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Postharvest Handling
Technical Bulletin

COCONUT

Postharvest Care and Market Preparation

Technical Bulletin No. 27

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POSTHARVEST HANDLING TECHNICAL SERIES

COCONUT

Postharvest Care and Market Preparation

Ministry of Fisheries, Crops and Livestock
New Guyana Marketing Corporation
National Agricultural Research Institute

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Preface

This publication is part of a series of technical bulletins that seek to provide specific recommendations for improvements in postharvest care and market preparation for selected non-traditional agricultural products. The intended audience for this series is primarily extension agents.

Initial market assessments in current export markets and visits with producers and exporters in Guyana have shown the quality of fresh produce currently exported is uneven and in some instances very poor. Stages all along the export chain from harvest and pre-harvest to transportation and final export are all in need of improvement. Pre-harvest practices, sanitation at the packinghouse, packaging, bacterial and fungal problems, and transportation were all identified as areas where improvement could benefit the quality and increase the shelf life of Guyana's fresh produce exports. The technical bulletins address these issues specific to each product. Harvesting techniques and crop maturity indices are provided. Preparation for market, including cleaning, sorting, packing and transportation are covered. The bulletins address and recommend specific storage conditions, covering temperature and humidity controls. Finally the bulletins address postharvest diseases and insect damage.

The undertaking of these technical bulletins is a joint effort of the Ministry of Fisheries, Crops and Livestock; the New Guyana Marketing Corporation (NGMC) and the National Agricultural Research Institute (NARI) to improve quality, increase production and promote exports. As a team, the three agencies are working on the problems, limitations, and constraints identified in the initial reconnaissance surveys, from production and post harvest handling problems, to packaging and transportation, to final market.

Introduction

The coconut (*Cocos nucifera*) is an important commercial crop in Guyana, contributing significantly to the overall economy. Several cultivars of coconut palms are grown. The 'Jamaican Tall' and 'Panama Tall' cultivars are tall, robust palms with a large diameter crooked trunk, rapid growth rate, and either green or bronze-coloured fruit. The 'Malayan Dwarf' cultivar has three different selections that vary in the colour of the immature fruit (green, yellow, or gold). It is smaller and slower-growing than the 'Jamaican Tall' and has a narrow straight, non-swollen trunk. The 'Maypan' is a hybrid between the 'Malayan Dwarf' and the 'Panama Tall'.

The coconut palm starts fruiting 3 to 5 years after planting, depending on the type. A normal-bearing, adult palm produces at least one mature ready-to-harvest bunch of coconuts every month. Depending on the variety, the number of nuts per bunch can vary from 5 to 15. Mature trees continue to produce fruit regularly throughout the year. The chief product is copra (dried kernel), the source of coconut oil used for making soap, shampoo, cosmetics, cooking oils and margarine. A significant quantity of fruit is also consumed fresh as a refreshing drink made from the water inside immature fruit. These fruit are often referred to as water coconuts. Water coconuts should be opened carefully, by chopping the blossom end, in order to preserve the uncontaminated drink. The jelly-like endosperm is also typically eaten, by scooping out with a spoon.

Harvest Maturity Indices

Coconuts are harvested at two different stages of development, depending on the intended use. Coconuts intended to be consumed fresh for the water content and jelly-like meat should be harvested when the fruit have reached full size, but at an immature stage with soft inner white meat (endosperm). Fruit intended to be harvested for copra and further processed into oil should be harvested at a mature stage, when the inner white meat has thickened and hardened. Several different indices can be used to determine coconut maturity. These include time from flowering, fruit size, external appearance, and amount and texture of the meat.

Water coconuts should be harvested soon after the fruit has reached full size, but while it is still immature. This coincides with maximum water content and occurs about 7 months after flowering (Figure 1). In immature coconuts, the skin surface around the cap on the top of the fruit is typically whitish-yellow. Also, the short stem above the individual coconuts that originally contained the male flowers will have partially dried (Figure 2).

