CIFSRF CARICOM UWI-McGill Food Security Project

"IMPROVED PRODUCTION SYSTEMS FOR PUMPKIN FOR LOCAL AND EXPORT MARKETS"

Prof N. Badrie, Deputy Dean of Research and Innovation, Faculty of Food and Agriculture &

Sophia Balfour, Ph.D student food safety & quality

Pumpkin Quality and Safety

- Consumers generally expect the pumpkin ((*Cucurbita maxima* Duch) to be of good quality and safe;

- Pumpkins are rich in vital antioxidants, and vitamins. This low calorie vegetable contains vitamin A, flavonoid poly-phenolic antioxidants such as leutin, xanthin, and carotenes in abundance.

Importance of pumpkin to Trinidad and Tobago

- The tropical pumpkin (*Cucurbita maxima (moshata)* Duch.) is an important member of the Cucurbitacae family;

- Other members of this family include squash, watermelon, cucumbers and bitter melon.
- Locally, the crop is an important ingredient in many types of dishes e.g. pumpkin soup, pumpkin puree

Export and foreign market

- In 2004, Trinidad exported over 2200 tonnes of pumpkin which translate into substantial foreign exchange earnings (Mohammed and De Chi 2006).
- Having found a niche on foreign markets, the projection is for increased export earnings in the foreseeable future.
- This development further reiterates the need for a sustained effort at ensuring that the Good Agricultural Practices (GAP) protocols are adhered to as stringently as possible;

Farmers grow pumpkins…

- The use of animal manure is far more common during the production of pumpkins than composted plant material.
- Animal manure is known to contain very high levels of dangerous microorganisms that can result in human illnesses. These include *Salmonella, Escherichia coli*
- 157:H7, *Cryptosporidium spp. and the tetanus bacteria, Clostridium tetani*

Water Quality?

- Water is essential for a number of operations carried out on the farm including irrigation, pesticide application, fertilizer application and post harvest washing.

- Poor quality farm water can be an important vehicle in microbial contamination of fresh produce.

Fruit Crack

- Periods of drought followed by sudden watering often causes the fruit to crack thereby providing an additional portal of entry for bacteria and other harmful microorganisms;
- The marketability of the fruits is also reduced.

What is of concern to pumpkin quality?

- Poor postharvest management including less than ideal storage on farms, and poor display at retail establishments.
- Much remains to be done to improve the postharvest handling on the local market.
- Research has also shown that the crop has tremendous potential as a fresh cut product and has good eating quality when frozen following the right treatments.
- Both freezing and fresh cut technologies demand a higher level of hygiene from farm to processing.

What is of concern to pumpkin quality ?

- Of serious concern as well, is the presence of high levels of faecal *Coliform* and *Salmonella* on both the surface and more importantly in the pulp (flesh) of the fruit.

- Adoption of the principles of good agricultural practices (GAP) is perhaps the most important protocol that one can use that will significantly reduce microbial and other contamination.

Principles of GAP

- **Principle 1**: Prevention of microbial contamination of fresh produce is favoured over reliance on corrective actions once contamination has occurred.

- **Principle 2**: To minimise microbial food hazards in fresh produce, growers, packers, or shippers should use good agricultural and management practices in those areas over which they have control.

Principles of GAP…

- **Principle 3**: Fresh produce can become microbially contaminated at any point along the farm to food chain. The major source of microbial contamination with fresh produce is associated with human and animal faeces.

- **Principle 4**: Whenever water comes into contact with fresh produce the water's quality dictates the potential for contamination. The potential for microbial contamination from water used with fresh fruits and vegetables should be minimised.

Principles of GAP…

- **Principle 5**: The use of animal manure must be closely monitored to minimize microbial contamination.

- **Principle 6**: Worker hygiene and sanitation practices during production, harvesting, sorting, packing and transport play a critical role in minimising the potential for microbial contamination of fresh produce.

Principles of GAP…

- **Principle 7**: All applicable laws that are aimed at reducing microbial contamination of fresh produce should be obeyed.

- **Principle 8**: Accountability at all levels of the agricultural environment is important to a successful safety programme. Qualified personnel and effective monitoring are critical in ensuring all elements of the programme are operating effectively. This helps to effectively implement trace back through distribution channels if things go wrong.

