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Postharvest Handling Technical Bulletin

GINGER

Postharvest Care and Market Preparation



Technical Bulletin No. 23

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POSTHARVEST HANDLING TECHNICAL SERIES

GINGER

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 postharvesting 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

Ginger (*Zingiber officinale*) is a popular underground root crop widely grown throughout the country. The edible part is the swollen underground root stem or rhizome. In contrast to the ground provision crops, ginger is consumed in much smaller quantities and primarily used as a flavouring agent or spice. Almost the entire ginger production volume is consumed domestically, with limited quantities exported to Barbados.

Harvest Maturity Indices

The principal indices used to determine ginger harvest maturity are foliage senescence and rhizome size. Ginger should be harvested once the foliage begins to turn yellow and starts to dry. This natural aging process typically begins between 7 to 9 months after planting. One sign of maturity for the rhizome is yellowing foliage. Rhizomes will not continue to enlarge and grow without healthy foliage. Delaying harvest until all of the leaves have died is not recommended as it will reduce rhizome quality, increase fiber content, decrease storage life, and increase the incidence of sprouting.

When market demand for ginger is high, it is more cost-effective to harvest prior to the beginning of natural senescence. In this case, several randomly selected plants should be sacrificed and dug up to determine average rhizome size. If the size is acceptable, the remaining plants can be harvested. If the rhizomes are too small, they will require additional time to grow. The early harvest of non-senescent plants can result in more weight loss and decay. The skin of early harvested ginger is very tender. Furthermore, the fresh wound created at the point of separation between the stem and rhizome will be difficult to heal.

Harvest Methods

Ginger is almost entirely harvested by hand in Guyana, although mechanical digging devices are available for use on large-scale plantings. The initial step in harvesting is to remove a significant portion of the senescent foliage with a machete to make the rhizomes more accessible. Ginger is dug by hand using a fork or cutlass to loosen the soil around the crown of the plant. The process should be done carefully in order to avoid damaging the rhizomes. The rhizomes should be gently pulled out of the soil using the remaining length of stem as a handle. Care should be taken not to injure the ginger, which has a delicate skin and is easily wounded during harvest and handling. Ginger harvested early will still have an actively growing green stem attached to the rhizome which needs to be snapped or cut off slightly above the point of attachment to the rhizome (Figure 1).



Figure 1. Early harvested ginger still has a vigorous green stem attached to the rhizome.

Excess soil and roots should be removed by hand before placing the rhizomes in the field container. Cotton gloves are typically worn to facilitate field cleaning. The rhizomes should never be thrown or dropped. Ginger should be pre-graded in the field and any unmarketable, damaged, or diseased rhizome should be discarded (Figure 2). Wounded tissue is an entry point for decay causing bacteria and fungi.

Avoid leaving the rhizomes exposed to direct sun for longer than 30 minutes. The harvested ginger should be placed directly into strong well-ventilated wooden or plastic field crates for removal from the field (Figure 3). Transporting ginger in mesh sacks will increase the level of skin damage due to rubbing of the delicate skin against the mesh. Harvesting during very wet or very dry conditions is not desirable as this will increase the amount of skinning and make removal of the rhizomes from the soil much more difficult.



Figure 2. Small unmarketable rhizomes should be out-graded and left in the field.

Larger scale growers may elect to use a modified potato digger to mechanically harvest ginger. These diggers perform best when the ginger is grown on raised beds in straight rows. The rhizomes are lifted out of the ground with a metal shovel which undercuts the rhizomes and lifts them to the top of the soil. Rhizomes are then picked up by hand after excess soil and roots are removed.



Figure 3. Strong, well-ventilated plastic field container for harvested ginger.

Preparation for Market

Cleaning

Relatively clean rhizomes sold in the domestic market may not require any further cleaning. However, ginger intended for export must be thoroughly cleaned before packing. Also, the ginger intended for long-term storage should be washed immediately after harvest and then cured. A considerable amount of hand labour is required. Soil adhering to the rhizome should be removed and the roots and stem may have to be trimmed back. Ginger should be scrubbed by hand or with a soft-bristled brush in clean water sanitized with 150 ppm hypochlorous acid (Figure 4). The rhizomes should be washed as soon as possible after harvesting, as soil is more difficult to remove when dry.

