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Postharvest Handling Technical Bulletin

OKRA

Postharvest Care and Market Preparation



Technical Bulletin No. 10

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POSTHARVEST HANDLING TECHNICAL SERIES

OKRA

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 seeks 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 postharvest handling problems, to packaging and transportation, to final market.

Introduction

Okra (*Abelmoschus esculentus*) is a commonly grown vegetable in Guyana, with considerable diversity in size, shape, and colour of the edible pods. Plants range in height from 1 meter (3 feet) in dwarf cultivars to over 2.6 meters (8 feet) in tall cultivars. Okra plants can be cut back to 15 to 20 cm (6 to 8 inches) above the ground to produce a second crop. This is usually done when pod quality starts to deteriorate. Most growers save their own seed or purchase seed from another producer, resulting in considerable plant and fruit variability. In addition, several imported cultivars are also available through agriculture supply stores. The edible part of the okra plant is a long slender immature pod. The pod is generally ribbed and spineless in cultivated varieties. The success of okra growing is dependant on careful handling and packing of the product and rapid cooling of the pods as soon as possible after harvest. Okra is a highly perishable vegetable with a limited market life.



Figure 1. Well-formed okra pod ready for harvest.

Harvest Maturity Indices

Each plant commonly produces numerous fruiting pods borne in axils along the lateral shoots (Figure 1).

Under normal growing conditions, the first pods are ready for harvest within 2 months after seeding. The plants continue to flower and set fruit over at least 3 months under favorable weather conditions, if the pods are regularly harvested. Okra pods are ready for harvest four to six days after flowering (Figure 2).

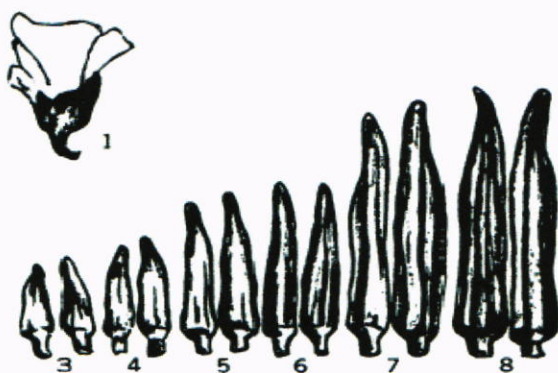


Figure 2. Pods develop extremely fast. From bloom to 15 cm length takes about 8 days.

The most widely used index of harvest maturity is pod length and diameter. Typically, okra should be harvested when the pods are 7.5 to 12.5 cm long (3 to 5 inches) (Figure 3). However, in some situations there may be a strong market demand for smaller sized okra and harvest stage should be adjusted accordingly. Due to the rapid rate of growth and development, okra should be harvested every other day to ensure pods remain within the marketable size range. Regular picking increases yield and prevents the pods from becoming over-mature. Okra pods should be harvested

while still tender and with immature seeds. Pods with tips that bend between the fingers without breaking are undesirably tough. If left to grow, the pods will attain lengths of 20 cm (8 inches) and up to 2.5 cm (1 inch) or more in diameter. After that period, the pod becomes pithy and tough, and the green colour and mucilage content decrease. Old pods should be removed and discarded, since they will retard the plant's production ability.



Figure 3. Okra pods between 7.5 to 12.5 cm long at ideal harvest maturity stage.



Figure 4. Bright green colour of okra ready for harvest.

External pod colour is another commonly used index of harvest maturity. The pods should be picked when they are bright green in colour (Figure 4). As they become over-mature, the pod colour will lighten.

Pod texture can also be used to determine harvest maturity. The texture should be crisp, moist, and fleshy inside. Over-mature pods are tough, dry, and pithy (hollow) inside. Pods with tips that will bend between the fingers without breaking are too over-mature and tough. Seed size is also indicative of pod maturity. The seeds should be small and succulent. Okra pods should be harvested before the seeds are more than half developed in size. Over-mature pods have large dry seeds.

