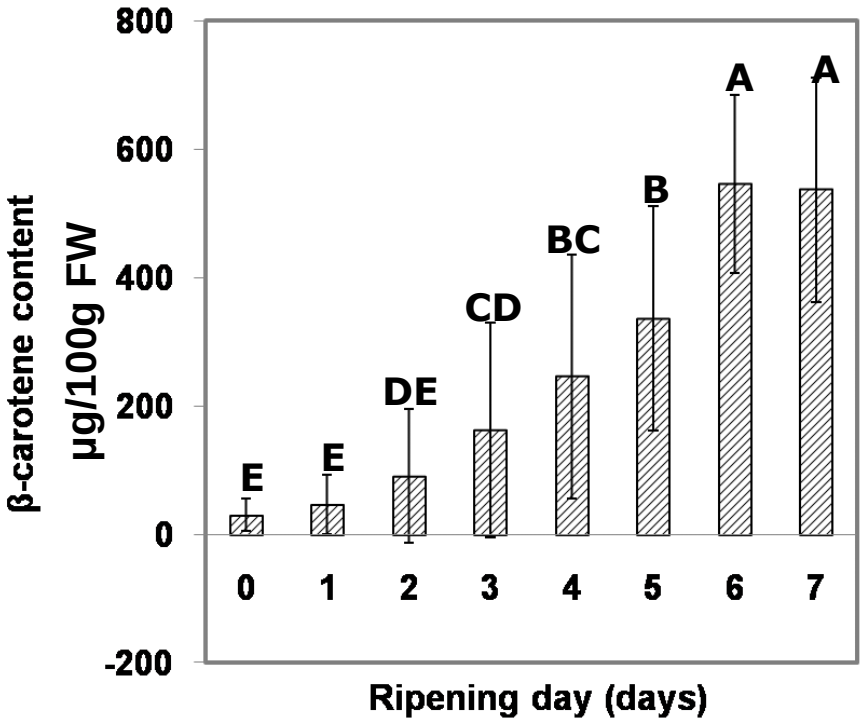
- β-carotene determination
  - Shimadzu HPLC system, UV-VIS detector set at 450 nm
  - Column C_{18}
  - Mobile phase: methanol:acetronitrile (70:30)



Source: Rungpichayapichet et al. 2015

Quality Assessment of Fresh Mango

β-carotene content of Mango cv. Golden Nam DokMai during ripening



Source: Rungpichayapichet et al.

Quality Assessment of Fresh Papaya

Determination of Bioactive Compounds

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Lycopene content

Lycopene

Source: Udomkun et al. 2014

Quality Assessment of Fresh Papaya

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Lycopene analysis

- Extraction
  - Sample was homogenized.
  - Using mixture of ethyl acetate and light petroleum (1:1, v/v) as solvent extraction
  - Solvent was evaporated at 25°C using rotary evaporator
  - Extract were dissolved in acetonitrile and tetrahydrofuran (THF) (4:1, v/v)

Source: Udomkun et al. 2014

Quality Assessment of Fresh Papaya

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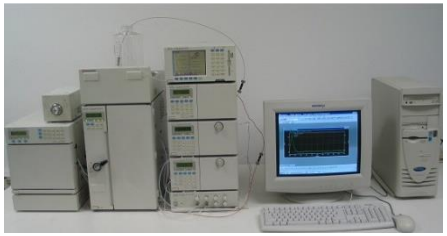
Lycopene analysis