Care is required during this operation to prevent rhizome breakage. Broken, split, or bruised rhizomes are susceptible to decay and shrinkage.

The water pH should be maintained at 6.5 for optimal sanitizing activity of the hypochlorous acid. The water needs to be changed after it builds up with soil particles and the 150 ppm hypochlorous acid concentration cannot be maintained. A fungicide treatment is also recommended and can be applied in the wash tank or as a separate overhead spray application after cleaning (Figure 5). Recommended fungicides are benomyl (500 ppm active ingredient) or thiabendazole (1000 ppm). After the cleaning process, the ginger should be air dried, sorted, and packed.



Figure 4. Hand cleaning of ginger in a sanitized wash tank.



Figure 5. Overhead fungicide spray application to cleaned ginger rhizomes.

Sorting

Remove all damaged and injured rhizomes. The remaining marketable rhizomes should be sorted according to size and overall appearance. The ginger surface should be clean, bright yellow-brown, and appear fresh. It should not be wilted or have any evidence of sprouting. The rhizomes should be free from bacteria or fungal infection and not have any objectionable skin blemishes. High quality ginger is characterized by large thick rhizomes with limited branching, light skin colour, and a glossy appearance (Figure 6). The skin colour will slowly darken and lose its shine during storage.



Figure 6. High quality ginger with light skin colour and limited branching.

The minimum rhizome size for export is 250 g (9 ounces). There is no maximum size limit. The main stem should not be less than 3 cm (1.25 in) thick and 12 cm (5 in) long. Market requirements demand that rhizomes be large and well-formed with limited branching. Rhizomes which have more than 4 side branches should not be packed for export (Figure 7). The skin should be tight and light brown. Export quality ginger should be smooth and firm, with uniform shape and size, be free from insect damage and decay, and have a uniform peel colour typical of the variety. The internal flesh should be firm and uniformly coloured, without any indication of darkening. Depending on type and cultivar, ginger flesh colour should either be cream or pale yellow.



Figure 7. Excessively branched ginger rhizomes should not be packed for export.

Packaging

Ginger of roughly similar size per rhizome should be packed in each market container. The container should be strong, well-ventilated, and capable of being stacked without damaging the rhizomes. For the domestic market, wooden crates provide better protection to the ginger than mesh or synthetic sacks. For the export market, ginger rhizomes should be placed in a clean, strong, well-ventilated fiberboard carton (Figure 8). The carton should have a minimum bursting strength of 275 lb per square inch. A two-piece full telescopic corrugated carton is preferred. A double-walled self-locking waxed carton is also acceptable. The surface of the rhizomes should be thoroughly dry prior to packing. Wet or damp ginger should not



Figure 8. Strong, well-ventilated fiberboard carton used for exporting ginger.

be packed into cartons destined for export, as surface mould will soon develop. Ginger destined for export should be loosely packed in layers inside the carton. The carton should not be overfilled. Net carton weight is typically 10 kg (22 lb) for the U.K. export market and 14 kg (30 lb) to North American destinations. However, carton size and weight may vary depending on the market destination and importer requirements. For marine shipments, an additional 5% packing weight is needed to account for weight loss during transit.

Curing

Ginger intended for storage should be cured by air drying the rhizomes at ambient temperature (22°C to 26°C or 71°F to 79°F) and 70% to 75% RH for several days to allow the skin to thicken and the cut surfaces to suberize. Curing will help reduce postharvest weight loss and decay. Following this brief curing treatment, the ginger should be put in well-ventilated containers for long-term storage.

