



Postharvest Technologies of Indigenous Fruits of Bangladesh: Constraints and Opportunities

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BANGLADESH PROFILE

- North-eastern part of South Asia
- Stretching between 20.34° & 26.38° N latitude and between 88.01° and 92.41° E longitudes
- Diverse ecosystems like, hills, plains, coastal and wet lands
- The climate is tropical and sub-tropical
- High and medium high land are mostly suitable for fruit production
- Rabi (cool and dry months: October-March) and kharif (hot and humid months: April-September)
- Most of the fruits are produced in kharif season

Importance of Postharvest Technologies in Bangladesh

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

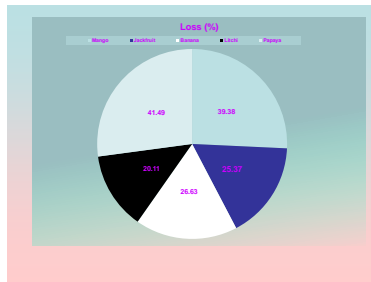


Table 1. List of indigenous fruits in Bangladesh

Sl. No.	English	Bengali	Scientific name	Family
1	Amloki	আমুলি	<i>Emblica officinalis</i>	Euphorbiaceae
2	Banana	কালা	<i>Musa spp.</i>	Musaceae
3	Bael	বেল	<i>Aegle marmelos</i>	Rutaceae
4	Ber	কুল	<i>Zizyphus mauritiana</i>	Rhamnaceae
5	Bilimbi	বিলাম্বি	<i>Azadirachta indica</i>	Asteraceae
6	Bullock's heart	আঁস	<i>Annona reticulata</i>	Annonaceae
7	Burmese grape	লটকা	<i>Baccaurea sapida</i>	Euphorbiaceae
8	Carabola	কামরাঙ্গা	<i>Averrhoa carabola</i>	Asteraceae
9	Cashewnut	কাশুনাড়	<i>Anacardium occidentale</i>	Anacardiaceae
10	Coconut	নারীসল	<i>Cocos nucifera</i>	Palmaeae
11	Cowa	কাগুফল	<i>Garcinia cowa</i>	Annonaceae
12	Custard apple	শারিফ	<i>Annona squamosa</i>	Euphorbiaceae
13	Date palm	খিজুর	<i>Phoenix zeyheria</i>	Palmaeae
14	Dracontomelon	কাড়াল	<i>Ferula draco</i>	Rutaceae
15	Flacourtia	লুকুলি	<i>Flacourtia jampouzei</i>	Flacourtiaceae
16	Gilani apple	বিলাই আম	<i>Spondias pinnata</i>	Anacardiaceae
17	Guava	গুয়া	<i>Psidium guajava</i>	Myrtaceae
18	Hooploom	দুইশ আম	<i>Spondias dulcis</i>	Anacardiaceae

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

Sl. No.	English	Bengali	Scientific name	Family
19	Indian dillenia	চুলি	<i>Dillenia indica</i>	Dilleniaceae
20	Indian goose	জাম্বি	<i>Eleocharis floribunda</i>	Eleochariaceae
21	Jackfruit	কাঁচালা	<i>Artocarpus heterophyllus</i>	Moraceae
22	Jaman	জাম	<i>Syzygium cumini</i>	Myrtaceae
23	Kanada	কানাদা	<i>Cordia alliodora</i>	Apocynaceae
24	Lemon	লেমন	<i>Citrus limon</i>	Rutaceae
25	Lima	কাঞ্জি লেমা	<i>Citrus aurantifolia</i>	Rutaceae
26	Litchi	লিচু	<i>Litchi chinensis</i>	Sapindaceae
27	Mango	আম	<i>Mangifera indica</i>	Anacardiaceae
28	Mahagonur plum	মাহাঙ্গুর আম	<i>Flacourtia indica</i>	Flacourtiaceae
29	Mandarin	কামাটা	<i>Citrus reticulata</i>	Rutaceae
30	Monkey jack	ডেমা	<i>Artocarpus lakucha</i>	Moraceae
31	Papaya	পেপা	<i>Carica papaya</i>	Caricaceae
32	Pineapple	আনারস	<i>Annona comosoides</i>	Bromeliaceae
33	Palmira palm	তাল	<i>Borassus flabellifer</i>	Palmaeae
34	Passion fruit	প্যাসিফল	<i>Passiflora edulis</i>	Passifloraceae
35	Pine	পিনা	<i>Cedrus deodora</i>	Taxaceae
36	Pumelo	বাতাবিহা	<i>Citrus grandis</i>	Rutaceae

