Postharvest Value Addition of Oranges and Mangoes

Teso Womens Development Enterprise Ltd. and Horticulture Innovation Lab Trellis Fund

Prepared by Claire Adkison and Okalo Paul

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PURPOSE OF THE MANUAL

This manual was prepared for use by Teso Women Development Enterprise Ltd. for use in training small-holder fruit farmers in the Teso region of eastern Uganda.

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SECTION 1: Introduction

1.1 Introduction

The purpose of this training manual is to provide information on good postharvest practices and value addition of fruit. Improving postharvest handling of fruits will enhance fruit quality and decrease losses. Value addition of fruit creates the opportunity for turning perishable fruit into a product that can store for longer periods of time. Increased knowledge in these subjects can result in increased income for farmers, availability of nutritious fruit for a longer part of the year, and less fruit wasted.

1.2 Why Postharvest?

Postharvest practices include everything after a crop is harvested to when it gets to the final market or consumer. This includes harvesting, packing, storing, transporting, processing, and marketing of produce. Good postharvest practices will increase the quality and the worth of the product while decreasing the amount that deteriorates. By understanding the optimal conditions for your product, you can decrease losses due to

1.3 Why Value Addition?

Value addition refers to the transformation of a product from its original state to one of enhanced worth. For produce this includes the creation of jams, jellies, juice, pulp, nectar, and dried product that can be sold to businesses, restaurants, and consumers for an increased profit.

Section 2 describes the harvest and postharvest practices that are important to optimize quality of fruit.

SECTION 2: Harvest and Postharvest of Oranges and Mangoes

2.1 Postharvest Basics in the Field

Good fruit quality begins with harvesting and immediately after harvest. Fruit are living – they breathe, respond to temperature changes, and can get injured.

General good postharvest practices:

- Be gentle with produce. Do not drop, throw, or toss fruits. Gently lower fruits to ground or container instead of pouring them out.
- Do not place fruits in the sun. Shade will protect the fruit from damage caused by the sun and prevent it from reaching high temperatures.
- Do not over pack containers or boxes with too many fruit.
- Remove material such as sticks, leaves, or unwanted substances from fruit after harvest.
- If packing into a container, do not place too many fruits in crates, boxes, bags, or baskets as it will damage the fruit.

2.2 Harvesting Oranges

Oranges do not continue to ripen after being harvested, so they must be left on the tree until fully mature. Oranges might remain green even if fully ripe. If you are not sure an orange is ready to be harvested, remove it from the tree and cut it in half with a knife. If juice from the orange drips down and the flavor and color of the pulp are sufficient, the oranges are ready to harvest. When harvesting oranges, cut them off the tree with a bit of stem remaining so the point of attachment from the stem to the fruit does not leave a wound. Any type of

wound on the fruit will cause rapid deterioration as moisture will move out of the fruit and pathogens will move in.

2.3 Postharvest Handling of Oranges

Fruit should be handled gently and with care. They are living tissues that can be bruised, can get too wet, too dry, too hot, too much sun, or too crowded. See general postharvest information for more information.

2.4 Harvesting Mangoes

Mango maturity differs due to varieties. Mangoes will often continue to ripen after harvest. As mangoes grow in trees, it is often difficult to harvest due to the height. Harvesters must take precaution to not injure the fruit when harvesting or lowering fruit to the ground. Using a net with a sharp blade attached can allow for harvest without having to pull the fruit off of the tree. Latex staining can occur in some varieties of mango and precaution should be taken to avoid, see the section below on latex staining.

2.5 Postharvest Handling of Mangoes

Fruit should be handled gently and with care. They are living tissues that can be bruised, can get too wet, too dry, too hot, too much sun, or too crowded. See general postharvest information for more information. Mangoes are sensitive to temperatures that are too cold and the fruit will be damaged if stored at less than 10°C. Mangoes do not have a protective layer around them that aids in protection from damage and therefore will bruise very easily. Extra care should be taken to be gentle with mangoes and to avoid over packing of containers. Packaging should not include more than 2-3 layers of fruit. If it is available, a liner should be placed in between each layer to decrease bruising. Mangoes are sensitive to the sun and should be placed in the shade after harvest. The sun will harm the skin of the mangoes, especially in varieties that are sensitive to latex staining. It will darken the stain and cause an unsightly fruit.

