Importance of Postharvest Technologies in Bangladesh

- Minimization of Postharvest losses
- Nutritional improvement
- Food and financial security of the people of Bangladesh
- Employment generation

Postharvest Technologies of Indigenous Fruits of Bangladesh: Constraints and Opportunities

Name of participants:

1. Dr. Md. Nazrul Islam
   Principal Scientific Officer, Pomology Division
   HRC, BARI, Gazipur-1701
2. Dr. Md. Nazmul Islam
   Senior Scientific Officer
   Postharvest Technology Section, HRC, BARI
3. Mohammad Mostofa, Molla
   Scientific Officer, Postharvest Technology Section
   HRC, BARI, Gazipur
4. Nauma Parvin Lato
   Private Entrepreneurs
   Naktoli Food Products Ltd.
   Savar, Dhaka

Table 1. List of indigenous fruits in Bangladesh (contd..):

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Fruit</th>
<th>Scientific name</th>
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Project A: Maturity indices, handling, chemical treatments, packaging, transportation and storage

Project B: Processing and preservation
Harvesting period
Optimum harvesting period of Gopalgog, Khirshapat, Langra, Fazli, Bombai and Ashina were 84-91, 87-95, 97-105, 112-120, 97-105 and 139-146 days respectively.

Storage life
The mangoes harvested at the above mentioned period was the shelf life 9-10 days at ambient condition (28-32°C).

Assessment of Artificial Ripening Practices
Conducted area
Five regions of Bangladesh like chapaiNawabgonj, Rajshahi, Jessore, Kustia and Modhopur
Ripening practices
The growers and wholesalers practiced different artificial ripening at immature/mature stage for early ripening;
- Calcium carbide
- Ripen-15
- Promote
- Tom tom
Purpose To develop yellow colour within 2-3 days.

Shelf life and quality of mango fruit in zero energy cool chamber
The mangoes were treated with hot water at 55°C and then packed in;
- Non-modified
- Modified
Shelf life
8 days under non-modified and 16 days under modified condition

Extension of Shelf life of Mango
There were three packaging techniques
- Without package
- Polyethylene bag (0.24cm thickness) and bamboo basket with cushioning material (straw)
After carrying in destination place, the fruits were exposure at 3 days of interval
Shelf life
The fruits carried out by bamboo basket with cushioning material had the maximum shelf life
The fruit packed in polyethylene bag accelerated opening and rotting compared to others.

Effect of modified atmosphere packaging on shelf life and quality of mango
Packaging techniques: Three packaging techniques
- Carton and covered with paper
- 0.5% perforated polyethylene bag
- Without paper
Shelf life
Mango packed in carton and perforated polyethylene bag had the maximum shelf life

Minimization of Postharvest Losses of Mango Through Adapting Improved Postharvest Practices
Operations
- The mangoes were sorted based on immature, damage, pest and disease infestation
- Then the sorted mangoes were treated with hot water at 55°C for 5 minutes and then dried through pedestal fan
Packaging techniques
- Corrugated fibre board carton
- Plastic crate and Bamboo basket
Shelf life and Minimization of losses
- The shelf life of mango was increased up to 10-15 days with wrapped in the above mentioned packages
- The minimization of postharvest loss was 38.68%
Postharvest life and quality of mango

Variety: Cavendish

Treatments
Factor A: Postharvest treatments
A1: Sprayed with fresh banana leaves. T1: Treated with rice straw
A2: Sprayed with rice dust. T2: Treated with rice
A3: Sprayed with rice straw and A4: Treated with rice straw
A5: Calcium carbide

Results/Output
- Calcium carbide (2g) is taken in a small cloth bag
- Kept in poly bag containing mango in closed condition for 18, 24 and 32 hours
- mangoes, are taken out from bag and kept under ordinary storage condition (28-32°C)

Results/Output
- Calcium carbide was not suitable for improving colour of mangoes.
- It was also reduced the shelf life of mango

Preparation of mango candy

Preparation
1. Wash the mangoes
2. Cut into 100 grams pieces
3. Take 5 mg calcium carbonate and 10 mg of camphor
4. Then encase in two small polyethylene poly bags
5. Put the product in room temperature (28-32°C)

Project B: Processing and preservation of mango

Colour development of mango

Preharvest treatment: Ethanol was sprayed on the fruits in the plant 3 days after flowering at the rate of 100/200

Results:
- Ethanol was sprayed on the fruits in the plant 3 days after flowering at the rate of 100/200

Postharvest treatment: Cotton was sprayed on the surface of fruits one and two weeks before harvest

Out put
- Spraying of CaCl2 and Ca(NO3)2 did not reflect the chemical parameters of mango species.