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

Sl. No.	English	Bengali	Scientific name	Family
37	Pomegranate	ভালি	<i>Punica granatum</i>	Punicaceae
38	Rose cherry	রাভ	<i>Shorea pterocarya</i>	Faboaceae
39	Rose apple	গোলাপ	<i>Syzygium jambos</i>	Myrtaceae
40	Sapota	সুফটা	<i>Artocarpus zapota</i>	Moraceae
41	Sarkara	সারকা	<i>Citrus microcarpa</i>	Rutaceae
42	Star gooseberry	আঁসুল	<i>Phyllanthus acidulus</i>	Euphorbiaceae
43	Tamarind	তামার	<i>Tamarindus indica</i>	Leguminosae
44	Tulsi	তুলসি	<i>Ocimum sanctum</i>	Lamiaceae
45	Velvet apple	বেলি গাভ	<i>Diospyros velvetea</i>	Ebenaceae
46	Water chestnut	পাংশাল	<i>Trapa natans</i>	Trapaceae
47	Wax jamba	জাম্বা	<i>Eugenia jambon</i>	Myrtaceae

Postharvest Technologies of Indigenous Fruits

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

Project-B: Processing and preservation

Mango

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

Maturity indices of mango

Cultivars:

- Gopalbhog
- Khirshapat
- Langra
- Fazli
- Bombai and
- Ashina have been standardized

Harvesting period

Optimum harvesting period of Gopalbhog, 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 9-10days 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 2-3days.

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 and Modified

Shelf life

- 8 days under non-modified and 10 days under modified condition

Extension of Shelf life of Mango

There were three packaging techniques

- Without package
- Polyethylene bag (0.04mm thickness) and
- Bamboo basket with cushioning material (straw)

After carrying in destination place, the fruits were exposed to 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 ripening 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 10-15days with wrapped in the above mentioned packages
- The minimization of postharvest loss was 38.68%

Postharvest life and quality of mango
 Variety: Langra
 Treatments
 Factor A: Concentrations
 A₀= 0.5% and
 A₁=1.0%
 Factor B: Chemical treatments
 B₀=CaCl₂ and
 B₁= Ca(NO₃)
 Operational system: Sprayed on the surface of the fruits one and two weeks before harvest
 Out put
 • Spraying of CaCl₂ and Ca(NO₃) did not reflect the chemical parameters of mango
 • Spraying of CaCl₂ solution (both 0.5 and 1.0%) increased the shelf life of mango with retention of good surface colour

Colour development of mango
 Preharvest operation: Ethrel was sprayed on the fruits in the plant at 80days after flowering at the rate of 150,200 and 250ppm.
 Postharvest operations: After harvest, the ethrel was sprayed in the bamboo basket contained mango at the rate of 0.2ml, 0.4ml and 0.6ml and then soaked with tissue paper
 Results
 • Preharvest spraying of ethrel (150,200 and 250ppm) on the fruits in the plant showed less response to develop colour
 • Maximum yellow fruits (56%) were obtained fruits treated with 250 ppm followed by 150 and 200 ppm.
 • Physical parameter (fruit weight, pulp, seed, skin etc.) and chemical parameters (TSS, sugar, acidity, pH etc.) were not affected by the ethrel

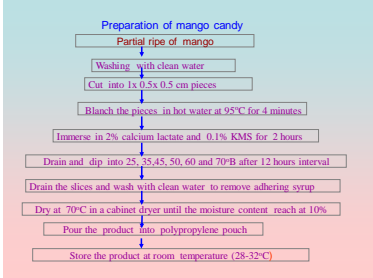
Postharvest treatments on shelf life of mango
 Variety: Carabao
 Treatments
 Factor A: Postharvest treatments
 A₀= Treated with bavistin (500ppm)
 A₁= Hot water treatment at 55°C for 5 minutes
 A₂= Ethylene absorber
 Factor B= Packaging techniques
 B₀=Packed in poly bag without ethylene absorber
 B₁=Packed in poly bag with ethylene absorber
 Results/Out put
 • The minimum rotting percent were packed in polyethylene bag with ethylene absorber
 • Minimum physiological loss was fruits treated with bavistin.