Curing and Post-harvest Quality

- The objective of curing and storing pumpkin is to prolong the post-harvest life of the fruit;

- Curing heals wounds, helps ripen immature fruit, enhances colour, and ensures longer post-harvest life.

- All pumpkins should be well matured and free from injury and decay when stored

Processed pumpkin quality is determined by:

- The quality of the raw materials utilized
- cultivar
- maturity
- cultural practices and
- the efficiency and care taken during
  - handling,
  - processing,
  - storage and
  - distribution.

Postharvest quality

- Crops have been sampled at the farm and storage area for quality measurements such as:
- unit weight, diameter, length and width, surface and internal temperature, brix, pH, instrumental colour, and bio-yield point (crop firmness)
- Pumpkin varieties for the project include: *Bodles Globe, FutureNP999, Crapaud-back, Jamaican squash and Black diamond.*

Average quality measurements of Pumpkin *Future NP999*

Pumpkin- *Future NP999*	Average Quality Measurements	Maximum value	Minimum value
Weight/Kg	4.7	5.9	3.9
Circumference Vertical/inches	32.8	35.5	31.0
Circumference Horizontal /inches	26.8	29.0	25.5
Flesh Firmness/g	587.9	863.0	314.1
Bioyield Point/g	2436.1	3541.6	1467.1

Average quality measurements of Pumpkin *Future NP999n(Contd)*

Pumpkin- *Future NP999*	Average Quality Measurements	Maximum value	Minimum value
External temp/^{0}C	23.7	24.0	23.0
Internal Temp/^{0}C	26.6	27.0	26.3
pH	6.3	6.3	6.2
Brix	1.4	1.5	1.4
L -lightness	66.5	70.1	62.8
c- chroma	86.1	91.4	80.8
h°- hue	44.4	50.3	38.5

Postharvest quality...

- Cooked pumpkin were sampled at the caterers for microbiological determination of *aerobes, Staphylococcus spp., Escherichia coli spp. and Salmonella spp.*

Postharvest handling: Maintaining quality and ensuring food safety

- Postharvest handling consists of several components which must be seen as a systematic series of operations aimed at achieving several objectives including:
  - Maintenance of fruit quality
  - Reduced incidence of postharvest diseases
  - Reduction in moisture loss
  - Reducing the risk of food borne illnesses

A good postharvest system involves the following steps:

Harvesting and field operations

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Transportation to packing facility

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Packinghouse operations

Typical postharvest operations

Postharvest losses occur in the present system because of the following reasons:

- Lack of knowledge by growers of the correct stage of maturity
- Rough harvesting and handling during field operations
- Poor transportation operations
- Poor packinghouse operations

Maturity Indices

- Horticultural maturity coincides with physiological maturity in pumpkins.
- Fruits are generally harvested by hand.
- Determination of the correct stage of maturity is critical to shelf life and marketability.

The determination of the correct stage of maturity is essential if:

- One is to obtain the maximum shelf life from this crop.
- Maturity is determined by looking at a number of characteristics while the fruits are still on the vine.

Immature fruits have a very short shelf life:

- lose water rapidly leading to shriveling and
- loss of saleable fresh weight;
- they have a high propensity for developing post
- harvest rots, and
- are easily bruised and
- damaged during postharvest operations because of an underdeveloped peel or rind.

Harvest Maturity Indices

- Several different measurements that can be used to determine harvest maturity, including time after planting, external appearance, hardness of the rind, stem texture, die-back of the tendril nearest the fruit, and internal colour.

Maturity Index -External Appearance

The fruit surface should have a good colour, characteristic of the cultivar;

Immature fruit typically have a bright surface shine that lessens as the fruit matures. The rind of mature pumpkins has a dull

- waxy appearance.
- There will usually be a noticeable lighter coloured ground spot on the fruit underside.

Maturity characteristic – Change in Fruit Colour

Immature developing fruits are shiny green.

As they begin to mature the peel (rind) colour changes from green to yellow starting with the ground colour (i.e. the colour of the peel that is contact with the soil).;

The peel then loses its sheen due to the development of a surface wax.