2.6 Latex Staining – Harvest and Post-Harvest Practices for Avoidance of Latex Staining

Some varieties of mangoes have latex in the stem. Upon harvesting, the pressure inside the fruit changes and the latex will come out of the stem, dripping down the fruit. This causes issues as it will stain the skin of the fruit. Latex can also lead to rot and fungal disease. Harvesting immediately after rainfall or early in the morning will cause more latex to come out of the stems. However, this can be avoided if stems are left longer upon harvest. If the mango is separated from the tree with 2 cm or more of stem remaining attached to the fruit, it will not cause the latex to flow out. Once harvested, place the stem pointing downward and trim to 1 cm. Place on racks above the ground so that latex will flow from the cut stem and away from the fruit. The latex will drain out for 20 minutes to 4 hours depending on variety and amount of pressure within the fruit.

In Section 3, the general preparation for processing fruit is described.

SECTION 3: Preparation for Processing

3.1 Fruit Selection for Processing

After harvest, fruit can be sorted to select for which will be processed. If you are not planning on processing all of your harvest, the highest quality fruit can be taken for fresh market while the next best will be utilized for processing. Fruit that are defected or unevenly ripe can be processed, but pieces of the fruit that are damaged, rotting, or immature must be cut off and not included.

Fruit used for processing must be mature and healthy. Using diseased or contaminated fruit will lead to a final product that is of poor quality or not safe to consume.

Do NOT use:

- Unripe or immature fruit
- Fruit with disease, rot, or insects
- Dirty fruit

Do use:

- Mature, good quality fruit
- Cleaned and washed fruit
- Fruit that would not be able to be sold at market but are still high quality

3.2 Food Safety

Extra precaution must be taken to ensure that value added products are of high quality due to food safety. Many harmful microorganisms can live in environments that are high in sugar or moisture. To protect from creating a poor quality product or one that could make people sick, it is important to take great care to maintain good practices. These include personal hygiene, equipment cleaning, creating an acidic environment, and pasteurization.

3.3 Preparing for Processing

Those making value added products should be sure to have clean hands. Fruit should be washed prior to processing. Equipment and supplies that will be utilized should also be cleaned. Bottles or jars that will be utilized should be sterilized (if glass) in boiling water. Plastic containers are not as safe to use, as high temperatures can melt the plastic.

All materials should be on-hand and ready to be used, as the processing can often occur rapidly and it is better to be prepared.

3.4 Materials Needed for Processing

- High quality, ripe fruit with no deterioration or mold
- Clean, sharp knife for peeling and cutting mangoes
- Jars or bottles for juice
- Jars for jam or preserves
- Juice extractor
- Cheese cloth or filter paper
- Thermometer
- Pot large enough to boil filled jars in
- Funnel
- Saucepan to heat the juice for pasteurization
- Thermometer
- Towel to wipe down lids of jars
- Tongs to remove jars from water
- Sugar and lemon juice for addition to processed products

Section 4 provides protocol for creating various value added products.

SECTION 4: Value Addition

4.1 Mango Juice Production

Mango juice can be enjoyed at full strength, diluted with water, or combined with other juices to achieve a delicious and healthful beverage.

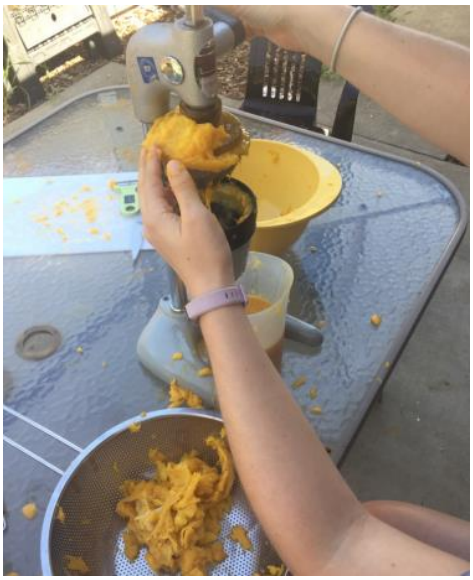
To prepare the mango juice:

- Sterilize glass jars or bottles and lids in clean, boiling water, making sure they are completely submerged for at least 2 minutes.
- Wash fruit, peel, and remove pit.
- Chop remaining mango pieces into cubes. Dip mango pieces into lemon, orange, grapefruit, lime, or some other citrus fruit juice. This will bring the pH (a measure of acidity) of the juice to levels where microorganisms cannot survive. Dipping pieces in citric acid (the juice from citrus) will also prevent browning of mango pieces, which will aid in quality as color is an important factor when consumers choose a beverage.
- Extract juice from mangoes using juice extractor. If no juice extractor is available, mango can be placed in cheese cloth or fabric to be filtered out by squeezing into a bowl.
- If juice is too fibrous, filter through layers of cheese cloth or fabric to remove more pulp.
- The strength, sweetness, and acidity of the juice can be altered to taste, but lemon or lime juice should be added to help decrease the pH. Clean, filtered water can be added to dilute juice to desired strength.
- Pasteurize the juice. The easiest way to pasteurize is to heat the juice in a saucepan or pot over a fire while stirring continuously so that juice on the bottom of the pot does not burn. Juice should be brought up to a temperature of 90°C to be considered pasteurized. Pasteurization, like acidity, is also a step to prevent microorganisms from harming the juice and to decrease processes that would cause deterioration or compromised safety of product.
- Remove jars from boiling water and pour hot juice into the jars. Seal jars.

If using jars or bottles that do not have a sealing mechanism, turn hot jars onto their side for one minute to sterilize the cap. Cool jars in water and store.

If using jars that have a sealing mechanism, jars can be canned with the following instructions.

- Clean the rims and threads of the jar with a towel or piece of clean fabric so that the seal of the lid will close completely. Failure to do so will result in poor sealing and low quality juice that will deteriorate. Screw the lid onto the jar.
- Submerge jars in boiling water again (the same pot can be used as to sterilize the jars). Boil for 10 minutes once water returns to boil to vacuum seal the jars.
- Carefully remove the jars from the hot water and let cool. Seals of jar should “pop” and make a noise as the indentation is vacuum sealed to the jar. If this is not the case, the jar has not been properly sealed. The ring of the lids can be unscrewed to test if the seal of the lid is tight. Rinse jars and label with the date processed.



4.2 Orange Juice Production

Orange juice can be enjoyed at full strength, diluted with water, or combined with other juices to achieve a delicious and healthful beverage.

- Sterilize jars and lids in clean, boiling water, making sure they are completely submerged for at least 2 minutes.
- Cut oranges into quarters.
- Extract juice from oranges.
- If desired, add 30 milliliter of sugar for each 1 liter of juice. Adding lemon or lime juice can prevent the juice from darkening in storage.
- Pasteurize the juice. The easiest way to pasteurize is to heat the juice in a saucepan or pot over a fire while stirring continuously so that juice on the bottom of the pot does not burn. Orange juice should be brought up to a temperature of 70°C to be considered pasteurized. Pasteurization, like acidity, is also a step to prevent microorganisms from harming the juice and to decrease processes that would cause deterioration or compromised safety of product.
- Remove jars from boiling water and pour hot juice into the jars. Seal jars.

If using jars or bottles that do not have a sealing mechanism, turn hot jars onto their side for one minute to sterilize the cap. Cool jars in water and store.

If using jars that have a sealing mechanism, jars can be canned with the following instructions.

- Clean the rims and threads of the jar with a towel or piece of clean fabric so that the seal of the lid will close completely. Failure to do so will result in poor sealing and low quality juice that will deteriorate. Screw the lid onto the jar.
- Submerge jars in boiling water again (the same pot can be used as to sterilize the jars). Boil for 10 minutes once water returns to boil to vacuum seal the jars.
- Carefully remove the jars from the hot water and let cool. Seals of jar should “pop” and make a noise as the indentation is vacuum sealed to the jar. If this is not the case, the jar has not been properly sealed. The ring of the lids can be unscrewed to test if the seal of the lid is tight. Rinse jars and label with the date processed.