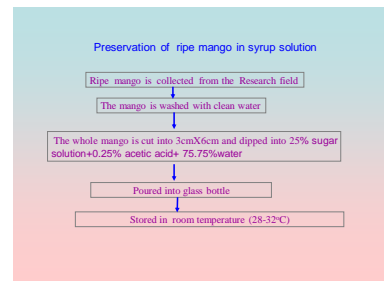
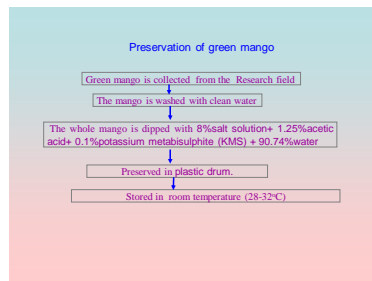
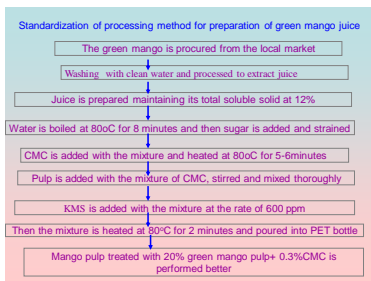
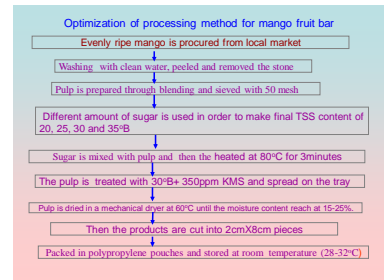
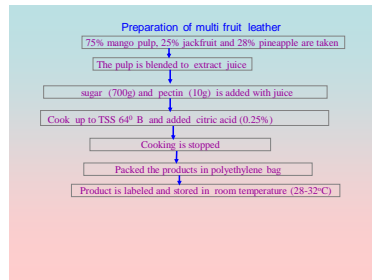
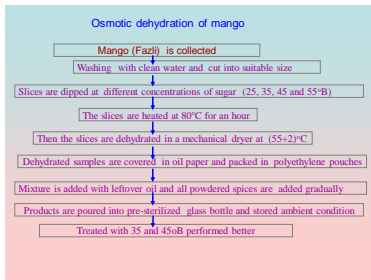
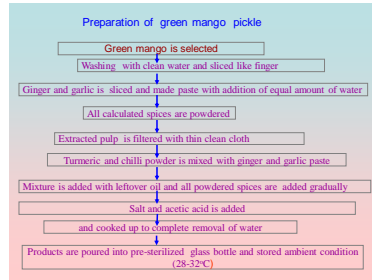
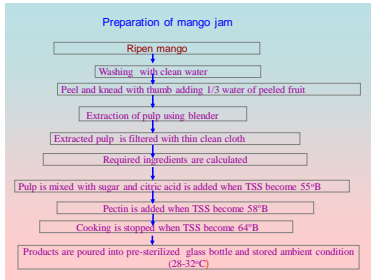
Extension of shelf life of mango under different storage conditions
 Variety: Langra
 Treatments
 Factor A= Packaging techniques
 A₀=without package
 A₁= Sealed poly bag and
 A₂=Perforated poly bag
 Factor B= Storage conditions
 B₀=Ambient condition
 B₁= Deep freeze and
 B₂= Refrigerator
 Shelf life
 The shelf life of mango could be extended in refrigerator condition.

