

Postharvest Technology of Tropical Fruits in Thailand: Mango and Young Coconut

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Thailand or the Kingdom of Thailand is located just above the equator at the center of Indochinese peninsular in Southeast Asia. The stable hot humid climate with average temperature of 25-35°C and 75-85% relative humidity is suitable for growing wide varieties of tropical plants throughout the year. Banana, coconut, mango and papaya can be grown anywhere in Thailand. However, the main production of these fruits is in the central region of Thailand (Krisanapook, 2015). Thailand export various kinds of agricultural products for about 43,000 million USD in 2013 ranging from natural rubber, rice & products, fish & products, cassava & products, sugar & products, fruits & products (2,700millionUSD), etc (Figure 1). The major export markets were China (22%), Japan (13%), USA (9%), Malaysia (5%), Indonesia (3%), South Korea (3%), United Kingdom (3%), Cambodia (2%), Vietnam (2%), Myanmar (2%), and etc. (36%) (Figure 2). Even though, China, Japan and USA are the biggest markets, the ASEAN community (Malaysia, Indonesia, Cambodia, Vietnam, Myanmar and etc.) is also Thailand's big market shared at least 14%. Among

fresh fruits and their products, pineapples had the highest export value, however, export of fresh pineapple was still very low compared to longans, durians mangosteens and mangoes. The chilling sensitivity of pineapple makes it difficult to export. The highest export values of fresh fruits in 2013 were longans, durians, mangosteens, mangoes and young coconut respectively (Table 1). USA, China, Hong Kong, the Netherlands, Japan, Indonesia, Germany, Canada, Russia and Australia were the most important market for fresh fruits and fruit products. Some major markets like Japan and USA have a specific requirement in controlling pest infestation. Fruits exported to Japan and South Korea including mangoes and mangosteens are required to pass vapor heat treatment (VHT) to eliminate fruit flies and other insect pests. Those fruits exported to USA including longans, mangoes, mangosteens, pineapples, lychees and dragon fruits need to be treated with gamma irradiation at 400-1,000 Gray (Gy). However, different fruits tolerate to different dose of irradiation. Fruits exported to all countries are also under the minimum

requirement of Thailand, Codex and/or European standards for fruit quality and chemical residues upon markets requirement.

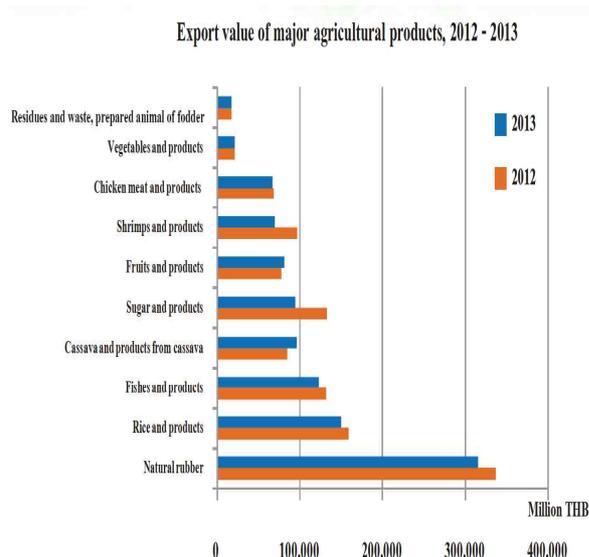


Figure. 1. Export value of major agricultural products in the year 2012-2013 (Centre for Agricultural Information, 2013)

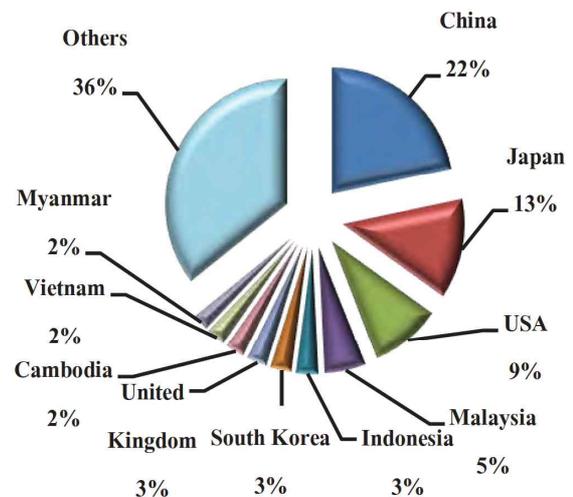


Figure. 2. Export value shares of agricultural products by major country in 2013 (Centre for Agricultural Information, 2013)