Results:
- Sprayed of CaCl2 solution (both 0.5 and 1.0%) increased the shelf life of mango with retention of good surface colour.

Postharvest treatments on shelf life of mango

Variety: Cavendish

Treatments
Factor A: Postharvest treatments
A1: Sprayed with fresh banana leaves. T1: Treated with rice straw
A2: Sprayed with rice dust. T2: Treated with rice
A3: Sprayed with rice straw and A4: Treated with rice straw
A5: Calcium carbide

Results/Output
- The shelf life of mango could be extended using appropriate packaging techniques

Effect of opening materials on mango

Treatments
- The shelf life of mango could be extended in refrigerated conditions

Effect of calcium carbide to improve the colour of mango

Treatments
- Calcium carbide (2g) is taken in a small cloth bag
- Kept in poly bag containing mango in closed condition for 18, 24 and 32 hours
- Mangoes, are taken out from bag and kept under ordinary storage condition (28-32°C)

Results/Output
- Calcium carbide was not suitable for improving colour of mangoes.
- It was also reduced the shelf life of mango
**Preparation of mango jam**

- Ripe mango is procured from the local market.
- Mango pulp is prepared through blending and sieved with 50 mesh.
- Pulp is treated with 30% sugar, mixed and spread on the tray.
- Pulp is dehydrated in a mechanical dryer at 60-32°C until the moisture content reach at 15-75%.
- Products are packed into polypropylene pouches and stored at room temperature (28-32°C).

**Osmotic dehydration of mango**

- Mango (Fazli) is collected.
- The mango is washed with clean water and processed to extract juice.
- The pulp is blended to extract juice.
- Pulp is prepared through blending and sieved with 50 mesh.
- Pulp is dried in a mechanical dryer at 60-32°C.
- The products are cut into 2 cm x 3 cm pieces.
- The pulp is treated with 30% sugar, mixed and spread on the tray.
- Pulp is dehydrated in a mechanical dryer at 60-32°C until the moisture content reach at 15-75%.
- Products are packed into polypropylene pouches and stored at room temperature (28-32°C).

**Preparation of multi fruit leather**

- Evenly ripe mango is procured from local market.
- The pulp is blended and sieved.
- The mixture is added with 600 ppm citric acid.
- The mixture is kept in room temperature (28-32°C) for 3 minutes.
- The pulp is dipped into a syrup solution of 25% sugar and 0.3% KMS and spread on the tray.
- The mixture is dried in a plastic drum.
- The products are cut into 2 cm x 3 cm pieces.
- The pulp is treated with 30% sugar, mixed and spread on the tray.
- Pulp is dehydrated in a mechanical dryer at 60-32°C until the moisture content reach at 15-75%.
- Products are packed into polypropylene pouches and stored at room temperature (28-32°C).

**Standardization of processing method for preparation of green mango juice**

- It is a procedure for preparing green mango juice using a standardized method.
- Different amount of sugar is used in order to maintain total soluble solid content of 65-25 and 35%.
- Sugar is mixed with pulp and then the mixture is heated at 80°C for 3 minutes.
- The mixture is added with 600 ppm citric acid.
- The mixture is kept in room temperature (28-32°C) for 3 minutes.
- The pulp is dipped into a syrup solution of 25% sugar and 0.3% KMS and spread on the tray.
- The mixture is dried in a plastic drum.
- The products are cut into 2 cm x 3 cm pieces.
- The pulp is treated with 30% sugar, mixed and spread on the tray.
- Pulp is dehydrated in a mechanical dryer at 60-32°C until the moisture content reach at 15-75%.
- Products are packed into polypropylene pouches and stored at room temperature (28-32°C).

**Preparation of green mango pickle**

- Green mango is procured from the Research field.
- The pulp is blended and sieved.
- The mixture is added with leftover oil and all powdered spices are added gradually.
- Slices are dipped at different concentrations of sugar (25, 35, 45, and 55%).
- Pulp is mixed with sugar and citric acid is added when TSS become 55.
- Pulp is added with the mixture of CMC, stirred and mixed thoroughly.
- CMC is added with the mixture and heated at 80°C for 5 minutes.
- Products are poured into pre-sterilized glass bottle and stored ambient condition.