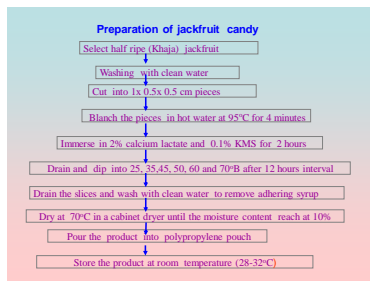
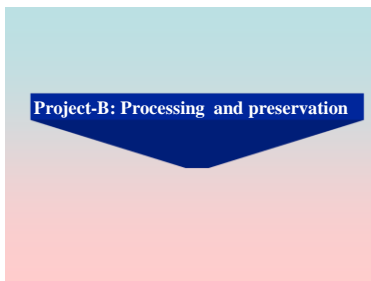
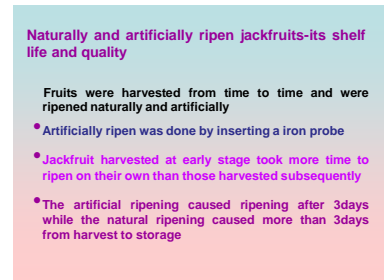
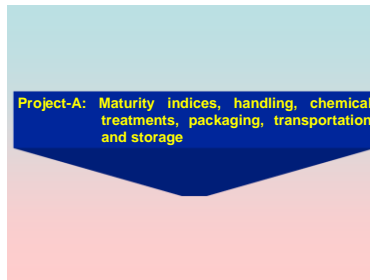
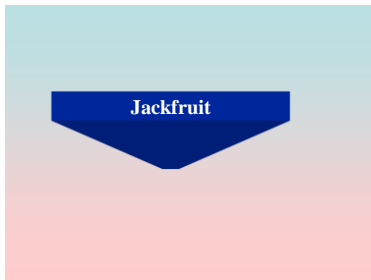
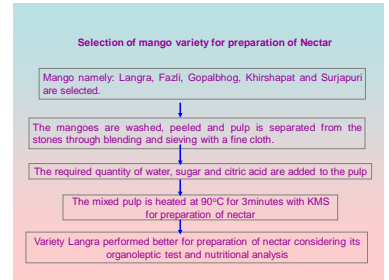
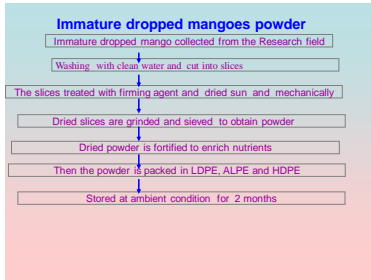
Effect of ripening materials on mango
 Treatments
 T₀= Treated with fresh banana leaves,
 T₁= Treated with rice straw
 T₂=Rice hull
 T₃= Saw dust
 T₄=Fresh shirish leaves and
 T₅=Calcium carbide
 Results/Output
 • Calcium carbide ripened mangoes within 3days
 • Rice straw ripened mangoes at 4.47 days
 • Fresh banana leaves reduced weight loss but activated the incidence of the diseases.
 However, rice straw performed better in respect of most of the qualitative parameter.

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 16, 24 and 32 hours
 • Treated mangoes are taken out from bag and kept under ordinary storage condition (28-32°C)
 Results/Out put
 • Calcium carbide was not suitable for improving colour of mango
 • It was also reduced the shelf life of mango.