Temperature Management

Ginger may be successfully stored for several months if the correct postharvest handling and storage procedures are utilized, and healthy, undamaged rhizomes are initially selected. The optimal temperature for storing and transporting ginger is 12°C (55°F). At this temperature, the rhizomes will remain in marketable condition for at least 3 months, depending on initial rhizome vigor and condition. Holding ginger at ambient temperatures (25°C to 30°C or 77°F to 86°F) will result in high moisture loss, surface shriveling, and sprouting of the rhizome. Market life under these conditions is less than 1 month. Therefore, ginger exports from Guyana can be made in non-refrigerated marine containers if the rhizomes are shipped within a week of harvest. At the other temperature extreme, ginger is very sensitive to chilling injury and should not be stored below 12°C (55°F).

Relative Humidity

Dehydration is a common postharvest disorder of ginger held under low relative humidity (RH) conditions (i.e. less than 65% RH). Shriveling of the rhizome becomes noticeable after the loss of more than 10% of the initial harvest weight. On the other hand, surface mould will begin to grow at a RH above 90% and sprouting will be stimulated, especially if the temperature is above 16°C. In order to minimize weight loss but avoid surface mould, a compromise RH range of between 70% to 75% is recommended for storing ginger. Ginger stored at 22°C (72°F) and 70% RH for 3 months will lose about 20% of its initial weight.

Principal Postharvest Diseases

Postharvest disease in ginger is normally due to rough harvesting and handling practices which result in injury to the skin and flesh of the rhizome. Holding ginger at a less than optimal temperature and RH will accelerate postharvest decay. Postharvest losses from diseases are caused by various fungi and bacterial soft rot. Decay can be kept to a minimum by following careful harvesting and handling practices, sanitation of the wash water, curing of the rhizomes after washing to promote wound healing, application of a postharvest fungicide, and holding the rhizomes at 12.5°C (55°F) and 70% to 75% RH.

Blue Mould

Blue mould, caused by the fungus *Penicillium*, is a common postharvest rot of ginger stored at a high RH. Blue mould generally requires moisture condensation on the rhizome surface, or storage at a RH above 95%. Mild surface infestations may be superficial only and not cause decay. However, the ginger has an unsightly appearance. Blue mould which develops on cut ends and injured areas will typically result in internal tissue decay (Figure 9). The rotted tissue is pale to dark brown, and may be firm or soft. Decay is particularly rapid at temperatures between 15°C and 20°C (59°F and 68°F).



Figure 9. Blue mould growth in cut area of ginger rhizome which will decay.

Dry Rot

Dry rot, caused by the soil-borne fungus *Fusarium*, is a common postharvest disease of ginger. Infection is typically associated with wounds or insect and nematode damaged tissue. External symptoms of dry rot include off-coloured dry sunken lesions on the rhizome surface. The lesions are typically bordered by a brown margin. The fungus subsequently invades the entire rhizome, which becomes brown, dry, and shriveled. In humid environments, the ginger surface may become covered with a dense white mould (Figure 10). Internal symptoms include a pale brown discolouration of the vascular tissue.

Watery Rot

Watery rot, caused by the fungus *Rhizopus*, is one of the most rapidly developing storage rots of ginger. Symptoms include a soft, watery rot that progresses rapidly and may rot an entire rhizome in a week. Infected tissue is mottled brown and soft, and in a humid atmosphere the infected area is soon covered with large amounts of white mould. The mould will eventually turn black. *Rhizopus* is a wound pathogen and is not effective in colonizing healthy tissue. The postharvest fungicide 2,6-dichloro-4-nitroaniline (Botran) applied just prior to packing may reduce watery rot during transport to export market destinations.



Figure 10. Dry rot on cut ends of ginger rhizome.

Pythium

Pythium is another common soil-borne fungus that can be severe on ginger harvested during the rainy season or on rhizomes grown in poorly drained soils. Symptoms appear as small brownish spots on the skin, which may rapidly enlarge into sizeable lesions. As the decay progresses, the tissue breaks down into a soft and watery mass.

Armillaria Rot

Armillaria rot, caused by the fungus *Armillaria mellea*, can be a problem on ginger grown in recently cleared forest land. Symptoms include the development of tough, dark, string-like growths which adhere to the rhizomes (Figure 11). These structures are aggregations of fungal strands, commonly called the 'shoe-string fungus'. Control involves the uprooting of all remaining tree stumps.