**Optimization of processing method for mango fruit bar**

- Ripe mango is procured from local market.
- The pulp is blended and sieved.
- The mixture is added with 600 ppm citric acid.
- The mixture is kept in room temperature (28-32°C) for 3 minutes.
- The pulp is dipped into a syrup solution of 25% sugar and 0.3% KMS and spread on the tray.
- The mixture is dried in a plastic drum.
- The products are cut into 2 cm x 3 cm pieces.
- The pulp is treated with 30% sugar, mixed and spread on the tray.
- Pulp is dehydrated in a mechanical dryer at 60-32°C until the moisture content reach at 15-75%.
- Products are packed into polypropylene pouches and stored at room temperature (28-32°C).
Immature dropped mango powder:
- Harvested, sorted, and cleaned mangoes
- Watered and sun-dried
- Sliced and washed with clean water
- Peeled and sliced into thin pieces
- Dried slices are ground and sieved to obtain powder
- Powder is fortified to enrich nutrients
- Stored at ambient condition for 2 months

Selection of mango variety for preparation of nectar:
- Variety: Langra
  - Performed better for preparation of nectar considering its organoleptic test and nutritional analysis
- Other varieties: Fazli, Gopalbhog, Khirshapat, and Surjapuri

Immature dropped mango drink:
- Variety: Langra
  - Selected for preparation of nectar
  - Mangoes are washed, peeled, and pulp is separated from the stones through blending and sieving with a fine cloth

Jackfruit project:
- A: Maturity indices, handling, chemical treatments, packaging, transportation, and storage
  - Fruits were harvested from time to time and were ripened naturally and artificially
  - Artificially ripening was done by inserting an iron probe
  - Jackfruit harvested at an early stage took more time to ripen on their own than those harvested subsequently
  - The artificial ripening caused ripening after 3 days while the natural ripening caused more than 3 days from harvest to storage

Project-B: Processing and preservation

Preparation of jackfruit candy:
- Select half ripe (Khaja) jackfruit
- Washing with clean water
- Cut into 1x0.5x0.5 cm pieces
- Blanch the pieces in hot water at 95°C for 4 minutes
- Immerse in 2% calcium lactate and 0.1% KMS for 2 hours
- Drain and dip into 25, 35, 45, 50, 60, and 70°C after 12 hours interval
- Drain the slices and wash with clean water to remove adhering syrup
- Dry at 70°C in a cabinet dryer until the moisture content reaches 10%
- Pour the product into polypropylene pouches

Preparation of Jackfruit candy:
- Storage periods: 6 months
Preparation of jackfruit chips

Select mature (Khaja) jackfruit
Washing with clean water
Cut into 4x2 cm pieces
Blanch the pieces in hot water at 95°C for 5 minutes
Fry the slices at 60°C for 1 hour and 70°C for 6 hours to save oil
Finally fry the slices at 160°C in palm oil and stirred with narrow stick
Put out the slices from the pan and mix with salt and gloves
Pour the product into ALPE pouch

Preparation and packaging of jackfruit chips

Storage periods: 4 months

Preparation of jackfruit leather

Select fully ripe jackfruit
Washing with clean water
Cut into half lengthwise
Take bulb and remove seeds
Blend the bulb with 10-15% sugar and boil for 5-7 minutes to extract juice
Add KMS (0.1g/kg) and then boil for 3-5 minutes
Concentrate the mixture with steam jacket pan
Spread the mixture in a stainless steel tray
Put the tray in cabinet dryer and dry at 60°C for 20 hours
Cool and store in polypropylene pouches

Jackfruit leather

Storage periods: 4 to 6 weeks at room temperature

Preparation of jackfruit jam

Select the fully ripe jackfruit
Washing with clean water
Cut into half lengthwise
Take bulb and remove seeds
Blend and boil for 5-7 minutes and extract juice
Add sugar (700g) and pectin (10g) with juice
Cook up to TSS 640 and add citric acid (0.25%)
Determine end point through flake test
Sterilize bottle and pour into bottle and then waxing