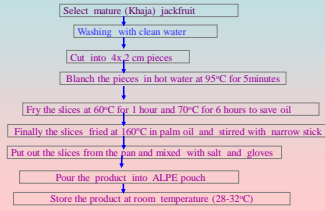
Project-B: Processing and preservation



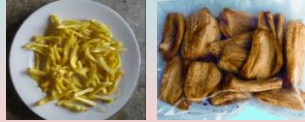




Preparation of jackfruit chips

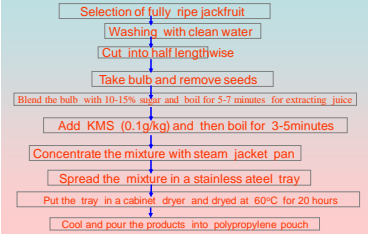


Preparation and packaging of jackfruit chips

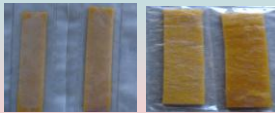


Storage periods: 4 months

Preparation of jackfruit leather

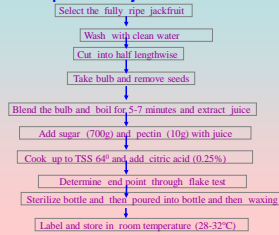


Jackfruit leather



Storage periods: 4 to 6 weeks at room temperature

Preparation of jackfruit Jam

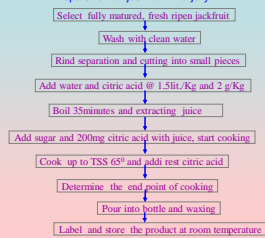


Jackfruit rags jam



Storage periods: One year

Preparation of jackfruit rind jelly

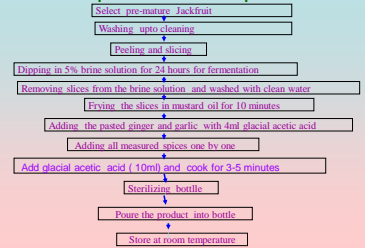


Jackfruit rind jelly



Storage period: One year

Preparation of Jackfruit pickle

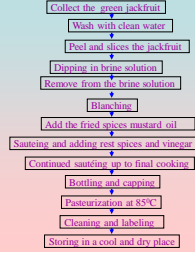


Jackfruit pickles



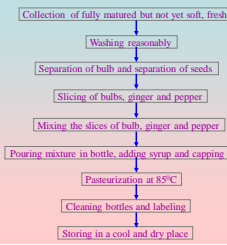
Storage periods: One year

Preparation of Jackfruit hot pickle



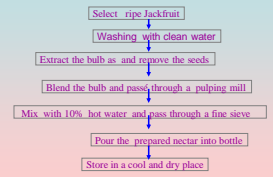
Jackfruit hot pickle.

Preparation of jackfruit sweet pickle

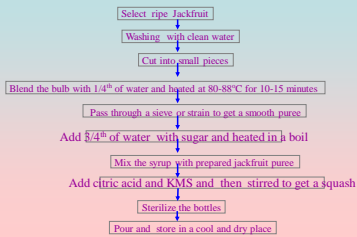


Storage period: One year

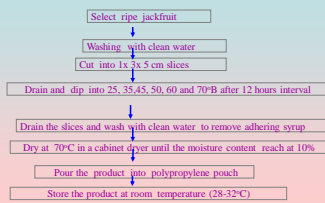
Preparation of Jackfruit nectar



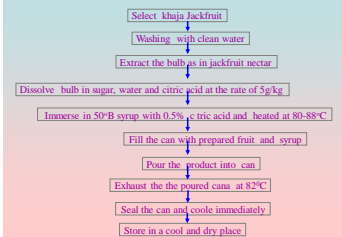
Preparation of jackfruit squash



Dehydration of jackfruit



Canning of jackfruit



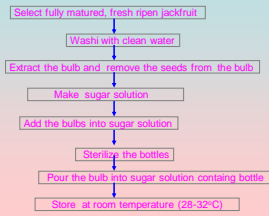
Preservation of jackfruit in brine solution

Jackfruit (Khaja) are washed with clean water and peeled and then kept in 8% salt, 1.25% acetic acid, and 0.1% KMS and 91.65% water solution. Then the materials poured into air tight plastic container.



Storage periods: 10 months

Preservation of jackfruit bulb in sugar solution



Preservation of jackfruit bulb in sugar syrup



Storage periods: One year

Banana

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

Extension of shelf life of banana through scrubber

Banana treated and packed in;

- Polyethylene bag without scrubber and
- Packed in polyethylene bag with scrubber.

Results/Output

Maximum shelf life and less ripening were observed in fruits treated with scrubber and packed in polyethylene bag

Prolonging shelf life of banana

- Mature banana (sabri, sagar and Champa) of uniform size, shape and colour were harvested from the farmers field carefully.
- The banana treated with different postharvest treatments like
 - without treatments (control), partially
 - vacuum poly bag
 - sealed polyethylene bag with ethylene absorber
 - paraffin coated and
 - soyabean oil emulsion.