Figure 11. Dark, string-like growths of *Armillaria* rot on ginger.

Sclerotium Rot

Sclerotium rot, caused by the soil-borne fungus *Sclerotium rolfsii*, is most commonly found on rhizomes harvested from stressed plants. Symptoms of decay include a well-defined separation between rotted and healthy tissue. A white mould forms on the ginger surface and noticeable shrinkage of the rhizome occurs. Small spherical fungal resting bodies about 1 to 2 mm (0.04 inch to 0.08 inch) in diameter develop on the mould. They are initially white but later turn brown.

Bacterial Soft Rot

Bacterial soft rot, caused by *Erwinia carotovora*, is the principal postharvest bacterial disease of ginger. These bacteria are widespread, especially in poorly drained soils, and enter the ginger rhizome via wounds in the tissue. Symptoms of bacterial soft rot include a soft wet rot of the tissue, which has a strong foul odour. Development of this disease is rapid under warm, humid conditions.

Postharvest Disorders

Sprouting

Ginger rhizomes will sprout at temperatures above 15.6°C (60°F). Sprouting may begin after several weeks at ambient temperature (Figure 12). The rate of sprouting grows as the temperature increases. Keeping temperatures at 12.5°C (55°F) will prevent sprouting. There



Figure 12. Ginger rhizomes beginning to sprout after several weeks at 27°C (80°F).

is no effective chemical sprout inhibitor for ginger.

Chilling Injury

Ginger rhizomes are very sensitive to chilling injury (CI) or low temperature breakdown if stored below 12°C (54°F). CI is a physiological disorder that results in pitting and sunken lesions on the rhizome surface, shriveling, softening, flesh darkening, and postharvest decay (Figure 13). Shelf life is significantly shortened and eating quality of chilled rhizomes is inferior to non-chilled rhizomes.

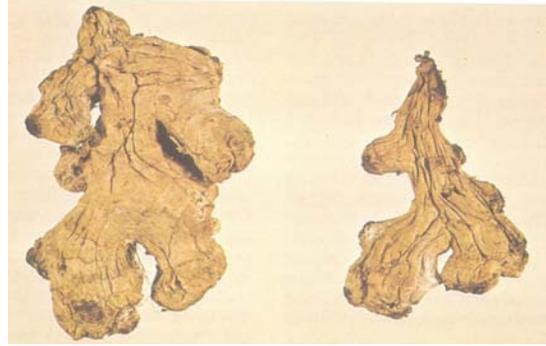


Figure 13. Ginger rhizomes exposed to chilling injury (CI) or low temperature breakdown.

The amount of CI damage to the ginger rhizomes depends on the specific temperature and the duration of exposure to the low temperature. The lower the temperature and longer periods of exposure will result in more CI. Also, the damage is cumulative. Slight injury may occur after 5 days at 7°C (45°F). Uncured rhizomes are more susceptible to chilling injury than properly cured rhizomes. Two weeks of exposure at 7°C (45°F) will result in significant CI and decay to uncured rhizomes.

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 (Boulangier): 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.

OTHER PLANNED PUBLICATIONS

Breadfruit: Postharvest Care and Market Preparation.

Cabbage: Postharvest Care and Market Preparation.

Calaloo: Postharvest Care and Market Preparation.

Coconut: Postharvest Care and Market Preparation.

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.

Harvest Maturity

The principal measurements used to determine ginger harvest maturity are age of the leaves and bulb size. Ginger should be harvested once the leaves begin to turn yellow and start to dry. This natural aging process typically begins between 7 to 9 months after planting. Delaying harvest until all of the leaves have died is not recommended as it will reduce bulb quality, increase fiber content, limit storage life, and increase sprouting.

In some markets, ginger harvested before the beginning of the natural aging processes may be of higher value. In this case, several randomly selected plants should be dug up to figure out average bulb size. If the size is acceptable, the remaining plants can be harvested. The drawback of harvesting less mature ginger is that bulbs are susceptible to greater weight loss.