Jackfruit jam

Storage periods: One year

Preparation of jackfruit rind jelly

Select fully matured, fresh ripe jackfruit
Washing with clean water
Rind separation and cutting into small pieces
Add water and citric acid @ 1.5lit./Kg and 2 g/Kg
Boil for 35 minutes and extracting juice
Add sugar and 200mg citric acid with juice, start cooking
Cook up to TSS 650 and add more citric acid
Determine the end point of cooking
Pour into bottle and waxing

Jackfruit rind jelly

Storage period: One year

Preparation of Jackfruit pickle

Select pre-mature Jackfruit
Washing up to cleaning
Peeling and slicing
Dipping in 5% brine solution for 24 hours for fermentation
Removing slices from the brine solution and washed with clean water
Frying the slices in mustard oil for 10 minutes
Adding the pasted ginger and garlic with 4ml glacial acetic acid
Adding all measured spices one by one
Add glacial acetic acid (10ml) and cook for 3-5 minutes
Sterilizing bottle
Pour the product into bottle
Store at room temperature

Jackfruit pickle

Storage period: One year
**Jackfruit Pickles**

**Preparation of Jackfruit Hot Pickle**
- Collect green jackfruit.
- Wash with clean water.
- Peel and slice the jackfruit.
- Dip in a brine solution.
- Remove from the brine solution.
- Blanch.
- Add fried spices and mustard oil.
- Sauté and add rest spices and vinegar.
- Continue sautéing up to final cooking.
- Bottle and cap.
- Pasteurize at 85°C.
- Clean and label.
- Store in a cool and dry place.

**Storage Period:** One year

**Preparation of Jackfruit Sweet Pickle**
- Collect fully matured but not yet soft, fresh jackfruit.
- Wash reasonably.
- Separate the bulb and separate the seeds.
- Slice the bulb, ginger, and pepper.
- Mix the slices of bulb, ginger, and pepper.
- Pour the mixture in a bottle, add syrup, and cap.
- Pasteurize at 85°C.
- Clean bottles and label.
- Store in a cool and dry place.

**Storage Period:** One year

**Preparation of Jackfruit Nectar**
- Select ripe jackfruit.
- Wash with clean water.
- Extract the bulb and remove the seeds.
- Blend the bulb and pass through a pulping mill.
- Mix with 10% hot water and pass through a fine sieve.
- Pour the prepared nectar into a bottle.
- Store in a cool and dry place.

**Preparation of Jackfruit Squash**
- Select ripe jackfruit.
- Wash with clean water.
- Cut into small pieces.
- Blend the bulb with 1/4th of water and heated at 80-88°C for 10-15 minutes.
- Pass through a sieve or strain to get a smooth puree.
- Add 3/4th of water with sugar and heated in a boil.
- Mix the syrup with the prepared jackfruit puree.
- Add citric acid and KMS, then stir to get a squash.
- Sterilize the bottles.

**Dehydration of Jackfruit**
- Select ripe jackfruit.
- Wash with clean water.
- Cut into 1x3x5 cm slices.
- Drain and dip into 25, 35, 45, 50, 60, and 70°C after 12-hour intervals.
- Drain the slices and wash with clean water to remove adhering syrup.
- Dry at 70°C in a cabinet dryer until the moisture content reaches 10%.
- Pour the product into a polypropylene pouch.

**Canning of Jackfruit**
- Select khaja jackfruit.
- Wash with clean water.
- Extract the bulb as in jackfruit nectar.
- Dissolve the bulb in sugar, water, and citric acid at the rate of 5g/kg.
- Immerse in 50°C syrup with 0.5% citric acid and heated at 80-88°C.
- Fill the can with prepared fruit and syrup.
- Pour the product into a can and exhaust at 82°C.
- Seal the can and cool immediately.
Prolonging shelf life of banana
* Mature banana (sabri, sugar and Champa) of uniform size, shape and colour were harvested from the farmers field annually.
* The banana treated with different postharvest treatments like vacuum treatments (control), partially peeled polyethylene bag, fully peeled polyethylene bag with ethylene absorber, paraffin coated and paraffin coated with ethylene absorber.

Results/Output
Fruits packed in partially vacuum polyethylene bag (Banana) were grown and stored up to 20 days storage while it was 7 days (champa) and 2 days at ambient condition (20-22°C).