Results/Output

Fruits packed in partially vacuum polyethylene bag (Banavac) were green and fresh up to 21days storage while it was 7days (champa) and 9days at ambient condition (28-32°C)

Effect of different ripening methods on quality of banana

Treatments

Factor A: Variety with two levels (1. BARI Kola-1 and Sabri)

Factor B: Postharvest treatments with nine levels

- B0= Control
- B1= Ripen-15; 250 ppm
- B2= 3, Ripen-15; 500 ppm
- B3= Ripen-15; 750 ppm
- B5= Ripen-15; 1000 ppm
- B6= Tundur 12 hours
- B7= Tundur 18 hours
- B8= Tundur 24 hours and
- B9= In heap, covered with polyethylene and heated for 24 hours

Factor C: Packaging techniques with two levels

- C0= Perforated polyethylene bag and
- C1= Non- perforated polyethylene bag.

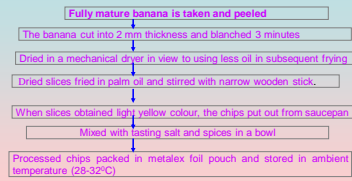
Results/Output: Fruits heated in Tundur at 31.3°C for 18 hours and packed in non-perforated poly bag prolonged the shelf life with good quality

Effect of ripening chemical on the quality of banana

- Different concentrations of ethrel solution viz. without ethrel, 2,4,6,8 and 10ml ethrel/l of water were used for ripening of banana (Nepali sagar)
- Banana treated with 8and 10ml/l of water had activated very early (3days) and more uniform ripening than untreated banana (9days).
- Untreated banana was light yellowish colour and medium soft texture while treated banana showed attractive yellowish colour and very soft texture.

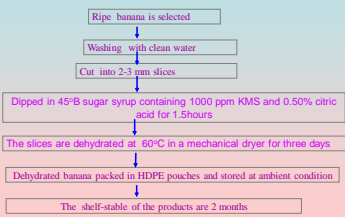
Project-B: Processing and preservation

Preparation of Banana chips

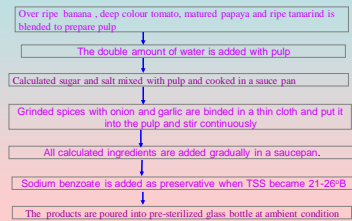


Banana Chips

Osmotic dehydration of banana

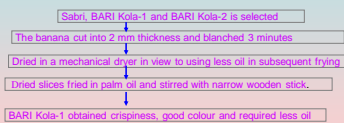


Preparation of mixed banana ketchup



Mixed banana Ketchup

Suitability of banana varieties in relation to preparation of Banana chips



Litchi

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

Extension of shelf life of litchi

Treatments

Factor: packaging techniques

- A₀=Without package
- A₁= Sealed polyethylene bag
- A₂ =0.5% perforated polyethylene bag
- A₃= browned paper)

Factor B: Storage techniques

- B₀= Ambient condition
- B₁=Zero energy cool chamber and
- B₂= Refrigerator temperature (5-7°C).

Results/output

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

Project-B: Processing and preservation

Preservation of Litchi in syrup solution

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



Storage periods: 12 months

Pineapple

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

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 21days compared to sealed polyethylene bag.

Storage at low temperature

Factor A: postharvest treatments

- A₀=Blanched and
- A₁=Unblanched

Factor B: storage condition

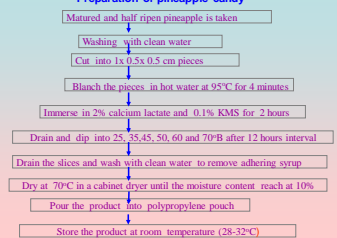
- B₀=Refrigerator and
- B₁=Deep freeze

Results/Output

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

Project-B: Processing and preservation

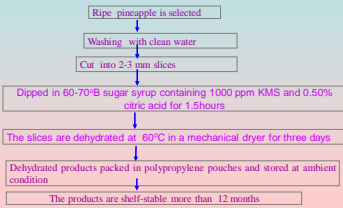
Preparation of pineapple candy





Pineapple candy

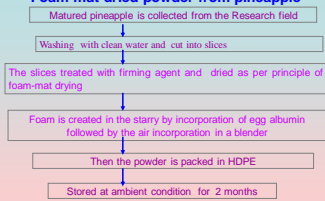
Osmotic dehydration of pineapple



Preservation of pineapple in syrup solution

Pineapple preserved in 30-40°B 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