Harvest Methods

Pods should be cut from the plant with clippers or a sharp knife. A small length of the stem, approximately 1 cm (0.4 in) long, should remain attached to the pod with a smooth neat cut at the end. They may also be snapped off by hand, but the stem end will need to be re-cut to remove the torn tissue at the edge. Pods should be harvested and handled with care, since they discolour and darken quickly when bruised or if the skin is damaged. Plastic pails or small baskets with a smooth internal lining are ideal harvest containers.



Figure 5. Rubber gloves and a long sleeve shirt provide protection to worker at harvest.

Okra plants and pods may have small spines to which some people are allergic. Pickers should wear gloves and long

sleeved shirts for skin protection (Figure 5). It is recommended that harvesting be conducted at the coolest time of the day, typically in the early morning. Okra should not be harvested in the rain or when the pods are wet.

The pods should be moved to a shady, cool area as soon as possible after harvest to maintain product quality and minimize moisture loss. The harvested pods should be left in the plastic harvest container or gently transferred from the harvest container to a well-ventilated field crate for transport to a nearby packing facility. Sacks or bags should not be used for transporting okra. They allow for heat build-up inside and can result in considerable abrasion of the pod surface and subsequent discolouration. Field containers should have sufficient ventilation to prevent heat build-up. Pods kept in non-ventilated containers will lose colour rapidly due to bleaching. During transport from the field to the packinghouse, the field containers should be covered from the sun and rain.

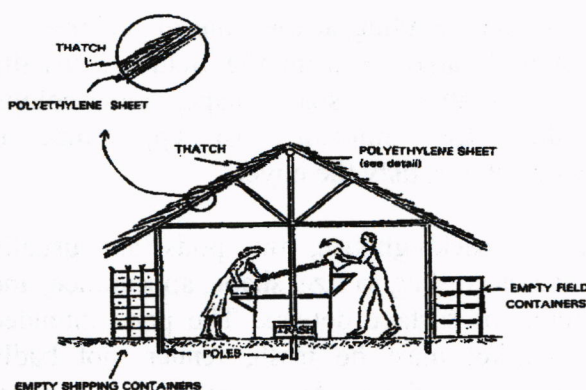


Figure 6. Simple and easy to construct field packing station for okra.

A simple field packing station for okra can be constructed from wooden poles and a sheet of polyethylene (Figure 6). Thatch over the roof will provide shade and keep the station cool. The structure should be oriented so that the roof overhang keeps out the majority of the sun's rays.

Preparation for Market

Cleaning

Cleaning of okra generally involves the elimination of leaves, stem sections, and other types of debris from the pods. Broken pods should also be discarded. This should be done in the packing area while the pods are spread on a flat surface (Figure 7) or conveyor belt. Okra should not be washed, since this would lead to a greater incidence of postharvest decay.



Figure 7. Elimination of organic matter and other types of debris from the harvested pods.

Grading

The initial grading of the harvested okra should take place in the field at the time of harvest. Pickers should separate unmarketable or damaged pods from the marketable ones. Oversized and partially decayed pods should also be removed from the plant and out-graded in the field. Even with some

preliminary grading at the time of picking, the okra pods arriving from the field are usually quite variable in size, shape, and colour. Grading for uniformity of appearance is important to satisfy the buyer.

At the packinghouse, the pods are usually graded according to size, shape, appearance, and amount of surface defects. The pods intended for market must be fresh, tender, not badly misshapen, and free from decay and damage. The stems should be cut cleanly and not have the appearance of being torn off the plant (Figure 8).



Figure 8. Torn stems are undesirable and should be cleanly cut before packing.

Okra is usually graded into the following sizes:

- Fancy; pods up to 9 cm (3.5 inches) long
- Choice; pods 9 to 11.5 cm (3.5 to 4.5 inches) long
- Jumbo; pods over 11.5 cm (4.5 inches) long, but still tender.