Mango

Mango production in Thailand is all year round due to the various micro climates among various regions (Table 2). The harvesting period varies with longitude and latitude starting from central, north eastern,

Table 1. Export quantity and value of some major fresh fruits and products in 2013

Commodities	Fresh		Products		Total Value (1,000\$)
	Quantity (Ton)	Value (1,000\$)	Quantity (Ton)	Value (1,000\$)	
1. Pineapples	3,032	2,729	743,477	751,235	753,964
2. Longans	413,400	283,441	152,561	155,626	439,067
3. Durians	367,057	244,823	14,357	39,477	284,300
4. Mangosteens	215,182	141,712	683	1,504	143,216
5. Mangoes	36,527	40,192	31,075	47,880	88,072
6. Young coconuts	51,491	29,375	-	-	29,375
7. Tamarinds	7,763	6,218	22,761	22,100	28,318
8. Rambutans	4,222	4,928	11,156	15,929	20,857
9. Bananas	22,571	8,845	1,753	5,970	14,815
10. Grapefruit & pomelo	14,776	7,894	1,535	1,007	8,901

(Centre for Agricultural Information, 2013)

Table 2. Seasons of some major tropical fruits in Thailand (Dark and light brown color represent high and average seasons, respectively)

Fruits	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Banana												
Young Coconut												
Dragon fruit												
Durian					East of Thailand			South of Thailand				
Grape												
Guava												
Longan												
Lychee												
Mango												
Mangosteen					East of Thailand			South of Thailand				
Rambutan				East of Thailand				South of Thailand				
Papaya												
Pineapple												
Pomelo												

northern and southern, respectively. Many farmers also produce off season mango especially farmers in the north eastern due to its rain shadow location. However, the peak season is between April to June. The major export varieties are ‘Nam Dok Mai Si Thong’ (Golden Mango), ‘Nam Dok Mai No.4’ and ‘Mahachanok’. ‘Nam Dok Mai’ mangoes are bagged with carbon paper bag when the natural fruit drop has ended or about 45 days after anthesis. This bag not only prevents fruit flies and other insects, it also prevents light penetration giving beautiful and smooth yellow skin when ripe. A white plastic bag is used for ‘Mahachanok’ just to prevent insect infestation but not light penetration, since ‘Mahachanok’ requires enough light for developing red blush skin.

The harvesting and postharvest handling for mango in Thailand is mention below.

Harvesting: Fruits bagged with carbon-brown bag

will be harvested with stem on for at least 2 inches then transported to the packing house by cold truck at 15°C. Anthracnose and stem end rot caused by *Collectotrichum sp.* and *Lasiodiplodia sp.* prefer temperature at about 27-30°C. Cold transportation will delay fruit rot development.

Trimming: Fruit stem will be then recut and left for only 5 mm to prevent stem end rot. Latex will be drained by turning fruit upside down for at least 30-45 minutes (Figure 3A).

Maturity sorting: Fruit maturity will be evaluated according to its specific gravity by floating in water and salt solution (2% NaCl). Immature fruit floating in water will be sold as green mango used for cooking. Mature fruit (about 90% maturity) sunk in 2% NaCl will be sold in domestic or exported to neighbor countries and short distance markets. Fruit sunk in water but floated in 2%NaCl will be exported to long distance markets. Sodium hypochlorite at 200 ppm can



Figure 3. Postharvest handling for export mango in Thailand.

A) Stem cut and latex removal; B) Maturity sorting using specific gravity technique in 2% salt solution and water with or without 200 ppm sodium hypochlorite; C) Hot water treatment at 50-55°C for 5 minutes followed by cooling at 3°C for 5 minutes can reduce fruit stem end rot (D)

be used instead of water to clean fruits within one step (Figure 3B).

Disease controlling: Fruits are immersed in hot water at 50-55°C for 5 minutes, then transferred to cold water at 3-5°C for 5 minutes to reduce respiration and prevent hot burn (Figure 3C). This hot water treatment can prevent latent infection both anthracnose and stem end rot. The addition of prochloraz at 250 ppm is recommended for shipping period of longer than 2 weeks.