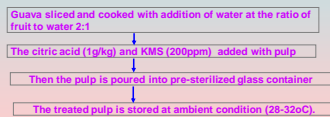
Foam-mat dried powder from pineapple



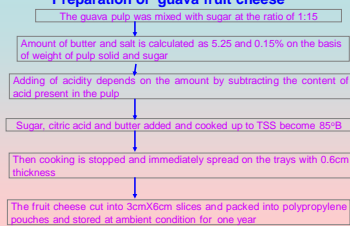
Guava (*Psidium guajava*)

Project-B: Processing and preservation

Optimization of processing methods for guava pulp preservation



Preparation of guava fruit cheese



Papaya (*Carica papaya*)

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

Minimization of Postharvest Losses of Papaya through Improve Postharvest Practices

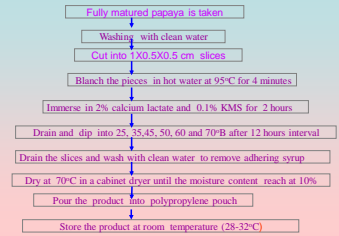
Papaya treated with different postharvest treatments;

- Wash with tap water
- Wash with chlorine
- Treated in hot water and
- Treated in hot water with sodium hypochlorite)

Results/Output

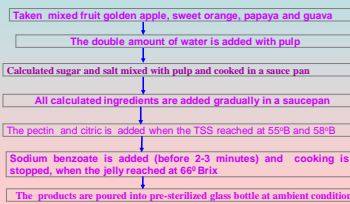
- Treated papaya performed better compared to untreated
- Postharvest diseases, physiological loss in weight and bruising could be minimized by wrapping without excessive deterioration
- Physical damage could be minimized by using plastic crate

Preparation of papaya candy



Papaya candy

Preparation of mixed papaya jelly



Ber (*Ziziphus mauritiana*)

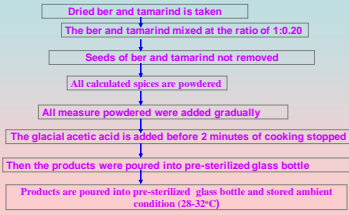
Project-A: Maturity indices, handling, chemical treatments, packaging, transportation and storage

Marketable 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 0.5% perforated polythene bag and non-perforated polythene bag after removing field heat
- Then the packed fruits put into plastic crates and CFB 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 (4.50 days).

Project-B: Processing and preservation

Preparation of mixed ber and tamarind chutney

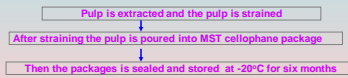


Ber Tamarind mixed chutney

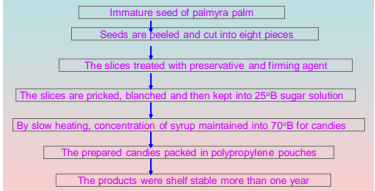
Palmyra palm (*Borassus flabellifer*)

Project-B: Processing and preservation

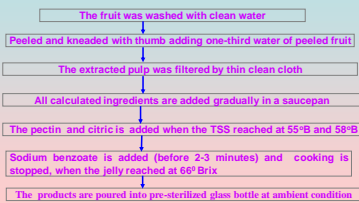
Preservation of Palmyra palm



Preparation of candies from immature palmyra palm seed



Formulation of jam from palmyra palm



Palmyra palm jam

Wax Jambu (*Eugenia javanica*)

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

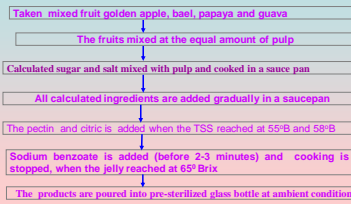
Extension of shelf life of wax jambu

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

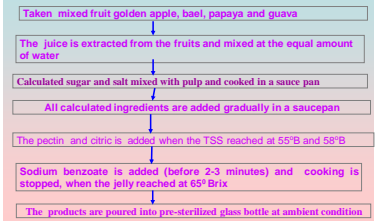
Golden apple (*Spondias pinnata*)

Project-B: Processing and preservation

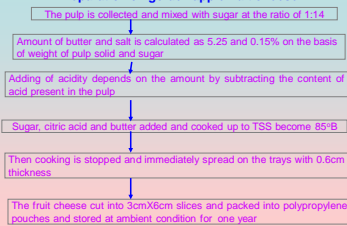
Preparation of mixed jam from golden apple