Harvest Methods

Ginger is dug by hand using a fork or cutlass to loosen the soil around the crown of the plant. The process should be done carefully in order to avoid damaging the bulbs. The bulbs should be gently pulled out of the soil using the stem of the plant as a handle. Care should be taken not to injure the ginger, which has a delicate skin and is easily wounded during harvest and handling. Early harvested ginger will still have an actively growing green stem attached to the bulb which needs to be snapped or cut off slightly above the point of attachment to the bulb.

Excess soil and roots should be removed by hand before placing the bulbs in the field container. Cotton gloves are typically worn to facilitate field cleaning. Ginger should be pre-graded in the field and any unmarketable, damaged, or diseased bulb should be discarded.

The harvested ginger should be placed directly into strong well-ventilated wooden or plastic field crates for removal from the field. Transport of ginger in mesh sacks will result in skin damage due to rubbing of the delicate skin against the mesh.

Preparation for Market

Cleaning

Relatively clean bulbs sold in the domestic market may not require any further cleaning. However, ginger intended for export must be



thoroughly cleaned before packing. Also, the ginger intended for long term storage should be washed immediately after harvest and then cured. Soil on the bulb should be removed and the roots and stem may have to be trimmed back. Ginger should be scrubbed by hand or with a soft-bristled brush in clean water sanitized with 150 ppm hypochlorous acid. This is equal to 2 oz of household bleach (such as Marvex) per 5 gallons of water, or .3 liters of bleach per 100 liters of water. Care is required during cleaning to prevent bulb breakage, which increases decay and shrinkage. The water pH should be maintained at 6.5 for optimal sanitizing activity of the hypochlorous acid. The water should be changed after it builds up with soil particles.

A fungicide treatment can also be applied in the wash tank or as a separate overhead spray application after cleaning. Recommended fungicides are benomyl (500 ppm) or thiabendazole (1000 ppm). Benomyl (500 ppm) should be measured at 6.6 oz to 5 gl water (0.2 l benomyl to 19 l of water). Thiabendazole (1000ppm) should be measured as 13.2 oz. to 5 gl waters (390 ml to 19 l). The ginger should be air-dried after cleaning.



Sorting

Remove all damaged and injured bulbs. The remaining marketable bulbs should be sorted according to size and overall appearance. The ginger surface should be clean, bright yellow-brown, and appear fresh. It should not be wilted or have any evidence of sprouting. The bulbs should be free from bacteria or fungal infection and not have any noticeable skin blemishes. High quality ginger is characterized by large thick bulbs with limited branching, light skin colour, and a glossy appearance. The skin colour will slowly darken and lose its shine during storage.

Market require that bulbs be large and well-formed with limited branching. The minimum bulb size for export is 250 g (9 ounces). There is no maximum size limit. The main stem should not be less than 3 cm (1.3 inches) thick and 12 cm (5 inches) long. Bulbs that have more than 4 side branches should not be packed for export. The skin should be tight and light brown. Export quality ginger should be smooth and firm, with uniform shape and size, be free from insect damage and decay, and have a uniform peel colour typical of the

variety. The internal flesh should be firm and uniformly cream or pale-yellow coloured, without any indication of darkening.

Packaging

Ginger of roughly similar size should be packed in each market container. The container should be strong, well ventilated, and capable of being stacked without damaging the bulbs. For the domestic market, wooden crates provide better protection to the ginger than mesh or synthetic sacks. For the export market ginger bulbs should be placed in a clean, strong, well-ventilated fiberboard carton. The surface of the bulbs should be thoroughly dry prior to packing. Ginger destined for export should be loosely packed in layers inside the carton. Net carton weight is typically 10 kg (22 lb) for the U.K. export market and 14 kg (30 lb) to North American destinations.