Effect of different ripening methods on quality of banana
Factor A: Variety with two levels (BARI Kola and Sabri) and ethrel
* Bio Control: B10, Ripen-15, 0.00 ppm
* Bio-3, Ripen-15, 0.00 ppm
* Bio-3, Ripen-15, 75 ppm
* Bio-3, Ripen-15, 150 ppm
* Bio-3, Tundur 12 hours
* Bio-3, Tundur 36 hours and
* Bio-3, Tundur 72 hours and
* Bio-3, Tundur, coated with paraffin and ethrel treated for 36 hours.

Factor B: Packaging techniques with two levels
* Plastis deformed polyethylene bag and
* 10% non-perforated polyethylene bag.

Results/Output: Fruits treated in Tundur at 36°C for 15 hours and packed in non-perforated poly bag prolonged the shelf life with good quality.

Effect of ripening chemical on the quality of banana
* Different concentrations of ethrel solution viz. without ethrel, 2.4, 6 and 10ml ethrel/l of water were used for ripening of banana (tropical sugar).
* Banana treated with 10ml ethrel/l of water had activated very early (7 days) and more uniform ripening than untreated banana (bana).
* Unripened banana was light yellowish colour and medium soft texture while treated banana showed attractive yellowish colour and very soft texture.
**Project B: Processing and Preservation**

**Preparation of Banana Chips**
- Fully mature banana is taken and peeled.
- The banana is cut into 2mm thickness and blanched for 3 minutes.
- Dried slices are fried in palm oil and stirred with a narrow wooden stick.
- When slices obtain light yellow colour, the chips are put out from the saucepan.
- Mixed with tasting salt and spices in a bowl.
- Processed chips are packed in metalex foil pouches.
- Stored in an ambient temperature (28-32°C).

**Osmotic dehydration of banana**
- Ripe banana is selected.
- Washed with clean water.
- Cut into 2-3mm slices.
- Dipped in 45°C sugar syrup containing 1000 ppm KMS and 0.5% citric acid and kept for 6 hours.
- The slices are dehydrated in a mechanical dryer for three days.
- Dehydrated banana packed in HDPE pouches and stored at ambient condition.

**Preparation of mixed banana ketchup**
- Over ripe banana, deep colour tomato, matured papaya and ripe tamarind is blended to prepare pulp.
- The double amount of water is added with pulp.
- Calculated sugar and salt mixed with pulp and cooked in a saucepan.
- Grinded spices with onion and garlic are wiped in a thin cloth and put into the pulp and stir continuously.
- All calculated ingredients are added gradually in a saucepan.
- Sodium benzoate is added as preservative when TSS became 21-26°B.

**Suitability of banana varieties in relation to preparation of banana chips**
- BARI Kola-1 and BARI Kola-2 is selected.
- The banana is cut into 2mm thickness and blanched for 6 hours.
- Dehydrated banana is packed in HDPE pouches and stored in ambient condition.

**Project A: Maturity indices, handling, chemical treatments, packaging, transportation and storage**

**Litchi**
Extension of shelf life of litchi

**Treatments**

**Factor: packaging techniques**
- **Ao:** Without package
- **A1:** Sealed polyethylene bag
- **A2:** 0.5% perforated polyethylene bag
- **A3:** Browning paper

**Factor: Storage techniques**
- **Bo:** Ambient condition
- **B1:** Zero energy cool chamber and refrigerator temperature (0-4°C)

**Results/output**
- Fruits packed in sealed polyethylene bag (0.09mm thickness) and kept in refrigerator had the maximum shelf life (105 days)

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Preservation of Litchi in syrup solution

Preservation of litchi and jaifruit slices in glass or plastic container covering with 30-40% B sugar syrup makes the product shelf stable.

Storage periods: 12 months

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Extension of storage life of pineapple

The fruits (var. Giant kew) treated with SO2 and hot water and packed in perforated polyethylene bag at ambient condition increased the storage periods 21 days compared to sealed polyethylene bag.

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Storage at low temperature

**Factor A: postharvest treatments**
- **Ao:** Blanched and
- **A1:** Unblanched

**Factor B: storage condition**
- **Bo:** Refrigerator and
- **B1:** Deep freeze

**Results/Output**
- The blanched fruit and stored in deep freeze had better considering its retention of colour, texture, less weight loss and spoilage.