The pods should be well formed, straight, and not show signs of dehydration or discolouration. Pods which are severely curved, malformed, or have dark spots should be discarded. The pods should be tender and not fibrous, and have a colour typical of the cultivar (generally bright green). Most export markets prefer fancy grade okra.

Packing

Only uniformly appearing pods should be put in the same package. Care should be taken to avoid injury to the pods during the grading process. The tender pods are easily damaged during handling, especially along the ribs. This leads to unsightly brown and black discolouration (Figure 9).

Okra is packed in various sized containers, differing in volume and weight, depending on the market destination. Domestic markets usually receive okra in sacks or baskets, although these packages provide minimal protection to the contents. Fiberboard cartons are the most common type of package for export markets. Typical sizes used are 4.5 kg (10 lb), 7 kg (15 lb), and 14 kg (30 lb). The cartons should be well ventilated and strong. The carton should have a 275 psi bursting strength in order to avoid collapse while stacked on a pallet. One-piece self-locking cartons or



Figure 9. External pod discolouration of bruised and skin-damaged okra.

two-piece telescopic cartons are the most widely used package configurations (Figure 10). Okra should be cooled and sent to the market as soon as possible after packing.

Temperature Control

Okra has a high rate of respiration and deteriorates rapidly, unless the pods are cooled soon after packing. Heat build-up will accentuate spoilage and cause pod blackening. A bleaching type of injury may also develop when okra is held in non-ventilated harvest containers for more than 24 hours without refrigeration. Unless intended for immediate marketing, pods should be cooled within a few hours after harvest.



Figure 10. Two-piece telescopic fiberboard carton used to pack okra for export.

The ideal storage temperature for okra is 10°C (50°F). Pod quality can be maintained for up to 10 days at this temperature. When held at higher ambient temperatures, pod quality quickly deteriorates due to dehydration, fading of the green colour, and decay. Okra held at 25°C (75°F) will become soft and unmarketable within 2 to 3 days. On the other hand, okra held at temperatures below 10°C will develop chilling injury.

Relative Humidity Management

Okra is very susceptible to postharvest moisture loss and pod shriveling. This results in a reduction in market quality as the pods lose their fresh appearance. In addition, pod texture is adversely affected due to an increase in toughening. In order to minimize dehydration, it is important to maintain the pods in a high relative humidity (RH) environment. Ideally, okra should be held at 95% RH.

Principal Postharvest Diseases

Okra is susceptible to postharvest decay from several different fungal and bacterial organisms. Decay is mostly associated with damaged or wounded areas of the pod. Deterioration is typically very rapid at high storage temperatures, which usually range between 24°C to 27°C (75°F to 80°F) in Guyana. At the other temperature extreme, chilling injured pods are also very susceptible to decay. The most common postharvest fungal diseases of okra are gray mold, soft rot, pod rot, and sour rot. Bacterial blight is the most common bacterial disease.

Gray Mold

Gray mold, caused by the fungus *Botrytis cinerea*, is a common postharvest disease of okra. Symptoms begin as small discoloured spots on damaged areas of the pod surface. They enlarge into circular water-soaked lesions covered with a gray mold growth. Fungal growth is rapid at ambient temperatures. The pods should be cooled immediately after

harvest and held as close to 10°C (50°F). as possible to minimize the development of gray mold. Use of protective pre-harvest fungicide or fixed copper sprays will help lower the incidence of this disease. Also, careful harvesting and handling practices which avoid damage to the pod surface will reduce the incidence of gray mold.