Modified Atmosphere: Fruits can be either coated with “CK[®] Natural Fruit Wax” or packed in active film bag. This process will minimize the injury from either VHT or irradiation.

Packing: Box with net screen is required for Japan, South Korea and USA.

Vapor Heat Treatment (VHT): VHT is required for trading with Japan and South Korea. Fruit core temperature at 47°C and 90%RH for 20 minutes is operated.

Irradiation: Gamma irradiation at 400-1,000 Gray (Gy) is required to export to USA.

Storage and shipping: Fruits can be stored at 12°C for up to 5 weeks with either “CK[®] Natural Fruit Wax” coating or active packaging.

Ripening: Mango can be ripened either with 200ppm ethylene gas or 20g of calcium carbide for every 1 kg of fruit or with 400ppm ethephon and store at room temperature for 2-3 days.

Young Coconut

The production of young aroma coconut in Thailand is also all year round (Table 2). The aroma of the Thai coconut is very unique due to its aromatic compound, 2-acetylcysteine-1-pyrroline (2-AP), same compound found in Thai Jasmine rice and pandan leaf. The nutritious

coconut water is known as natural energy drink. These benefits make the fruit become more popular not only for sport men but also tourists and in general. The main import countries are USA, Canada, China, Taiwan, Singapore, Australia, the Netherlands, etc. The export volume was increased about 20% each year for the last 6 years. In 2013, the total export value of fresh young coconut was 29,375,000 USD (Table 1) and 13,667,000 USD or about 46% was earned from USA alone (OAE, 2014).

The harvesting and postharvest handling for young coconut in Thailand is mention below.

Harvesting; Mature coconut trees generate new inflorescence constantly over time and thus fruits at 6.5 to 7 months old (known as standard levels 1.5 to 2.0) could be harvested every 3 weeks from each tree (Figure 4A). The liquid endosperm or coconut water of these two stages is sweet (7-8 Brix) and suitable for consumption along with the soft and tender solid endosperm (kernel). Too young fruits (less than standard level 1.5 or 6.5 months old) will be discarded as they could not be peeled nor store under low temperature for less than 4 weeks. Young fruits at standard level 2.5 and above or 7.5-8 months old with hard and thick kernel will be burnt to increase sweetness and separate kernel from the shell and sold as roasted coconut for domestic market. Fruits will be transported hot to packing house for the following postharvest handling (Siriphanich et al., 2011).

Sorting: Fruits size and maturity will be sorted again by vision of skill worker according to the Thailand standard for young coconut, TACF.15-2007.

Peeling: The green exocarp (husk) and some part of white mesocarp (fibrous husk) will be removed. Fruits are trimmed or polished up on market requirement (Figure 4B and C). The benefits of peeling process are

