Storage of Tropical Fruits in Thailand

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Abstract

Thailand produces many tropical fruits which are both consumed locally and exported. The storage of tropical fruits is still necessary for extending the supply to the markets. Only a few companies in the country have operated cold storage of tropical fruits, whereas this kind of operation is rare at farm level. The related storage potential is, however, limited by chilling injury and rapid ripening. These constraints are further limited by the lack of appreciation and application of proper postharvest handling practices.

Introduction

Horticultural industry plays an important role in the agricultural economy of Thailand. Tropical fruits are considered to be of leading economic value for both local and export markets among other horticultural commodities. For the time being, Thailand is the front runner among ASEAN countries in export of tropical fruits (Anon., 1981). However, a number of factors hinder the development of a major tropical fruit industry in Thailand. The chief stumbling block includes the problems of postharvest handling.

Postharvest losses of tropical fruits are still considered to be high (Chayasombat, 1987; Ketsa, 1990; Ketsa and Klaewkasetkorn, 1992; Ketsa and Pangkool, 1994). These losses must adversely affect the potential income of growers and diminish the trading and exporting prospects. Storage is one of the postharvest handling practices that can reduce the losses and prolong fruits' usefulness. This paper will report about the storage of tropical fruits in Thailand.

The need for storage of fruits

In temperate countries much of the production of fruits is confined to relatively short growing seasons and thus storage becomes essential for provision of fresh fruits out of the harvest season. In tropical countries like Thailand fruit production may be extended but storage is still necessary for extending the supply to consumers (Pantastico *et al*., 1975). In addition, fruit storage can be viewed as a great help for growers, retailers, wholesalers and exporters for the following reasons: 1) there is no immediate buyer, 2) transportation or some other essential facilities is not available, 3) extend the marketing period and increase volume of sale and 4) wait for a price increase.

The present status of fruit storage

Although Thailand produces many tropical fruits, only a few export companies have operated cold storage of tropical fruits, whereas this kind of operation is rare at farm level. The cold storage of tropical fruits is rarely operated in Thailand which may be due to the following reasons:

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1. High fixed cost

The cost of constructing cold storage is rather high for individual small and medium holding growers. If growers store their fruits once a year for a short period, this would cost more per year as well.

2. Poor cooperative farming system

Unlike Israel, Japan and Taiwan, cooperative farming system in Thailand is not well organized. Growers sometimes get together loosely for technology transfer or for training. They do not have a common or central cold storage to share for fruit storage. Growers will have to sell their fruits after harvest as soon as they can. If not, fruits will be left at ambient temperature until they are sold out or decay.

3. All year around fruiting season

Thailand is considered as a home of tropical fruit crops. The great diversity of tropical fruit crops in Thailand ranges from economic fruit crops to rare or uncommon ones. Different fruit crops have different fruiting seasons (Table 1). In addition, the average temperature in the north, particularly at night time is lower than in the central area, due to the greater elevation in the north. Therefore, the same fruit crop grown in the north will have a later harvesting season than that grown in the central area. Growers, middlemen and wholesalers feel that it is not necessary to store their fruits because they will have other tropical fruits in the markets when they bring out their fruits to the markets. Although off-season fruits fetch a higher price than on-season fruits, the demand is very low and consumers would like to try other new tropical fruits.

4. Lack of appreciation in fruit storage

Most growers, middlemen and exporters lack knowledge on the importance of cold storage in saving their fruits. They think that cold storage adds to the cost of the product. In addition, they believe that cold storage predisposes fruits to rapid deterioration after removal. As some of the potential life is used up in storage, it is not reasonable to expect the fruit to keep so long after removal as freshly harvested fruit. But if the correct temperature and humidity are used and suitable storage periods are not exceeded, there will be sufficient time for the commodity to pass through normal marketing channels after removal

Table 1 Harvesting seasons of economic tropical fruit crops grown in Thailand (Anon., 1989)

Commodity	Harvesting season											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Banana (Kluai Hom)	<----------											---------->
Banana (Kluai Khai)								<----------				---------->
Durian					<----------		---------->					
Guava	<----------											---------->
Longan						<----------	---------->					
Longkhong							<----------				---------->	
Lychee				<----------		---------->						
Mango			<----------		---------->							
Mangosteen					<----------				---------->			
Papaya	<----------											---------->
Pineapple	<--->			<----------			---------->					<-->
Pummelo								<----------			---------->	
Rambutan					<----------				---------->			
Sugar apple					<----------				---------->			
Sapodilla									<----------			---------->
Tangerine	<------->								<----------			---------->

(Lutz and Hardenburg, 1968).

The important role of cold storage

Tropical fruits are perishable produce. They continue their living processes after harvest. Their postharvest life depends on the rate of using stored food reserves, weight loss and decay. Tropical fruits have high respiration rates and soften rapidly which leads to fruit senescence or deterioration (Biale, 1960; FAO, 1981). The high temperature which is typical of the tropical region, leads to a rapid rate of deterioration of tropical fruits.