Preparation of mixed jelly from golden apple

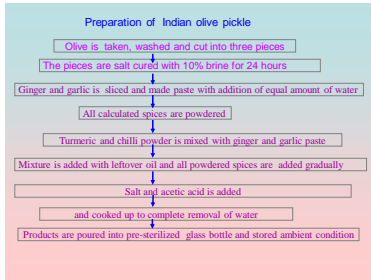


Preparation of golden apple fruit cheese



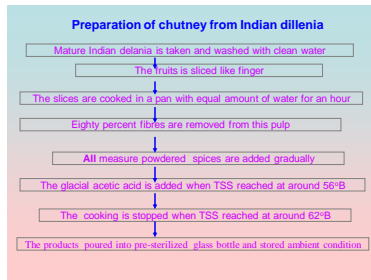
Indian Olive (*Elaeocarpus floribundus*)

Project-B: Processing and preservation



Indian dillenia (*Dillenia indica*)

Project-B: Processing and preservation



Lotkon

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

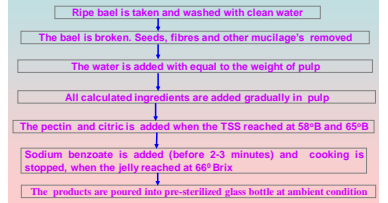
Effect of different storing technique on shelf life of lotkon

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 .

Bael (*Aegle marmalose*)

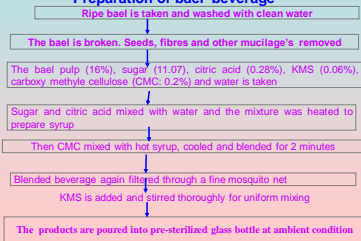
Project-B: Processing and preservation

Formulation of bael jam



Bael Jam

Preparation of bael beverage

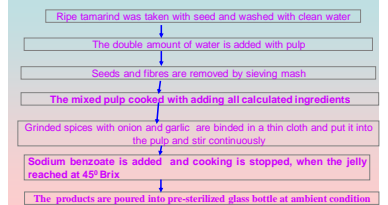


Bael Beverage

Tamarind (*Tamarindus indica*)

Project-B: Processing and preservation

Preparation of Tamarind sauce



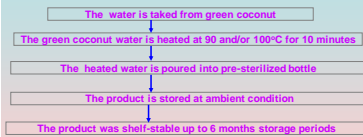


Tamarind sauce

Coconut (*Cocos nucifera*)

Project-B: Processing and preservation

Preservation of green coconut water



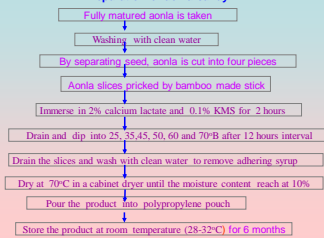
Optimization of processing parameters for coconut candy

- 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.

Aonla (*Emblica officinalis*)

Project-B: Processing and preservation

Preparation of aonla candy



Aonla candy

Constrains and Opportunities

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 at end user level
- ❖ 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

Constraints of Postharvest Technologies in Bangladesh

- ❖ 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 consumers' 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

Constraints of Postharvest Technologies in Bangladesh

- ❖ No special program for loan with minimum interest for SMEs
- ❖ High cost of the equipments
- ❖ Abuse of ripening chemicals

Opportunities

- ❖ Through developing large, medium and small scale processors in Bangladesh
- ❖ **Increased indigenous fruit production and its processed products**
- ❖ The application of Good Agricultural Practices (GAPs), Good Manufacturing practices (GMPs), Total Quality Management (TQM) and HACCP principles to the whole chains

- Developing postharvest technologies of indigenous fruits with their diversified products
- To develop simple low-cost postharvest technologies for small scale farmers
- Retaining nutritive value through value addition
- Establish integrated postharvest Horticulture management, training 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 contributing a lot in increasing income and nutritional status
- ❖ 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 disorders and generate more income to the farmers and traders
- ❖ It is therefore, high time to minimizing postharvest losses of indigenous fruits through improved postharvest practices especially cold chain management