Maturity Characteristic –Hardness of Rind

- As pumpkins mature, the rind tissue becomes noticeably tougher and harder.
- When the rind is hard enough to resist puncture from the thumbnail or from fingernail scratches, the fruit is mature
- enough for harvest;
- At this stage of development the seeds are also mature

Die-back of the Tendril

- When the tendril starts to dry from natural aging, the fruit is nearly mature;
- When the tendril completely dries, the pumpkin fruit nearest that node is mature and ready for harvest;
- The tendril is a small curly piece which grows on the vine in the joint (node) nearest the fruit;
- A green actively growing tendril indicates the fruit is immature

Change in the stem end of the fruit:

At maturity there is corking of the stem with the stem going from light green to brown and the development of a distinct abscission layer (line of fracture);

The tendrils nearest to the fruits dieback.

Maturity characteristics –Flesh Colour

When assessed objectively there is an intense yellow flesh colour due to carotene synthesis and maximum accumulation of sugars and solids which are well correlated with good eating quality;

- Immature fruit have a cream-coloured flesh. The intensity of internal pulp orange colour will increase as the fruit matures.

Maturity characteristic- Latex flow

Some growers will make a small incision at the stem end to check for latex flow. The absence of latex is indicative of fruit maturity;

Once the incision is small enough the rind heals.

Harvesting and field handling

- Care should be taken when harvesting to maintain the integrity of the product along the postharvest chain.
- Fruits should be harvested in the cooler times of the day - early mornings or late evenings.

Harvest methods

- Pumpkins are manually harvested. A pair of sharp pruning shears is needed to sever the stem and create an attractive, smooth, clean cut;
- The fruit should be carefully clipped off the vine, leaving about a 2.5cm (1 in) stem attached to the fruit;
- A short length of stem should always remain attached to the fruit.

Harvesting of pumpkin: cutting

- Fruits should be harvested by cutting as close as possible to the stem scar without damaging the calyx.
- This calyx serves a protective function since it is waterproof and prevents the entry of organisms which may cause rots in storage.
- Fruits with damaged calyces will rot very quickly after harvesting.
- Fruits which have not been properly trimmed will bruise adjacent fruits during transportation.

Sorting and Grading

- The pumpkins should be put in strong field crates for transport to the collection site or packinghouse;
- Sorting and grading pumpkins in the

field should be done to remove those affected by disease, insects, or physical damage

NAMDEVCO Pumpkin Grading

- There are three grades of pumpkins;
- **Grade 1** pumpkins are free from damage; well-shaped, trimmed, uniform colour and not more than 5 % of the surface area have blemishes including ground spot.
- . **Grade 2** pumpkins are free from damage, well shaped, fairly well trimmed, uniform colour, and not more than 10% of surface area have blemishes or ground spot.

NAMDEVCO Pumpkin Grading

- **Grade 3** pumpkins are free from serious damage, fairly well shaped, fairly well trimmed, fairly uniform colour and have no more than 20% of surface area blemish and ground spot.
- Only grade 1 and 2 are exported from Trinidad and Tobago

Sorting according to size (Kg)

Giant- > 25

Extra large 15-25

Large 10-15

Medium 5-10

Small <5

Field packing and transportation

- Fruits are harvested by hand and thrown to a catcher on the transport vehicle.
- Fruits sometimes fall and are bruised.
- In addition, fruits are roughly placed on the tray of the vehicle which increases the risk of internal bruising.

Field packing and transportation…

- Over-stacking of transport vehicles is quite common resulting in damage to the fruits at the bottom of the pile and substantial bruising on arrival at the packinghouse.
- Pumpkins stacked for transport should not be in piles more than 1 meter deep.

Field packing and transportation…

- In some cases, fruits are transported during the hottest times of the day resulting in high internal fruit temperature and quality losses.
- High core temperatures result in the product spending a longer time to pre-cool.

Preparation for the Market

- High density polyethylene crates can be easily sanitized.
- Sanitization will significantly reduce the risks associated with cross contamination.

Cleaning

- Soil in the ground spot area or other surface stains should be wiped off at the time of harvest with a soft cloth or cotton gloves;
- If washing is required to remove excess soil or to enhance the appearance for a particular market, the wash water should be clean
- and properly sanitized with 150 ppm hypochlorous acid (bleach)maintained at a pH of 6.5.