Figure 1. Full-sized immature coconut 7 months after flowering with maximum water.

Figure 2. Water coconuts ready for harvest showing partially dried male flower stems.

Coconuts intended for copra production should be harvested fully mature, which requires about 12 months from flowering. The skin will have turned mostly brown (Figure 3). The stem on top of the coconut is also brown at full maturity. At this stage, the coconuts will have their maximum copra content and oil recovery. At the fully mature stage, the meat is firm and is eaten without processing, or may be shredded, dried to produce copra, and then squeezed to produce coconut milk, a water-oil emulsion.

Although the fully mature stage is ideal for copra-production, in practice, immature coconuts are sometimes included during harvest if the entire bunch is picked. Immature coconuts will produce rubbery copra with low oil recovery. Rubbery copra is also susceptible to insects and mould due to its high moisture content.

Figure 3. Fully mature coconut with brown skin and thick meat.

External fruit appearance is an indicator of maturity. Depending on cultivar, coconut fruit are green, yellow, or gold in colour when immature (Figure 4). Water coconuts should be harvested at one of these colour stages. The fruit will turn a brownish colour as they become mature. Fruit size is also indicative of maturity. The fruit should be fully developed in size before being harvested, either as a water coconut or for copra.

Figure 4. Water coconuts from three different cultivars; green, yellow, and gold.

The amount and texture of the meat is a destructive index of harvest maturity. Several randomly selected fruit of different sizes are cut open to determine the amount and firmness of the meat. Other fruit of similar size from the same cultivar are assumed to be in the same stage of maturity. The meat of water coconuts should be thin, soft, and jelly-like. The water content of immature fruit is high, but is gradually absorbed into the meat with increasing fruit maturity. The meat of coconuts harvested for copra should be thick and firm with limited water content (Figure 5).

Figure 5. Thick and firm meat of mature coconut fruit harvested for copra.

Harvest Methods

The fruit from shorter growing coconut trees may be harvested from the ground using a machete or knife to cut the stem just above the shoulder of the fruit (Figure 6). The fruit may also be twisted or snapped off the tree by hand. Fruit borne on mature tall trees may be harvested with the aid of a ladder or climbing device (Figure 7), by skilled climbers

(Figure 8), or by using a sharp blade attached to a long pole. The coconuts are generally left to drop to the ground and collected after the entire tree has been harvested. If the majority of fruit on an entire bunch is ready for harvest, the coconuts can be harvested as a unit by severing the stem just above the first fruit in the cluster.

Figure 6. Fruit borne on short coconut tree being harvested from the ground by machete.

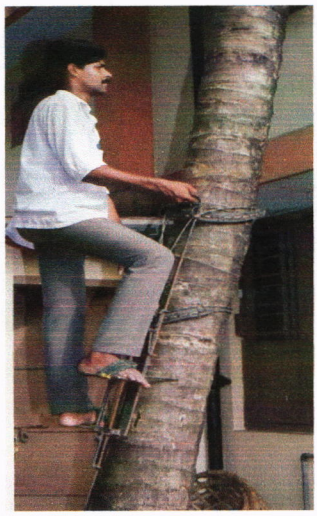

Figure 7. Palm tree climbing device serves as a portable ladder to facilitate tree ascent.

Figure 8. Skilled climber ascending a tall coconut tree for harvest.

Preparation for Market

The coconuts should be gathered from the field soon after harvest and taken to a shaded collection site (Figure 9). Fruit which are unmarketable due to excessive insect damage, decay, or undesirably small fruit size are discarded. The remaining fruit should be prepared for market by cleaning/de-husking, sorting, and packing.

Figure 9. Recently harvested water coconuts held in a shaded collection site area.