Curing

Ginger intended for storage should be cured by air drying the bulbs at average temperature, 22°C to 26°C, (71.5°F to 79°F) and 70% to 75% RH for several days to allow the skin to thicken and the cut surfaces to heal. Curing will help reduce postharvest weight loss and decay. Following this brief curing treatment, the ginger should be put in well-ventilated containers for long-term storage.



Temperature Management

The optimal temperature for storing ginger is 12.5°C (55°F). At this temperature, the bulbs will remain in marketable condition for at least 3 months, depending on initial bulb vigor and condition. Holding ginger at high average temperatures, 25°C to 30°C (77°F to 86°F) will result in high moisture loss, surface shriveling, and sprouting. Market life under these temperatures is less than 1 month. Sprouting may begin after several weeks at ambient temperature. Holding the bulbs at 12.5°C will prevent sprouting. At the other temperature extreme, ginger is very sensitive to chilling injury (CI) and should not be stored below 12.5°C. CI results in pitting and sunken spots on the bulb surface, shriveling, softening, flesh darkening, and postharvest decay.

The amount of damage depends on the temperature and the duration of exposure. Uncured bulbs are more susceptible to CI and 2 weeks of exposure at 7°C (44.5°F) will result in significant bulb damage.

Relative Humidity

Dehydration is a common postharvest disorder of ginger held under low relative humidity (RH) conditions (i.e. less than 65% RH). Shriveling of the bulb becomes noticeable after the loss of more than 10% of the initial harvest weight. On the other hand, surface mould will begin to grow at a RH above 90% and sprouting will be stimulated, especially if the temperature is above 16°C (61°F). In order to minimize weight loss but avoid surface mould, a compromise RH range of between 70% to 75% is recommended for storing ginger. Ginger stored at 22°C (71.5°F) and 70% RH for 3 months will lose about 20% of its initial weight.

Principal Postharvest Diseases

Ginger is vulnerable to a number of postharvest diseases, mostly associated with tissue injury following rough harvesting and handling practices. Decay can be kept to a minimum by following careful harvesting and handling practices, sanitation of the wash water, curing of the bulbs after washing to promote wound healing, application of a postharvest fungicide, and storing the bulbs at 12.5°C and 70% to 75% RH.

Blue Mold

Blue mould generally requires moisture condensation on the bulb surface, or storage at a RH above 95%. Mild surface infestations may be superficial and not cause decay. Blue



mould that develops on cut ends and injured areas will typically result in internal tissue decay. The rotted tissue is pale to dark brown, and may be firm or soft.

Dry Rot

Symptoms of dry rot include off-coloured dry sunken spots on the bulb surface, typically bordered by a brown margin. The fungus may eventually invade the entire bulb, which becomes brown, dry, and shriveled. In humid environments, the ginger surface may become covered with a thick white mould. Internal signs include a pale brown discolouration of the vascular tissue.

Watery Rot

Symptoms include a soft, watery rot that progresses rapidly and may rot an entire bulb in a week. Infected tissue becomes brown and soft, and in a humid atmosphere the infected area is soon covered with large amounts of white mould. The mould will eventually turn black. The fungicide 2,6-dichloro-4-nitroaniline (Botran) applied prior to packing may reduce watery rot during transport to export markets.

Pythium Rot

This rot is common on ginger harvested during the rainy season or on bulbs grown in poorly drained soils. Symptoms appear as small brownish spots on the skin, which may rapidly enlarge into sizeable lesions. As the decay progresses, the tissue breaks down into a soft and watery mass.

Bacterial Soft Rot

Signs of bacterial soft rot include a soft wet rot, which has a strong foul odour. The ginger bulbs collapse into a slimy mass of leaky tissue which spreads rapidly at average temperature.



New Guyana Marketing Corporation

GINGER

Postharvest Care and Market Preparation Information Sheet



Technical bulletins on curing. Contact:

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With the assistance of
The United States Agency for International Development

This information sheet provides growers and agriculture extension personnel with a summary of the recommended harvest and postharvest handling practices for ginger. A more technical and detailed bulletin is available from New Guyana Marketing Corporation (NGMC) and the National Agricultural Research Institute (NARI).