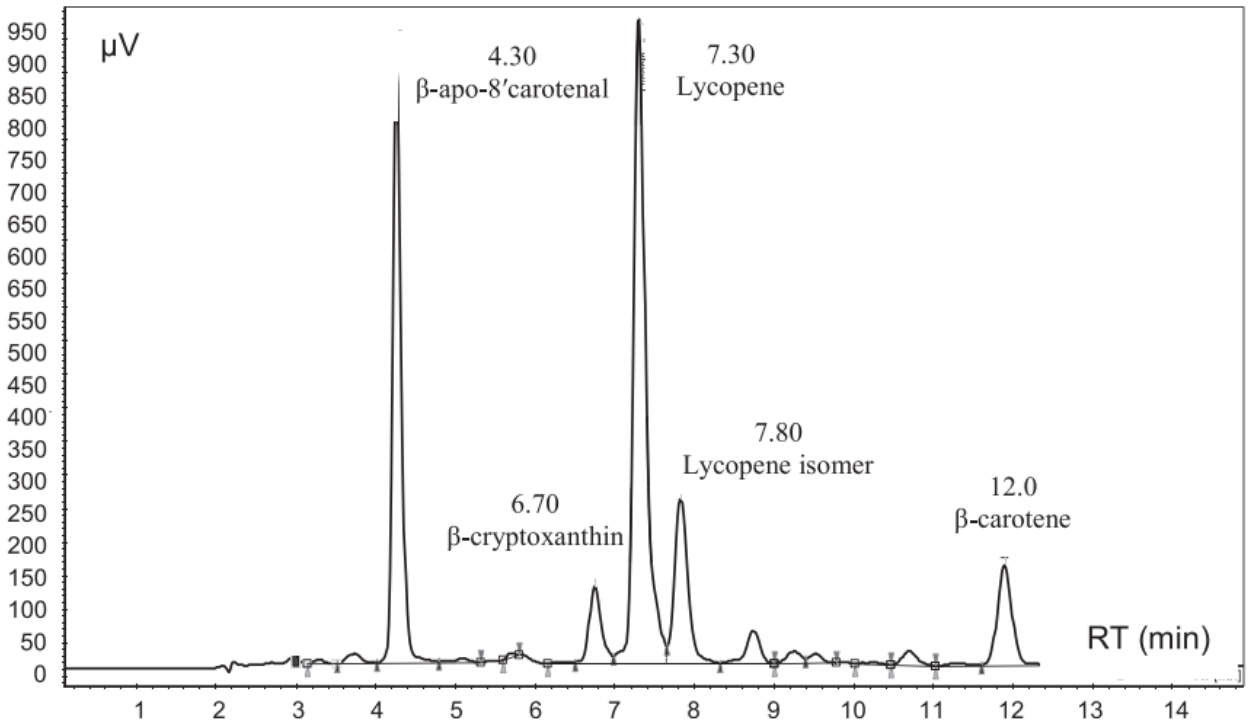
- Lycopene determination using a High Performance Liquid Chromatrography (HPLC)
  - Shimadzu HPLC system, UV-VIS detector set at 450 nm
  - Column C_{18}
  - Mobile phase: acetonitrile, THF and methanol with 0.1 mol/L ammonium acetate (82:15:3, v/v).