Cleaning/De-husking

The surface of water coconuts should be cleaned with a damp cloth or cotton gloves to remove excess dirt, dust, or undesirable stains. Water coconuts marketed domestically are typically not de-husked. However, most coconuts intended for export must be de-husked to reduce the transport weight and volume. Coconuts should be dried for several days at ambient temperature before de-husking by hand. The outer coloured skin (exocarp) plus the fibrous inner husk (mesocarp) are stripped away by striking the coconut against a sharp-pointed metal stake mounted on a platform. A few impaling strokes loosen the husk, making it easier to be removed. A machete can also be used to initiate the de-husking process (Figure 10).

Figure 10. De-husking coconuts in preparation for export.

De-husked coconuts are oval to round in shape with the eyes showing (Figure 11). To prevent browning, the de-husked coconuts can be dipped in a 1% to 3% sodium meta-bisulfite solution for 2 to 5 minutes. This treatment prevents browning for a period of 5 to 7 days. A fungicide may be included in the sodium meta-bisulfite solution to inhibit the growth of surface mould. The discarded husks can be placed several layers deep over the de-husked coconuts to help reduce desiccation.

Figure 11. De-husked coconuts dipped in 3% sodium meta-bisulfite to inhibit browning.

Grading

Water coconuts intended for export should be graded according to size, uniformity of shape, and degree of skin blemishes if they are not de-husked. The fruit should be categorized into small, medium, and large sizes. The fruit should be uniform in shape and free of noticeable blemishes or skin damage from insects, diseases, or physical injury. Surface colour should be uniform and characteristic of the cultivar. The preferred skin colour of non de-husked water coconuts in the export market is green. De-husked coconuts should be free of stress cracks and not have deeply sunken eyes. The fruit should not have any protruding germination tubes, leakage of water around the eyes, or surface mould. When shaken, the fruit should have a sloshing sound, indicating the presence of water in the coconut. Any fruit that does not have a sloshing sound when shaken should not be packed for market. The most common size for exported de-husked coconuts is between 750 gm to 850 gm (1.7 lb to 1.9 lb), although the acceptable sizes typically range from 600 gm to 1 kg (1.3 lb to 2.2 lb).

Waxing

The market life of water coconuts can be extended by waxing the fruit with paraffin. Waxing significantly reduces weight loss and is also very effective in reducing stress cracking of de-husked coconuts during transport. The fruit are waxed by rapidly dipping them in a tank of melted paraffin.

Packing

Coconuts are packed in various types of containers, depending on the market destination. Domestically marketed water coconuts may be sold in bulk or packed in large synthetic or mesh sacks of known fruit count per sack.

If the coconuts are sold in bulk, the fruit are usually loaded onto the bed of a large truck and transported to the destination market (Figure 12). Considerable manual labour is required to load and unload the bed of a truck with loose coconuts. In large-scale operations, the loading process is made more efficient by packing the fruit in large wooden bins on top of pallets (Figure 13). A hand jack or fork-lift can be used to move the bins onto the bed of the truck.

Figure 12. Loading/unloading of loose coconuts requires considerable manual labour.

Figure 13. Packing of coconuts in large wooden bins on pallets for domestic marketing.

If domestic marketed fruit are de-husked, usually 40 to 50 coconuts are put in the sack (Figure 14). Wooden crates may also be used.

Figure 14. De-husked coconuts packed in mesh sacks for domestic marketing.

Coconuts for export are usually de-husked and packed in strong well-ventilated fiberboard cartons, with a minimum 275 psi test strength. The carton typically has a net weight of 18 kg (40 lb). Uniform sized fruit should be packed in each carton. Dividers may be used to separate individual fruit (Figure 15). Wrapping of husked coconuts in thin polyethylene film will significantly reduce weight loss.

Figure 15. De-husked coconuts packed for export in a fiberboard carton with dividers.

There is a lesser export market demand for coconuts that have not been de-husked. However, some demand exists in high-priced niche markets. For these markets, water coconuts are packed by count in 3 kg (6.6 lb) fiberboard cartons (Figure 16). Typically 2 or 3 fruit are packed in each carton.

Figure 16. Two non de-husked water coconuts packed in 3 kg carton for export.