Cleaning

- This is equal to 2 oz of household bleach per 5 gallons of water, or .3 liters of bleach per 100 liters of water;
- Wash water will need to be changed in order to maintain the hypochlorous acid concentration. The washed fruit should be placed on a flat surface or table to air dry prior to grading

Crates can be sanitized using the procedure outlined below:

Wash crates thoroughly in running tap water

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Apply a food grade degreaser and scrub crates

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Rinse with clean water

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Dip or rinse crates with a food grade non-chlorine sanitizer

Vehicle sanitation

- It is quite common in Caribbean agriculture for farm vehicles to be used for a range of different tasks some of which may compromise the safety of farm produce.
- Farm vehicles that are used for transporting farm produce should not be used for:
  - transporting animal manure and
  - as temporary storage for facilitating pesticide operations.

Vehicle sanitation…

- Vehicles used to transport fresh produce must at all times be properly washed and the trays sanitised.

Trays can be sanitized using the following simple procedure:

Wash tray with clean running tap water

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Scrub with a detergent

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Rinse with clean tap water

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Final rinse with food grade sanitizer

Hazards associated with such packing house facilities include:

- Poor worker health and hygiene
- Poor water quality used for washing
- No postharvest treatments
- No proper washroom facilities
- Conditions which do not exclude pets and birds

Fruits handled in these poor conditions result in high losses to the importer:

- Rejection of entire shipment

Reasons contribute to this problem including: relative humidity

High relative humidity (r.h.) is another concern.

- The best relative humidity (RH) for storage and transport of pumpkins is between 85% to 90%.
- This RH range will minimize postharvest weight loss and avoid the growth of surface molds.
- Fruits which have not been precooled would have higher respiration rates during storage and therefore the relative humidity of the entire storage area will increase.

Relative Humidity

- Holding pumpkins at a RH above 90% will result in more decay.
- Storage at RH's below 80% will result in drying out of the flesh and textural changes.
- Total fruit weight loss during storage should not exceed 15%.

Reasons contribute to this problem including:Temperature Management

- The best temperature for pumpkin storage is 12°C (54°F);
- Healthy pumpkins can be stored for up to 3 months at this temperature without change in quality.
- Storage at average or room temperatures will result in a high weight loss, a decline in eating quality, and loss of surface colour in only a few weeks

Reasons contribute to this problem including: Temperature Management

- Pumpkins are vulnerable to chilling injury (CI) if stored below 10°C (50°F);
- Injury increases the longer the fruit is
- exposed and the lower the temperature.

Reasons contribute to this problem including:Temperature Management

- Early signs of CI include pitting and the formation of sunken water-soaked spots on the rind;
- Development of decay. Long exposure to temperatures below 10°C can result in internal tissue browning, softening, and off-flavour.

Early signs of chilling injury

- Early signs of CI include pitting and the
- formation of sunken water-soaked spots on the rind, and
- development of decay. Long exposure to temperatures below 10°C
- can result in internal tissue browning, softening, and off-flavour.

Principal Postharvest Diseases

- Pumpkins are vulnerable to a number of postharvest diseases;
- Decay can be controlled through good pre-harvest sanitation practices, harvesting and handling the fruit carefully, using a postharvest fungicide dip or spray treatment;
- A hot water dip treatment at 60°C (140°F)
- for several minutes prior to storage may also help to reduce storage rot.

Principal Postharvest Diseases

- Black rot
- Watery soft rot
- Dry rot
- Anthracnose
- Bacterial soft rot

Improving Packinghouse Sanitation

- Good manufacturing practices form the basis of all food plant sanitation including packinghouse sanitation.
- Standard operating procedures and standard sanitary operating procedures are the foundation on which microbial and other kinds of contamination are prevented during packing of produce.
- These procedures are developed written in a sanitation manual.
- All workers must become familiar with the procedures especially those workers who are in charge of enforcing them.

General principles upon which good manufacturing procedures are built are:

1. Written procedures for sanitising restrooms, breakrooms, waste areas, processing areas, floors and storage rooms.
2. Written procedures for sanitising harvesting crates, palettes and vehicles

Local Marketing

Poor postharvest handling practices are common in fruits destined for local markets.

These practices include:

- Poor harvesting and transportation: Fruits are harvested with protruding stems; they are overloaded on trucks and are generally roughly handled in the field.
- Poor on-farm storage exposes fruits to contamination by rodents, cockroaches and birds.

Local Marketing…

- In wholesale and retail markets, it is quite common to see fruits on the ground offered for sale either whole, or as cut pieces.
- Fruits are often seen in conditions which allow for contamination by stray animals.
- Fruits are not treated before being offered for retail sale and often have dirt still present on them at retail stands
- At retail stands fruits are not protected from pests of public health importance.

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