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Preservation of pineapple candy

- Blanch the fruit in hot water at 95°C for 4 minutes
- Immerse in 2% calcium lactate and 0.1% KMS for 2 hours
- Drain and dip into 25, 35, 45, 50, 60, and 70°C after 12 hours interval
- Drain the slices and wash with clean water to remove adhering syrup
- Dry at 70°C in a cabinet dryer until the moisture content reach at 10%
- Pour the product into polypropylene pouch

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Storage of pineapple:
- Pineapple is taken matured and half ripen pineapple is taken
- Washing with clean water
- Cut into 1x0.5x0.5 cm pieces
- Blanch the pieces in hot water at 95°C for 4 minutes
- Immerse in 2% calcium lactate and 0.1% KMS for 2 hours
- Drain and dip the pieces in 25, 35, 45, 50, 60 and 70°C after 12 hours interval
- Drain the slices and wash with clean water to remove adhering syrup
- Dry at 70°C in a cabinet dryer until the moisture content reach at 10%
- Pour the product into polypropylene pouch
- Store the product at room temperature (28-32°C)
Osmotic dehydration of pineapple

1. Dip pineapple in syrup
2. Wash with clean water
3. Cut into 2-3 mm slices
4. Dipped in 60-70°C sugar syrup containing 1000 ppm KMS and 0.50% citric acid for 1.5 hours
5. Dehydrated products packed in polypropylene pouches and stored in ambient condition

Preservation of pineapple in syrup solution

Pineapple preserved in 30-40°C syrup solution and poured into glass container. The products containing glass container were exhausted and preserved in ambient condition. The shelf life of the products more than one year

Foam-mat dried powder from pineapple

1. Mature pineapple is collected from the Research field
2. Washing with clean water
3. The slices treated with firming agent and dried as per principle of foam-mat drying
4. Foam is created in the stary by incorporation of egg albumin followed by the air incorporation in a blender
5. TIen the powder is packed in HDPE
6. Stored at ambient condition for 3 months

Project-B: Processing and preservation

Guava (Psidium guajava)

Preparation of guava fruit cheese

1. The guava slices were soaked in the syrup of fruit to water 2:1
2. Amount of acidity depends on the amount by subtracting the content of acid present in the pulp
3. Sugar, citric acid and butter added and cooked up to TSS become 85°B
4. Then cooking is stopped and immediately spread on the trays with 0.6 cm thickness
5. The fruit cheese cut into 3 cm x 6 cm slices and packed into polypropylene pouches and stored at ambient condition for one year

Optimization of processing methods for guava pulp preservation

1. Guava sliced and cooked with addition of water at the ratio of fruit to water 2:1
2. The pulp is boiled in pre-sterilized glass containers
3. The treated pulp is dried at ambient condition at 60°C

Papaya (Carica papaya)

Preparation of papaya fruit cheese

1. The papaya slices were soaked in the syrup of fruit to water 2:1
2. Amount of acidity depends on the amount by subtracting the content of acid present in the pulp
3. Sugar, citric acid and butter added and cooked up to TSS become 85°B
4. Then cooking is stopped and immediately spread on the trays with 0.6 cm thickness
5. The fruit cheese cut into 3 cm x 6 cm slices and packed into polypropylene pouches and stored at ambient condition for one year
Minimization of Postharvest Losses of Papaya through Improve Postharvest Practices

Papaya treated with different postharvest treatments:
• Wash with tap water
• Wash with chlorine
• Treated in hot water
• Treated in hot water with sodium hypochlorite

Results/Output:
• Treated papaya performed better compared to untreated
• Postharvest diseases, physiological loss in weight and bruising could be minimized by wrapping without excessive deterioration
• Physical damage could be minimized by using plastic crate

Preparation of papaya candy

Minimization of Postharvest Losses of Ber through Improve Preservation

Marketing life and quality of ber as affected by storage condition and packaging
• Fresh fruits of ber variety, BARI Kul-2 were harvested at colour turning i.e. greenish-yellow stage from Fruit Research Farm and packed in 0.9% perforated polythene bag and non-perforated polythene bag after removing field heat
• Then the packed fruits put into plastic crates and CF8 carton
• Stored at ambient condition and zero energy cool
• The marketable life of fruits packed in non-perforated polythene bag kept in plastic crates was 5.75 days followed by ambient condition (4.40 days)
Preparation of mixed ber and tamarind chutney

- The ber and tamarind is dried at the rate of 1:0.20
- Seeds of ber and tamarind are removed
- All spices are powdered
- All measure precision were added gradually
- The products were poured into pre-sterilized glass bottle
- The products are stored under ambient condition (28-32°C)