Source: Udomkun et al. 2014

Quality Assessment of Papaya

HPLC Chromatogram



PRODUCTION OF DRIED WHOLE BANANA

- Processing steps

Raw materials selection
- optimum variety
- optimum maturity

Ripening

PRODUCTION OF DRIED WHOLE BANANA

- Processing steps

Analysis of TSS of raw materials

Peeling

Drying

PRODUCTION OF DRIED WHOLE BANANA

- Processing steps

Drying using a tray dryer

PRODUCTION OF DRIED WHOLE BANANA

- Processing steps

Drying using a greenhouse solar dryer

PRODUCTION OF DRIED WHOLE BANANA

- Processing steps

Packing

PRODUCTION OF DRIED WHOLE BANANA

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- Processing steps

Labeling

Dried Product: water activity, moisture content, microbiological test

PRODUCTION OF MANGO LEATHER

- Processing steps

Analysis of TSS, TA, pH of raw materials

Raw materials selection
- optimum variety
- optimum maturity

Ripening

PRODUCTION OF MANGO LEATHER

- Processing steps

Peeling

PRODUCTION OF MANGO LEATHER

Analysis of TSS, TA, pH of raw materials

- Processing steps

overripe mango

sliced mango

blanching

mashing

after mashing

PRODUCTION OF MANGO LEATHER

- Processing steps

Boiling/ Evaporation/ Mixing

PRODUCTION OF MANGO LEATHER

Analysis of TSS

- Processing steps

Boiling/ Evaporation/ Mixing

Concentrated mango puree

PRODUCTION OF MANGO LEATHER

- Processing steps

Sun Drying

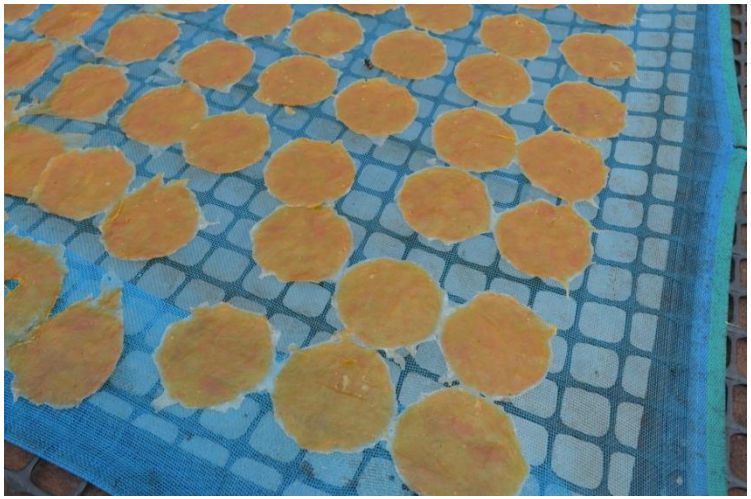
PRODUCTION OF MANGO LEATHER

- Processing steps

Solar Drying

PRODUCTION OF MANGO LEATHER

- Processing steps



Mango Leather

Dried Product: water activity, moisture content, microbiological test

PRODUCTION OF OSMOTIC DEHYDRATED PAPAYA

Analysis of TSS, TA, pH, texture of raw materials

- Processing steps

Raw materials selection
- optimum variety
- optimum maturity

Ripening

PRODUCTION OF OSMOTIC DEHYDRATED PAPAYA

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- Processing steps

Washing/ Peeling

Cutting/ Deseeding

PRODUCTION OF OSMOTIC DEHYDRATED PAPAYA

- Processing steps

Cutting in cube

Dipping in mixed solution of calcium chloride and malic acid

PRODUCTION OF OSMOTIC DEHYDRATED PAPAYA

- Processing steps

Blanching

Dipping in mixed solution of sugar and malic acid

PRODUCTION OF OSMOTIC DEHYDRATED PAPAYA

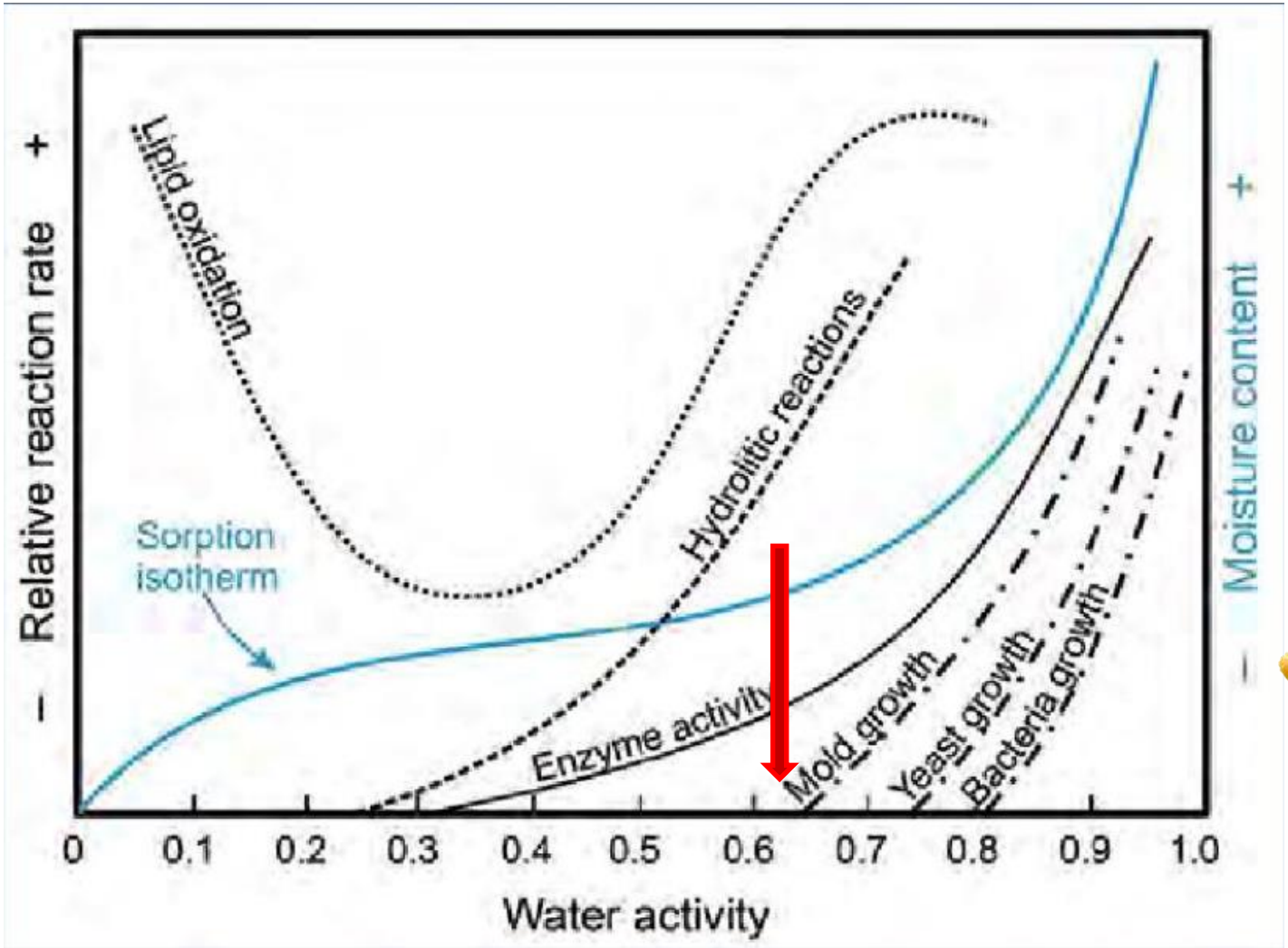
- Processing steps

Drying in a Tray Dryer