Temperature Control

Although coconuts are of tropical origin, the ideal storage temperature range is 0°C to 1°C (32°F to 34°F). They can be stored satisfactorily at this temperature range for 2 months. Therefore, it is possible to ship de-husked coconuts successfully by refrigerated sea container to any destination worldwide. Moderately cool temperatures of 12°C to 16°C (54°F to 61°F) will allow up to a 3 week market life. In the absence of refrigeration, the market life of fresh coconuts is short. They can be held in a shaded location at ambient temperature for up to 2 weeks without a significant loss in quality.

Water coconuts that have not been de-husked store for a longer period than de-husked fruit. The sugar content in the water of de-husked fruit declines more than in non de-husked fruit. Also, the acidity of the water of de-husked coconuts increases to a higher level than in non de-husked coconuts. Consequently, the taste of stored de-husked coconuts becomes less desirable than non de-husked fruit. The husk helps to preserve fruit quality and increase the storage life of water coconuts.

Relative Humidity

The ideal storage relative humidity (RH) for water coconuts is between 80% to 85%. Coconuts are subject to weight loss and transpiration loss of the water at low RH storage. However, if the RH is above 90% the fruit is susceptible to surface mould.

Postharvest Disorders

Fruit Cracking

De-husked coconuts are susceptible to stress cracking in which transverse fissures develop, mostly on the bottom half of the nut. Cracks may vary in width from a fine fracture up to 1 cm (0.4 in), which also splits the inner shell and results in leakage of the internal water. Stress cracks provide entry for fungi and bacteria which cause the water to turn sour and the meat to rot, rendering the fruit unsaleable. Younger de-husked coconuts have a lower rupture force than mature coconuts. De-husked coconuts are also susceptible to cracking if they are exposed to more than an 8°C (46°F) temperature change within a few minutes or to extreme heat or cold. In addition to cracking, mechanical damage to immature coconuts will cause the white husk to turn brown.

Mould

Mould growth on the husk surface, caused by various species of fungi, is largely cosmetic and does not penetrate into the coconut meat. Fungi commonly associated with surface mould are various species of *Penicillium*. Mould is caused by moisture condensation on the coconut surface or storing the fruit at a RH above 90%.

Copra Processing

After the coconut is de-husked, the hard but brittle shell is exposed and can be split open into two halves using a machete. The coconut water is drained off and the meat attached to the shell is dried. During the drying process, the meat shrinks and is easily detached or scooped out from the shell. Copra is produced from the dried coconut meat.

The copra quality is influenced by the method and the manner of drying the meat. Improper drying may result in contamination of the meat with certain harmful aflatoxin-producing moulds, including the dangerous yellow-green mould, *Aspergillus flavus*. Aflatoxin is harmful to both humans and animals. It is therefore extremely important the coconut meat be properly dried.

The three common methods of drying are sun drying, kiln drying, and hot-air drying. Small-holders typically use sun drying or kiln drying methods, whereas larger producers may use hot air dryers. During drying, the moisture content of the coconut meat is reduced from about 50% down to 6%.

For producers using sun drying, it is important to thoroughly clean the floor or pavement before spreading the cut coconut halves (Figure 17). Make sure that soil and other extraneous matter is not mixed with the coconuts. Plastic sheeting may be used under the coconut meat to avoid direct contact with the ground. Split the coconuts and expose the meat only when certain that drying can start immediately or within four hours from splitting in order to prevent mould formation. When there is a threat of bad weather, defer nut splitting. A portable cover made of plastic sheeting should be available to protect the coconut meat from rain or dew. The covers are normally shaped like roofing (inverted V's) to allow aeration. Continuous drying for four to five days in good sunlight typically lowers the moisture content to 6 %. If the weather suddenly turns bad during the sun-drying period and is expected to remain so for some time, use of mould inhibitors is recommended.