4.3 Quality Control for Juice

If it is available, the pH of the juice should be tested. A pH below 4.6 creates an acidic environment and decreases the likelihood of harmful microorganisms surviving. These microorganisms, such as *Clostridium botulinum*, can create very deadly toxins. pH paper is a quick way and cost efficient way to measure the pH of a substance and can be sourced for use with juice.

4.4 Mango Jam

- Sterilize jars and lids in clean, boiling water, making sure they are completely submerged for at least 2 minutes.
- Wash fruit, peel, and remove pit.
- Chop remaining mango pieces into cubes. Dip mango pieces into lemon, orange, grapefruit, lime, or some other citrus fruit juice. This will bring the pH (a measure of acidity) of the jam to levels where microorganisms cannot survive. Dipping pieces in citric acid (the juice from citrus) will also prevent browning of mango pieces, which will aid in quality as color is an important factor when consumers choose a product.
- For each kilogram of mango, the amount of sugar required is 60%. For example, processing 1 kilogram of mango requires 600 grams of sugar.
- For each kilogram of mango, 4 large spoonful's of lemon or lime juice is required.
- Cooking of the jam is accomplished in two stages:

  Step 1) In a saucepan, add the mango, 70% of the sugar, and 50% of the lemon juice calculated per kilogram. Stir continuously.

  Step 2) Add the remaining 30% of sugar and 50% of lemon juice. Stir well and bring to a boil. The mixture will froth but still must be stirred so it will all cook evenly and will not burn.

- Boil to 105°C and cook for about 30 minutes.
- Test whether or not the jam is finished by dipping a cool (not warm or hot) spoon into the mixture. If it is still very liquid-like, it must be heated more.

- If jam continues to be runny, lemon or lime peel can be chopped into slices and added to the jam. The pectin in the peels will aid in solidifying the jam.
- When done cooking, hot jam is filled into the hot jars using a funnel. Use tongs or cloth to grab a jar out of the boiling water. Be careful to not burn yourself. Scoop or ladle the jam into the jar. Leave space (1.25 cm) at the top of the jar.
- Clean the rims and threads of the jar with a towel or piece of clean fabric so that the seal of the lid will close completely. Failure to do so will result in poor sealing and low quality jam that will deteriorate. Screw the lid onto the jar.
- Submerge jars in boiling water again (the same pot can be used as to sterilize the jars). Boil for 10 minutes once water returns to boil to vacuum seal the jars.
- Carefully remove the jars from the hot water and let cool for up to 12 hours. Seals of jar should "pop" and make a noise as the indentation is vacuum sealed to the jar. If this is not the case, this jam has not been properly preserved. The ring of the lids can be unscrewed to test if the seal of the lid is tight. Rinse jars and label with the date processed.

Jars can be stored at room temperature out of direct sunlight for up to one year.

4.5 Orange or Mango Preserves

Fruit can also be processed by placing whole pieces into a solution of sugar and water (concentration to taste) and canning the jars.

- Sterilize jars and lids in boiling water.
- Wash, peel, and cut pieces to desired size and fill in jar.

- Dissolve sugar in water by cooking and stirring.
- Pour sugar water into jar to cover fruit. Be sure to pop any bubbles that form on the sides or bottom of the jar. Leave 1.25 cm of air at the top of the jar.
- Clean the rims and threads of the jar with a towel or piece of clean fabric so that the seal of the lid will close completely. Failure to do so will result in poor sealing and low quality preserves that will deteriorate. Screw the lid onto the jar.
- Submerge jars in boiling water again (the same pot can be used as to sterilize the jars). Boil for 10 minutes once water returns to boil to vacuum seal the jars.
- Carefully remove the jars from the hot water and let cool for up to 12 hours. Seals of jar should “pop” and make a noise as the indentation is vacuum sealed to the jar. If this is not the case, the preserves have not been properly preserved. The ring of the lids can be unscrewed to test if the seal of the lid is tight. Rinse jars and label with the date processed.

Section 5 provides the sources used for information and references for where more information can be located.

SECTION 5: References Used/Further Reading

5.1 References and Further Information

Information was obtained from the following sources. Please refer to these resources for additional information.

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