Osmotic dehydrated air dried Product

Dried Product: water activity, moisture content, microbiological test

Quality Assessment of Dried Tropical Fruits



Quality Assessment of Dried Tropical Fruits

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Water Activity of commercial dried tropical fruits from Thailand

Dried Products	Water Activity	Picture
Dried Banana	0.60 - 0.65	
Dried Longan Flesh	0.60	
Dried Mango Leather	0.53 – 0.60	
Dried Osmotic Dehydrated Tropical Fruits	0.50 - 0.60	

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Moisture content of commercial dried tropical fruits and Herbs from Thailand

Dried Products	Moisture Content, %	Picture
Dried Banana	20-25%	
Dried Longan Flesh	18%	
Osmotic Dehydrated Mango	12- 15%	
Dried Medicinal Plants/ Herbs tea	5 -10%	

PRODUCTION OF OSMOTIC DEHYDRATED MANGO

- Osmotic Dehydrated Mango

PRODUCTION OF OSMOTIC DEHYDRATED MANGO

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- Processing steps

Matured mango at optimum ripening

Peeling

Slicing

$CaCl_2$+ Acid pretreatment

Blanching

PRODUCTION OF OSMOTIC DEHYDRATED MANGO

- Processing steps

Immerse in osmotic solution (sugar solution)

Osmotic dehydrated slices

Drying

PRODUCTION OF OSMOTIC DEHYDRATED MANGO

- Processing steps

Drying using a conventional tray dryer or a greenhouse solar dryer

QUALITY ASSESSMENT OF OSMOTIC DEHYDRATED MANGO

- Major quality criteria impact on quality of dried product:
  Total sugar/Reducing sugar ratio (TS/RS) of osmotic dehydrated mango slices after sugar immersion and prior to the drying process

$$\frac{\text{Sucrose+fructose+glucose (TS)}}{\text{Fructose+glucose (RS)}}$$

QUALITY ASSESSMENT OF OSMOTIC DEHYDRATED MANGO

- Total sugar/Reducing sugar Ratio (TS/RS)

Too high TS/RS ratio, the product will get the thin whilte sugar crystal on the surface and the texture of product will be hard

Too low TS/RS ratio, the product will get more sticky and drying time increase

Quality Assessment of Dried Banana

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Chemical Properties – Browning Index

Quality Assessment of Dried Banana

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Chemical Properties – Browning Index

The sample was soaked in 50 ml of 2% (v/v) acetic acid for 2 h. Subsequently, the sample was homogenized for 1 min and then centrifuged at 8,000 rpm for 20 min.