Soft Rot

Soft rot, caused by the fungus *Rhizopus stolonifer*, is a frequently observed postharvest decay of okra. The fungus attacks wounded areas of the pod, including the broken stem. Symptoms begin as small water-soaked lesions in the areas of damaged tissue. They soon enlarge at ambient temperatures and the entire pod may become covered with a grayish-white mass of mold, which eventually turns black. Decayed tissue is brown, soft, and sticky. Nests of mold and decaying okra pods form within packed cartons. High temperature, high humidity, and damaged tissue increase the likelihood of disease development. Methods to control *Rhizopus* soft rot include the sanitization of harvest containers and grading surfaces, careful handling to minimize wounding of the pod surface, avoiding picking when the pods are wet, and cooling of the harvested okra to 10°C as soon as possible after harvest.

Pod Rot

Pod rot, caused by the soil-borne fungus *Rhizoctonia solani*, is another common postharvest disease of okra. This disease frequently occurs when harvest occurs during the rainy season. Wounding and injury to the pod encourages the development of pod rot. This disease is also spread through infected seed, which should be treated with a fungicide before planting. Good pre-harvest sanitation practices are important in order to reduce the build-up of inoculum in the soil. Pod rot symptoms include the presence of small brown to black spots closely pressed to the pod surface, which eventually cause tissue decay. Careful handling and postharvest cooling will reduce the incidence of this disease.

Sour Rot

Sour rot, caused by the fungus *Geotrichum candidum*, can be a serious problem of okra held in moist conditions at high temperatures. Rotting is associated with damaged tissue and the decay is soft, watery, but not discoloured. Surface lesions become covered with whitish spores. Complete pod decay can occur within a few days at ambient temperature. The pods have a distinct sour odour similar to vinegar. Sour rot can be minimized by careful harvesting and handling practices, and holding the pods at 10°C.

Bacterial Blight

Bacterial blight, caused by *Pseudomonas syringae*, is essentially a foliar disease, but the pods may also be affected. Pods having bacterial blight at the time of harvest are likely to rot during storage and marketing. Symptoms include numerous small lesions and reddish-brown spots on the pod surface. At ambient storage temperatures, bacterial blight quickly

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spreads, leading to significant amounts of rotting. The disease can be minimized by cooling the okra immediately after harvest and storing the pods at 10°C (50°F).

Physiological Disorders

Chilling Injury

Okra is a tropical-originating plant that is very susceptible to chilling injury (CI) if exposed to temperatures below 10°C. Typical symptoms of CI in okra include pod and seed discolouration, pitting, water-soaked lesions, and decay. Symptoms are particularly noticeable after removal of the pods to warmer temperatures, such as during marketing. Cultivars may differ in their susceptibility to CI. Holding okra for only 3 days at 0°C (32°F) followed by return to ambient temperatures will result in obvious pitting and discolouration of the pod.

Ethylene Discolouration

Ethylene is commonly produced by fruits and vegetables as they ripen. It is also produced by fungi and bacteria during postharvest decay. Ethylene accentuates okra senescence and shortens the market life of the pods. Exposure to ethylene also causes a fading of the bright green colour of the pod surface. High concentrations of ethylene in the storage atmosphere may cause the pods to yellow. Therefore, it is important to avoid exposing okra to ethylene. This can be accomplished by good ventilation in the storage environment and not keeping okra in the same location as other ripening fruit. In addition, decaying okra pods should be removed from the storage area.

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, November 2002.
PH Bulletin No. 3	Mango: Postharvest Care and Market Preparation, November 2002.
PH Bulletin No. 4	Bunch Covers for Improving Plantain and Banana Peel Quality, November 2002.
PH Bulletin No. 5	Papaya: Postharvest Care and Market Preparation, November 2002.
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.

PLANNED PUBLICATIONS - 2004

Cassava: Postharvest Care and Market Preparation.

Eggplant (Boulangier): Postharvest Care and Market Preparation.

Lime: Postharvest Care and Market Preparation.

Sweet Potato: Postharvest Care and Market Preparation.

Yam: Postharvest Care and Market Preparation.

Ginger: Postharvest Care and Market Preparation.

Pumpkin: Postharvest Care and Market Preparation.