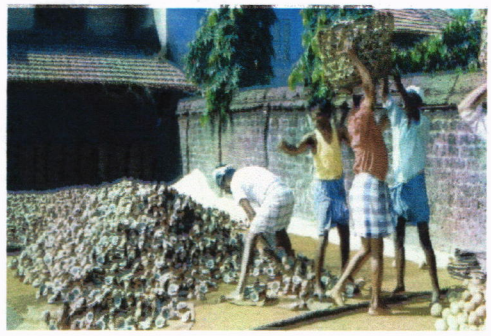

Figure 17. A clean surface is important in sun drying of coconut meat.

For producers using kiln dryers and hot-air dryers, a temperature of 35°C to 50°C (95°F to 122°F) should be maintained for the first 16 hours of drying followed by 50°C (122°F) during the next phase until a final moisture content of 6% is reached. It is important that drying begins within four hours after the coconuts are split in order to prevent mould contamination. In drying copra using kiln dryers, it is important to use a clean source of fuel and minimize the amount of smoke that passes through the drying coconut meat (Figure 18). The colour of the dried copra will depend on the source of fuel and cleanliness of the smoke. The colour of copra obtained from hot-air dryers is typically whiter than from kiln dryers since the coconut meat is dried by uncontaminated hot air that passes through the coconut meat. Since smoke does not come in contact with the meat, the copra produced from hot-air dryers is clean and white.

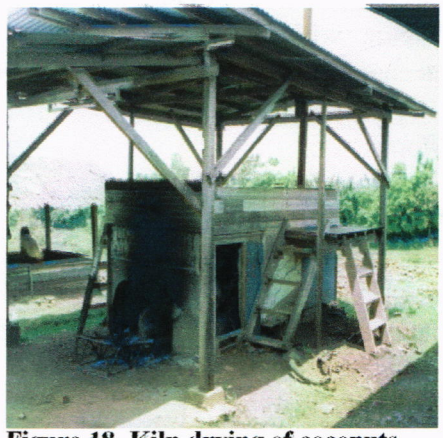

Figure 18. Kiln drying of coconuts requires a clean source of fuel to produce light copra.

The moisture content of the dried meat can be estimated by pressing it between the thumb and forefinger. If the dried meat does not stick to the thumb and readily drops when released, a moisture content of approximately 6% has been obtained.

ANNEX I

PUBLICATIONS IN THE POSTHARVEST HANDLING TECHNICAL BULLETIN SERIES

PH Bulletin No. 1	Pineapple: Postharvest Care and Market Preparation, November 2002.
PH Bulletin No. 2	Plantain: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 3	Mango: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 4	Bunch Covers for Improving Plantain and Banana Peel Quality, June 2003.
PH Bulletin No. 5	Papaya: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 6	Watermelon: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 7	Peppers: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 8	Oranges: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 9	Tomato: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 10	Okra: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 11	Pumpkin: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 12	Lime: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 13	Grapefruit: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 14	Passion Fruit: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 15	Green Onions: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 16	Sweet Potato: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 17	Eggplant (Boulanger): Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 18	Avocado (Pear): Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 19	Bitter Melon: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 20	Bora: Postharvest Care and Market Preparation, April 2004.
PH Bulletin No. 21	Cassava: Postharvest Care and Market Preparation, April 2004.
PH Bulletin No. 22	Eddoes: Postharvest Care and Market Preparation, April 2004.

PH Bulletin No. 23 Ginger: Postharvest Care and Market Preparation, May 2004.

PH Bulletin No. 24 Breadfruit: Postharvest Care and Market Preparation, May 2004.

PH Bulletin No. 25 Cabbage: Postharvest Care and Market Preparation, May 2004.

PH Bulletin No. 26 Calaloo: Postharvest Care and Market Preparation, May 2004.

PH Bulletin No. 27 Coconut: Postharvest Care and Market Preparation, May 2004.

OTHER PLANNED PUBLICATIONS

Cucumber: Postharvest Care and Market Preparation.

Lemon: Postharvest Care and Market Preparation.

Starfruit: Postharvest Care and Market Preparation.

Tangerine: Postharvest Care and Market Preparation.

Yam: Postharvest Care and Market Preparation.