The supernatant was extracted and measured the absorbency at 420 nm with UV–vis spectrophotometer and 2% acetic acid was used as a blank.

Dried “Thai Herb Tea” using a Solar Dryer

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Dried “Thai Herb Tea” using a Solar Dryer

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A Greenhouse Solar dryer

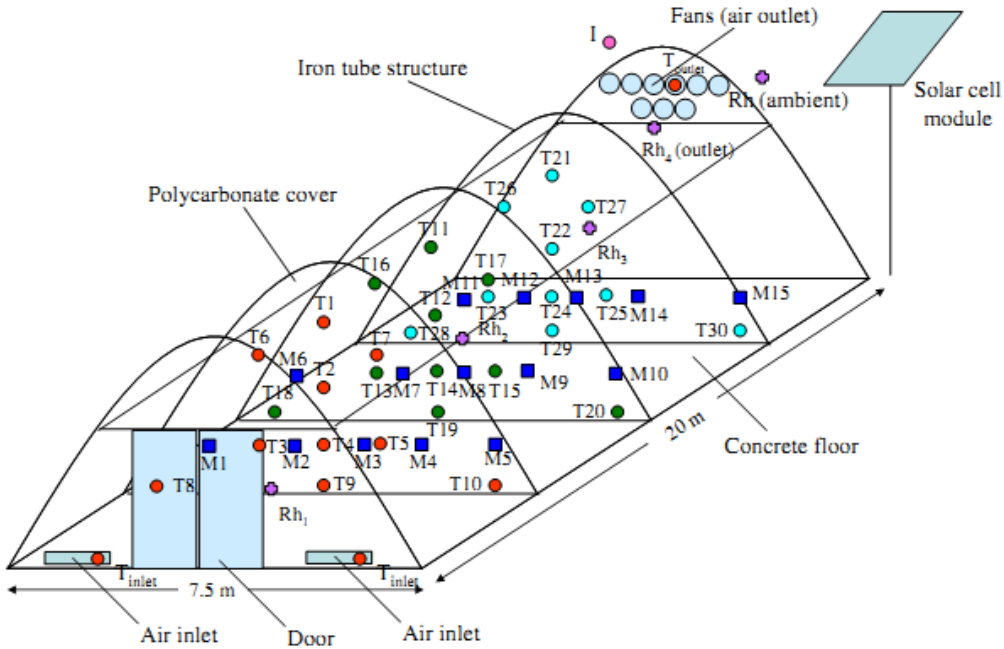
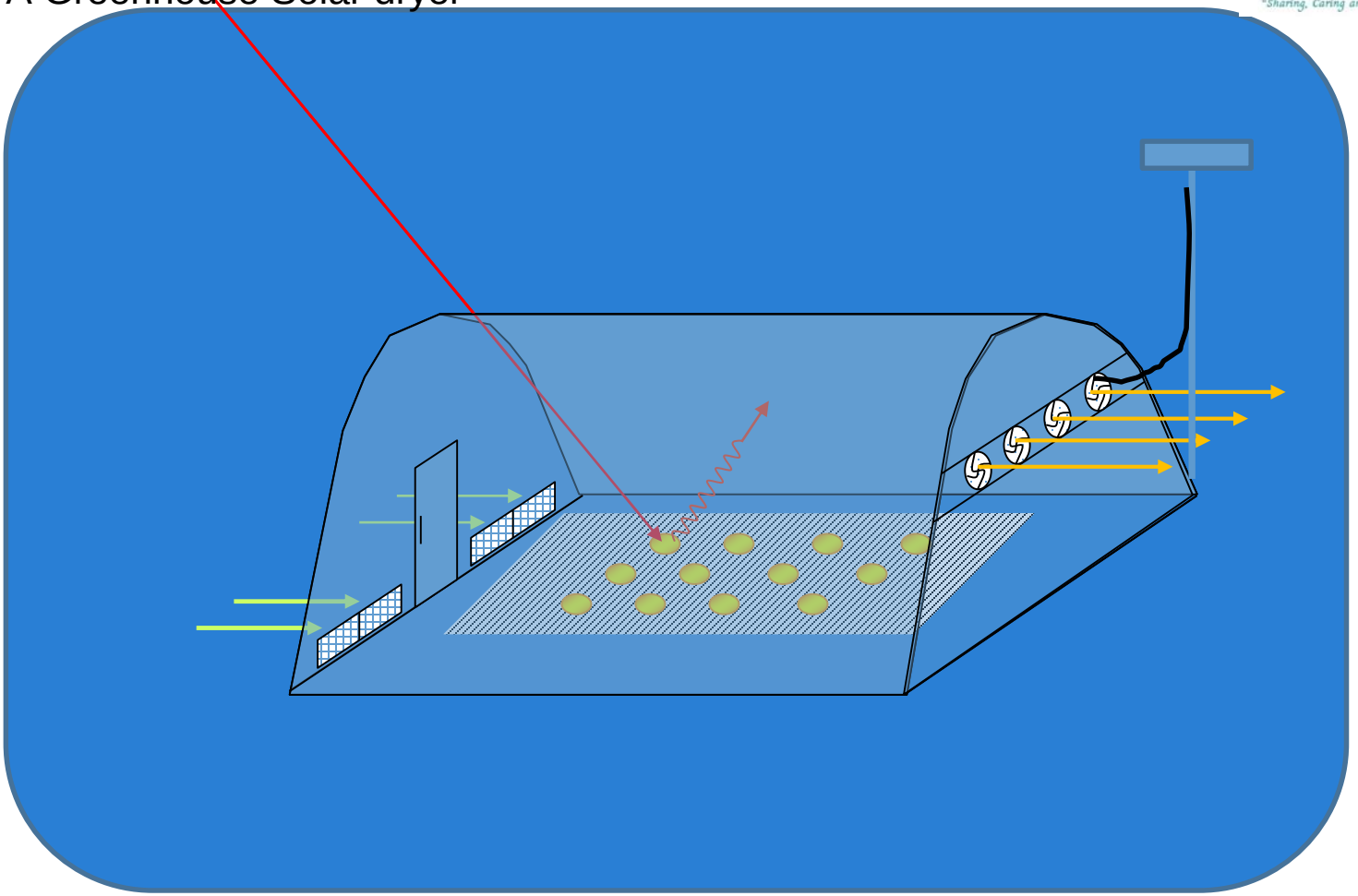