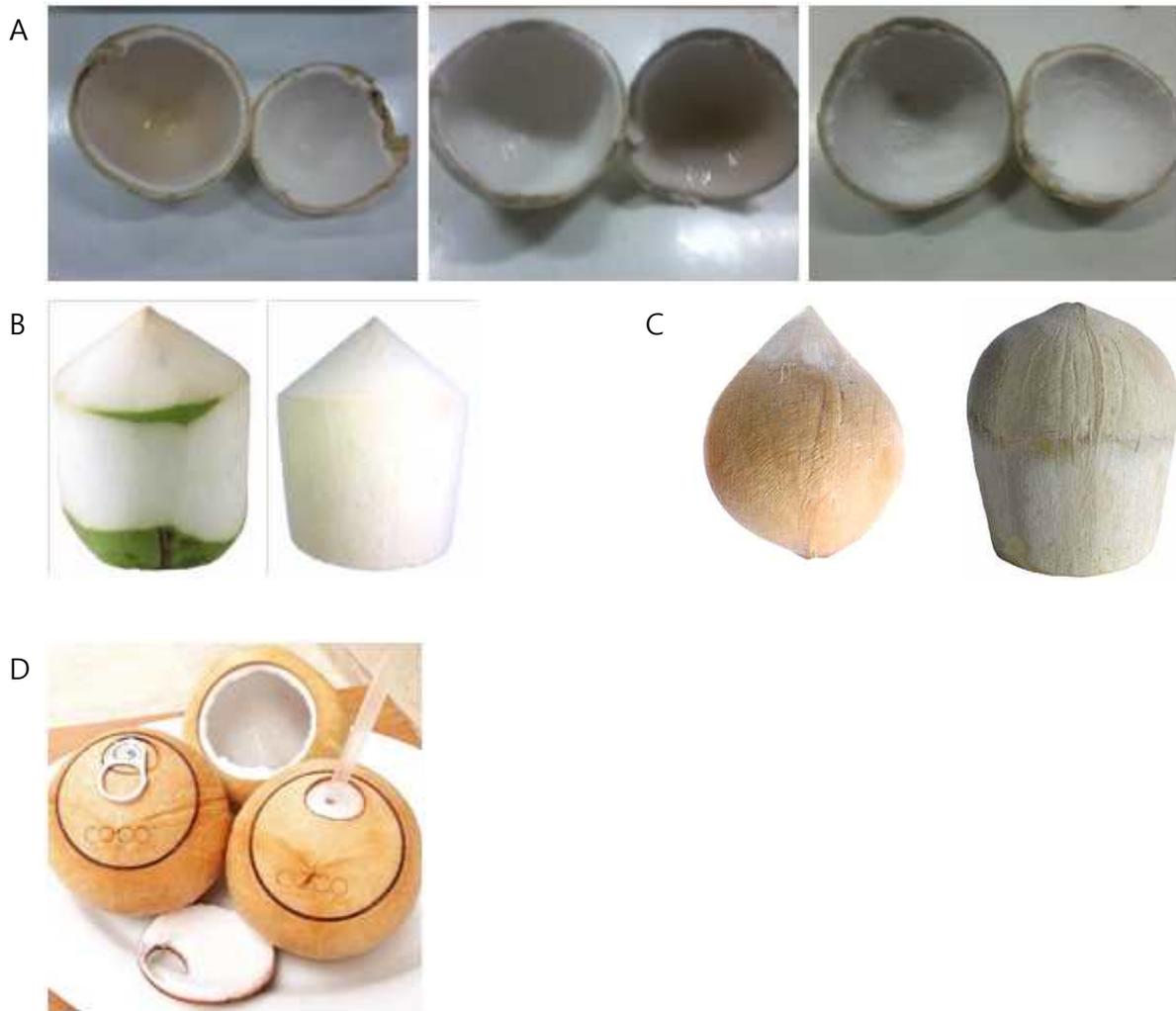


Figure 4. Postharvest handling for export young aroma coconut in Thailand.

- A) Coconut standard level 1.5, 2.0 and 2.5 (Thai Coconut Standard, TACF 15-2007)
- B) Trimmed and C) Polished coconut fruits
- D) Cocoeasy[®] with pulltab, (Picture, <https://mobile.twitter.com/hashtag/cocoeasy>)

to reduce fruit weight and volume resulting in increasing shipping volume and quantity, and also to increase storage period since the outer green husk is sensitive to low temperature.

Disease controlling: Trimmed and polished fruits will be soaked in 3% sodium metabisulfite (SMS) solution for 5 minutes or less. This preservative solution not only controls disease infection, it's also an

antioxidant and bleaching agent inhibiting browning reaction. Mohpramarn (2010) suggested that trimmed coconut fruits should be dipped in SMS of concentration less than 5% for 5 minutes or less, since the SMS residue in the coconut water is under the maximum residue limit (MRL) of 50 mg/kg fruit weight defined by CODEX STAN 192-1995 (Codex Alimentarius Commission, 2015). Husk should not be removed too deep to prevent SMS penetration through

soft tissue of the functional pore into the fruit water and kernel.

Quality evaluation: Nondestructive evaluation of coconut water could be done by near infrared spectroscopy (NIRs) only in polished fruit and extract coconut water.

Packaging: Fruits are wrapped with PVC film and labelling, then stored in card box. An innovative idea of laser-cutting and labeling allows consumers to easily open the shell with a pull-tab for drinking water and outer-circular cut for eating the pulp (Figure 4D).

Storage and shipping: Whole and intact young coconut is best stored at 13.5°C for up to 4 weeks which unattractive browning perianth. The one-and-a-half level peeled fruit can be stored at 2°C for 4-6 weeks, while the two-level fruit is up to 2 months (Siriphanich et al., 2011).

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