Preparation of candies from immature palmyra palm seed

- Immature seed of palmyra palm is peeled and cut into eight pieces
- The slices are treated with preservative and firming agent
- The slices are pricked, blanched and then kept into 25°C sugar solution
- By slow heating, concentration of syrup maintained into 70°C for candies
- The prepared candies packed in polypropylene pouches
- The products are shelf-stable more than one year

Preservation of Palmyra palm

- The fruit was washed with clean water
- Peeled and kneaded with thumb adding one-third water of peeled fruit
- The extracted pulp was filtered by thin clean cloth
- All calculated ingredients are added gradually
- The jelly is maintained into TSS 55°C and 58°C
- Sodium benzoate is added (before 2-3 minutes) and cooking is stopped, when the jelly reached 66° Brix
- The products are shelf-stable more than six months

Production of jam from palmyra palm

- The fruit was washed with clean water
- Peeled and kneaded with thumb adding one-third water of peeled fruit
- The extracted pulp was filtered by thin clean cloth
- All calculated ingredients are added gradually
- The pectin and citric acid is added when the TSS reaches at 55°C and 58°C
- Sodium benzoate is added (before 2-3 minutes) and cooking is stopped, when the jelly reached 66° Brix
- The products are shelf-stable more than six months

Wax Jambu (Eugenia javanica)

- The fruit was washed with clean water
- Peeled and kneaded with thumb adding one-third water of peeled fruit
- The extracted pulp was filtered by thin clean cloth
- All calculated ingredients are added gradually
- The jelly is maintained into TSS 55°C and 58°C
- Sodium benzoate is added (before 2-3 minutes) and cooking is stopped, when the jelly reached 66° Brix
- The products are shelf-stable more than six months
**Extension of shelf life of wax jambu**

The fruits packed in polyethylene bag and kept in refrigerator had the maximum shelf life (15 days) compared to ambient condition.

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**Golden apple (Spondias pinnata)**

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**Preparation of mixed jam from golden apple**

- Take the fruit, equal amount of sugar and pectin.
- Calculate the sugar and pectin required.
- Add all calculated ingredients in a saucepan.
- Adding citric acid when the TSS reached at 55\(^{\circ}\)B and 58\(^{\circ}\)B.
- Sodium benzoate is added before 2-3 minutes and cooking is stopped when the jelly reached at 65\(^{\circ}\)Brix.
- The products are poured into pre-sterilized glass bottle at ambient condition.

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**Preparation of mixed jelly from golden apple**

- Take the fruit, equal amount of sugar and pectin.
- Calculate the sugar and pectin required.
- Add all calculated ingredients in a saucepan.
- Adding citric acid when the TSS reached at 55\(^{\circ}\)B and 58\(^{\circ}\)B.
- Sodium benzoate is added before 2-3 minutes and cooking is stopped when the jelly reached at 65\(^{\circ}\)Brix.
- The products are poured into pre-sterilized glass bottle at ambient condition.

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**Preparation of golden apple fruit cheese**

- Take the fruit, equal amount of sugar.
- Amount of citric acid is calculated as 1.75% on the basis of weight of sugar.
- Adding of acidity is stopped on the point of making of golden color.
- Pulp is spread in dehydrator and spread on the trays with 0.6 cm thickness.
- The fruit cheese cut into 3 cm X 6 cm slices and packed into polypropylene pouches and stored at ambient condition for one year.

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**Indian Olive (Elaeocarpus floribundus)**

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**Project-B: Processing and preservation**
Preparation of Indian olive pickle

- Mature olive fruits are taken and washed.
- Fruits are cut into pieces and salt cured with 10% brine for 24 hours.
- Ginger and garlic are sliced and made into paste with an equal amount of water.
- All calculated spices are powdered.
- Turmeric and chilli powder are mixed with the paste.
- Mixture is added with leftover oil and all powdered spices are added gradually.
- Salt and acetic acid is added and cooked up to complete removal of water.

Indian dillenia (Dillenia indica)

Project-B: Processing and preservation

Preparation of chutney from Indian dillenia

- Mature dillenia fruits are taken and washed with clean water.
- Fruits are sliced into fingers.
- The fruits are sliced into fingers and cooked in a pan with equal amount of water for an hour.
- Eighty percent fibres are removed from this pulp.
- All measure powdered spices are added gradually.
- Glacial acetic acid is added when TSS reached at around 56 oB.
- The cooking is stopped when TSS reached at around 62 oB.