Fig. 2. The dimension and the positions of the thermocouples (T), hygrometers (Rh) and product samples for weights (M).

Dried “Thai Herb Tea” using a Solar Dryer

- A Greenhouse Solar dryer



Dried “Thai Herb Tea” using a Solar Dryer

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Production of Lemongrass Tea +

Butterfly pea, Pandan, Rosella, Ginger

Dried “Herb Tea” using a Solar Dryer

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Lemongrass + Rosella Tea

Dried Lemongrass slices 1-2 days

Dried Rosella
3-4 days

Dried “Thai Herb Tea” using a Solar Dryer

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Lemongrass + Butterfly Pea Tea

Dried “Thai Herb Tea” using a Solar Dryer

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Lemongrass + Pandan Tea

Dried Pandan leaf slices in a parabola dome 1-2 days

Dried “Thai Herb Tea” using a Solar Dryer

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Production of Lemongrass Tea+

Dried “Thai Herb Tea” using a Solar Dryer

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Thai Tom Yum Infusion Drink

Dried “Thai Herb Tea” using a Solar Dryer

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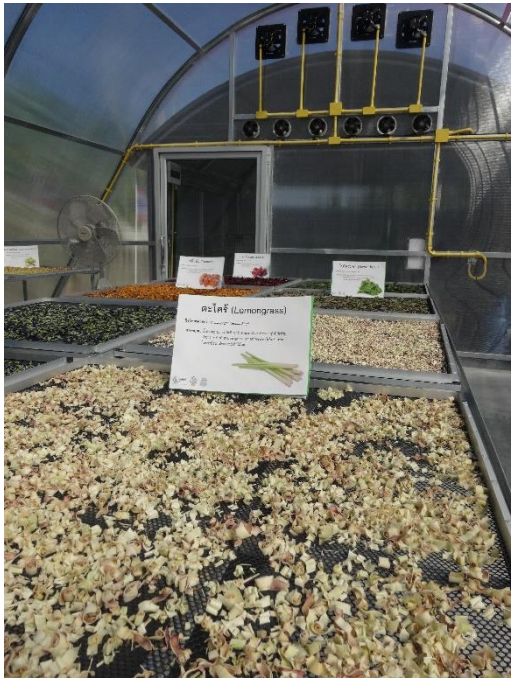
Thai Tom Yum Infusion Drink