The principal aim of storage is to control the rate of respiration, transpiration and infection of fruits. Storage life may be prolonged by proper control of postharvest diseases (Eckert and Sommer, 1967), regulating the atmosphere (Kader, 1985; Hatton and Spalding, 1990), chemical treatment (Dekazos, 1983), irradiation (Akamine and Moy, 1983) and refrigeration (Thompson, 1985). To date, refrigeration is the only known economical method for long-term storage of horticultural commodities including tropical fruits. All the other methods of regulating ripening and deterioration are at the best only supplemental to low temperature (Lutz and Hardenburg, 1968; Pantastico *et al*., 1975; FAO, 1981). Cold storage is therefore recommended for tropical fruits because it retards: 1) respiration and other metabolic activities; 2) senescence due to ripening, softening and textural and color changes; 3) moisture loss and shrivelling and 4) decay due to invasion by bacteria, fungi and yeast (Lutz and Hardenburg, 1968).

However, cold storage adds to the cost of a produce. It is usually not worthwhile storing a produce if the price increase resulting from cold storage does not exceed the cost of storage and shows a profit on the operation. Sometimes it is acceptable to break-even on the cost/return ratio if this means that a greater volume of produce is sold overall or that the cold storage facility is used more efficiently.

Problems associated with operation of cold storage of tropical fruits

There is a number of factors influencing storage behavior and quality of tropical fruits in cold storage. These factors are associated with fruits themselves, preharvest and postharvest handling practices.

1. The nature of tropical fruits

Tropical fruits tend to be softer and have high respiration rate at ripeness and therefore are more difficult to store. This is probably due in part to the fact that most tropical fruits will suffer from chilling injury when stored below 10°C (Lyons, 1973; Paull, 1990). The symptoms of chilling injury of tropical fruits include surface lesions, discoloration of peel, pulp, vascular strands and seeds, failure of ripening and increased susceptibility to decay (Morris, 1982; Paull, 1990). The development of chilling injury symptoms is usually aggravated after removal from the chilling temperature to nonchilling temperature.

2. Maturity

Some growers harvest their fruits without knowledge of importance how fruit maturity affects eating quality and storage life. Maturity at time of harvest is an important factor influencing the keeping quality of tropical fruits. Fruits that are harvested at an immature stage have low eating quality and may tend to shrivel in storage. When too mature at harvest, the fruit is soft, the flesh breaks down more quickly and it has a shorter storage life (Pantastico *et al*., 1975).

3. Temperature

It has always been recommended that refrigerated storage of tropical fruits is needed to avoid deterioration. However, many cold storage facilities in Thailand are planned for a variety of goods, like meat, fish, eggs, dairy products and horticultural commodities. They are designed accurately from the engineering point of view, but not solely for tropical fruits. The temperature of cold storage facilities is always below 10°C. These cold storage facilities are often rented for storage of tropical fruits resulting in chilling injury. In general, the approximately safe temperatures for storage of tropical fruits are 10-12°C.

4. Humidity

High humidity retards wilting and maintains the product in better condition. All tropical fruits are stored best in an atmosphere that has a relative humidity of 90% (Lutz and Hardenburg, 1968). However, cold storage of facilities for meat, fish, eggs and dairy products which have been rented for storage of tropical fruits have low humidity, less than 60–70%. This will cause a detrimental weight loss and shrinkage of fruits.

5. Mixed commodities

At time it may be necessary to store different commodities together. This may or may not be safer. Tropical fruits can generally be stored together if they have the same temperature requirements. Some tropical fruits are damaged when stored with other climacteric fruits because of ethylene evolution. Very low concentrations of ethylene will stimulate ripening of tropical climacteric fruits resulting in earlier termination of storage life. This ripening effect is negligible at low temperature (e. g. 1-2°C). However, the optimum temperatures for tropical fruits are far above 1-2°C at which tropical fruits can produce ethylene causing adverse effects (Lutz and Hardenburg, 1968; Abeles *et al*., 1992).

The present efforts

Tropical fruits are perishable produce. Their losses are great after harvest, particularly under tropical climate. Cold storage is considered to play an important role in postharvest practices that can save a lot of tropical fruits. Hence, cold storage of tropical fruits is rarely operated in Thailand. Therefore, Thai government has tried hard to promote the use of cold storage for tropical fruits as follows:

1. Convince growers, middlemen and exporters how the cold storage of tropical fruits can benefit them.
2. Promote the cooperative farming system in order to build a common or central cold storage to share for fruit storage.
3. Carry out more research associated with cold storage of tropical fruits in order to determine optimum temperature and storage duration.

Thus tropical fruits can be stored at right temperature with optimum storage life.

Concluding remarks

Thailand has a great potential for tropical fruit industry. However, the storage of tropical fruits in Thailand has not been well recognized by growers, middlemen and exporters. This may be due to chilling injury, rapid ripening of tropical fruits and lack of appreciation for benefit of storage. Thai government has promoted the research and use of cold storage of tropical fruits in order to extend their usefulness.

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Discussion

Uritani, I. (Japan) : Would it be possible to store fruits in boxes buried underground where the temperature would range between 20 and 25°C?

Answer : Underground fruit storage is not implemented in Thailand. In winter the temperature is low only during a short period of time. Some researchers have attempted to use passive cooling for cold storage above the ground but the results were not satisfactory.

Uematsu, H. (Japan) : What is the optimum temperature for the storage of mangoes to avoid chilling injury ?

Answer : The mango cultivar Nam Dorkm Mai which is exported to Japan can be stored at 12°C for three weeks. If stored for a longer period of time, chilling injury may develop.