Indian dillenia chutney

Lotkon

Project-A: Maturity indices, handling, chemical treatments, packaging, transportation and storage

Lotkon were kept under different packaging and storage conditions. Fruits packed in sealed poly bag with ethylene absorber under refrigerator had the maximum shelf life compared to without ethylene absorber.
**Preparation of Bael beverage**

The bael is broken, fibres and other mucilage’s removed.

The bael pulp (16%), sugar (11.07%), citric acid (0.28%), KMS (0.06%), carboxymethyl cellulose (CMC: 0.2%) and water is taken.

Sugar and citric acid mixed with water and the mixture is heated to prepare syrup.

Then CMC is mixed with hot syrup, cooled and blended for 2 minutes.

Blended beverage again filtered through a fine mosquito net.

KMS is added and stirred thoroughly for uniform mixing.

The products are poured into pre-sterilized glass bottles at ambient condition.

**Preparation of Tamarind sauce**

The bala is broken, fibres and other mucilage’s removed.

The bala pulp (16%), sugar (11.07%), citric acid (0.28%), KMS (0.06%), carboxymethyl cellulose (CMC: 0.2%) and water is taken.

Seeds and fibres are removed by sieving mash.

Grinded spices with onion and garlic are binded in a thin cloth and put it into the pulp and stir continuously.

Sodium benzoate is added, and cooking is stopped, when the jelly reached at 45 Brix.

The products are poured into pre-sterilized glass bottles at ambient condition.
Preservation of green coconut water

- The water is taken from green coconut
- The green coconut water is heated at 90 and/or 100°C for 10 minutes
- The heated water is poured into pre-sterilized bottle
- The product is stored at ambient condition
- The product was shelf-stable up to 6 months storage periods

Optimization of processing parameters for coconut candy

- Different amounts of sugar and rice malt are used with same amounts of coconut milk and flavoring materials
- Fifty percent coconut milk +25% rice malt + 25% sugar
- The products were shelf-stable up to 6 months of storage.

Preparation of aonla candy

- Fully matured aonla is taken
- Washing with clean water
- By separating seed, aonla is cut into four pieces
- Aonla slices pricked by bamboo made stick
- Immerse in 2% calcium lactate and 0.1% KMS for 2 hours
- Drain and dip into 25, 35, 45, 50, 60, and 70°C after 12 hours interval
- Drain the slices and wash with clean water to remove adhering syrup
- Dry at 70°C in a cabinet dryer until the moisture content reach at 10%
- Pour the product into polypropylene pouch
- Store the product at room temperature (28-32°C) for 6 months
**Constraints of Postharvest Technologies in Bangladesh**

- Lack of linkage among the different government organizations, universities, and private organizations at national level
- Inadequate national policy to develop and disseminate postharvest technologies of indigenous fruits and their cold chain management
- Lack of adequate training programme on postharvest technologies of indigenous fruits and their cold chain management
- Lack of Research strategy to develop full postharvest technological packages for individual crops
- Lack of cold chain management practices from harvest to consumption level
- Lack of users especially growers and wholesalers response to adopt the postharvest Technologies
- High cost of improve postharvest practices compared to traditional practices
- Lack of permanent awareness to purchase improved postharvest technological products
- Lack of entrepreneur’s interest to invest money on processing and preservation of indigenous fruits
- Lack of promotional activities to encourage the SMEs to enhance postharvest Technologies of indigenous fruits.

**Opportunities**

- Developing postharvest technologies of indigenous fruits with their diversified products
- To develop simple low-cost postharvest technologies for small scale farmers
- Returning nutritive value through value addition
- Establish integrated postharvest Horticulture management, marketing and Services Center
- Develop value chain and supply chain of horticultural crops
- Develop linkage among SMEs, University, Research and Private organizations

**Conclusion**

- Some of the post-harvest technologies of indigenous fruits are already developed and very popular among the users and producers but cost in recovering capital and returnable value is still high
- There is a tremendous scope to develop cold chain and integrated postharvest management and services centre in Bangladesh
- Increase consumption of processed products will prevent the incidence of malnutrition disease and generate more income to the farmers and traders
- It is therefore, high time in accelerating postharvest losses of indigenous fruits through improved postharvest practices especially cold chain management.