Dried “Thai Herb Tea” using a Solar Dryer

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Thai Tom Yum Infusion Drink

Dried “Thai Herb Tea” using a Solar Dryer

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Bael Fruit Tea

Dried “Thai Herb Tea” using a Solar Dryer

Bael Fruit Tea

Washing, slicing

Drying in a Parabolar Dome

Dried “Thai Herb Tea” using a Solar Dryer

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Dried Bael Slices are boiled with water to extraction aroma and bioactive compounds and then concentered.

After that sugar is added and further evaporated until crystallization is occurred.

Dried “Thai Herb Tea” using a Solar Dryer

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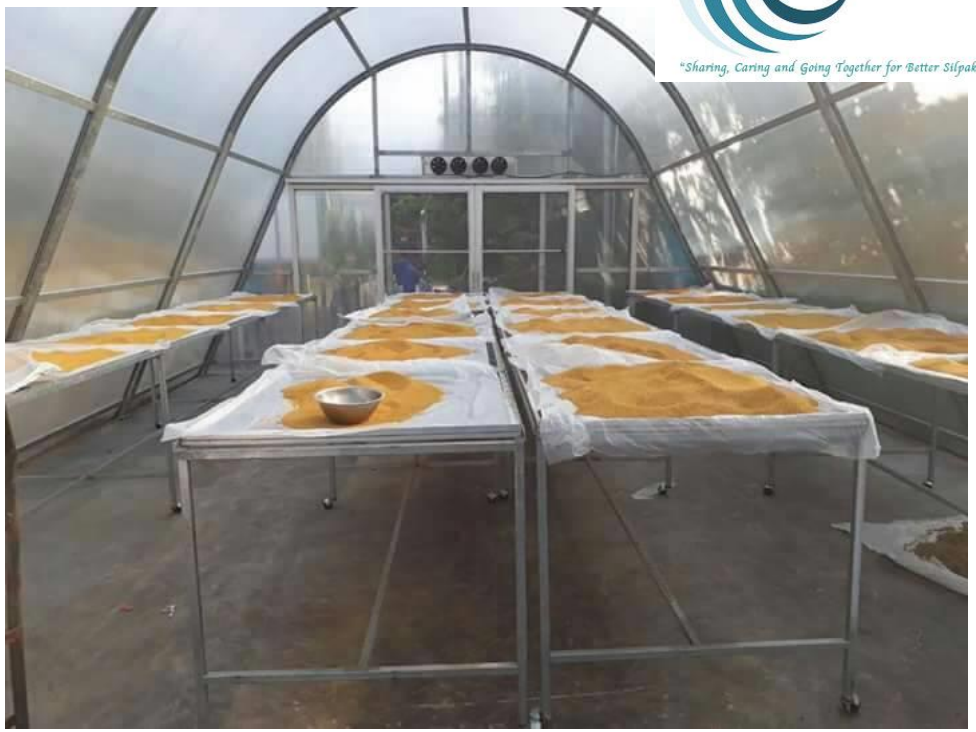

Drying in a Parabolar Dome

Dried “Thai Herb Tea” using a Solar Dryer

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Ginger Tea

Sensory Evaluation of Dried “Thai Herb Tea”

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7-Hedonic scale (liking score)

7 = Like very much
1 = Dislike very much

Attributes

- Aroma
- Flavor
- Taste
- Color
- Overall Acceptance

References

Patchimaporn Udomkun, Marcus Nagle, Busarakorn Mahayothee, Donatus Nohr, Alexander Koza, Joachim Müller. 2014. Influence of air drying properties on non-enzymatic browning, major bio-active compounds and antioxidant capacity of osmotically pretreated papaya. Food Science and Technology.

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THANK YOU VERY MUCH FOR YOUR ATTENTION

- You are highly welcome for educational exchange at SILPAKORN UNIVERSITY