

# Preparation and Quality Evaluation of Bilimbi Pickle

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**Abstract**— Bilimbi (*Averrhoa bilimbi L.*) is long lived underutilized perennial evergreen plant particularly cultivated in home gardens, belong to the family of oxalidaceae. Bilimbi pickle was prepared using bilimbi fruits and other ingredients of salt, cinnamon, cardamom, cloves, and black pepper. Formulations and procedures were created prior to prepare the product. Well matured fruits were selected and prepared product was filled into glass bottles and stored at room temperature for a week and evaluated color, aroma, and taste at an interval of one day. The product preserves by osmotic dehydration, in use of salt, by natural acidic environment within bottle, by antimicrobial and antioxidant properties due to added spices and heat and sun drying treatments as well.

**Index Terms**— bilimbi, new product, pickle, shelf life, storage study

## 1 INTRODUCTION

Bilimbi is evergreen tree with various potentials. The scientific name of bilimbi is *Averrhoa bilimbi* and it belongs to the oxalidaceae family. Bilimbi is perennial plant. Bilimbi tree is shown in Figure 1 [1]. Bilimbi is a seasonal fruit. Bilimbi fruits are appears as the trunk and bar stem. The fruit has juicy and firm flesh with greenish color and when it ripe fruit are become soft. Bilimbi fruits are sour in taste and its acidity is very high [2]. Bilimbi is a natural source of antioxidant, vitamin B and C and iron, phosphorus [3].

During maturity stage occurs the maximum increase in size, weight and color change green to yellow. Matured fruits are used to produce vinegar, wine, jam, jelly and pickles and added as sourness enhancer to food item such as “polsambola”, fish curry [4]. This fruit contain high amount of oxalic acid and water. Bilimbi extract is rich in flavonoid, saponins, like things and also this fruit contain amino acids, citric acid, potassium ion, sugar etc. It also has anti-inflammatory, anti-microbial, anti-diabetic properties [5].

Bilimbi fruit has a shorter shelf life due to its juiciness. After they harvest it has shelf life about 4-5 days and rapidly gone waste [6]. Post-harvest losses of bilimbi fruit can be seen in Figure 2. Never the less it can be preserved under certain traditional methods like drying and pickling. Bilimbi pickle is also traditional used, one of the preserved method of bilimbi in Sri Lanka. The mixture of preservation is used to extend the shelf life of the product. Those are, heat processing, salting, drying, adding spices, packaging and neutral acidity as well. The product can be stored around six month to 1 year in a glass bottle without refrigerating. The product can be added as the sourness enhancer of condiment, like salted lime pickles. As above mentioned, bilimbi is a seasonal crop, therefore consumers can consume bilimbi flavor in off season as well by adding bilimbi pickles as desired.



Figure 1: Bilimbi tree



Figure 2: Post harvest loss of bilimbi fruits

## 2 MATERIALS AND METHODS

The present study of product plant designing of bilimbi pickles was conducted by department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka. Bilimbi fruits were obtained by home garden tree at Mirigama, Sri Lanka. Salt and spices were purchased from the local market, Mirigama, Sri Lanka. Glass bottle of 360ml capacity was used for bottling of the product.

Preparation of bilimbi pickles: schematic representation of the preparation of bilimbi pickles are shown in Figure 3.

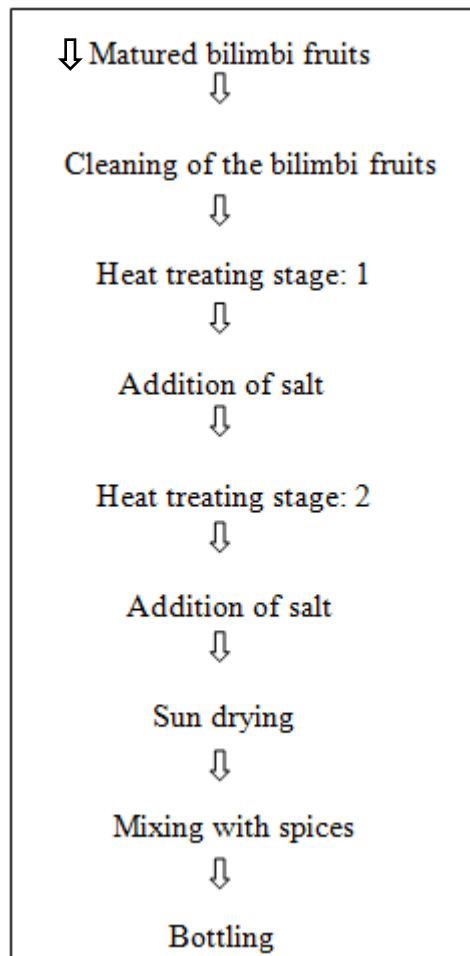


Figure 3 : process flow chart for the preparation of bilimbi pickle

### Processing procedure and ingredients formulations of bilimbi pickles:

The following procedure is based on 1kg of raw bilimbi fruits and other used ingredients are measured, according to the raw bilimbi weight and its dried amount of weight. When preparing other amount of product, suitable weights of other ingredients can be formulated according to this prepared process formulation and raw and dried weight of bilimbi fruits.

#### Procedure:

- Firstly, well matured bilimbi fruits are harvested into the container.
- Then 1kg of fruits are measured and passed into cleaning vessel.
- Next collected fruits are thoroughly cleaned by running portable water.
- Then cleaned fruits are placed on a flat vessel and allowed to drain remaining water on bilimbi fruits.
- After, fruits are fill in a clay vessel.
- Then fruits are heated by maintaining mild flame (heating stage: 01) around 1 ½ hours.

- Next portion of weighted salt is added to heated bilimbi containing vessel and mixed well.
- After that billing containing vessel is heated again about one hour while mixing.
- Then heat processed bilimbi should be allowed to cool into room temperature.
- After, heat treated bilimbi is placed on a flat tray and other portion of weighted salt is add onto bilimbi mixture.
- Then this bilimbi containing tray is put in a contaminant free place for sun drying around three days.
- After sun drying, dried bilimbi is weighted.
- Next powdered spices are measured equally according to dried bilimbi weight.
- Then spices are mixed with processed bilimbi.
- Eventually, prepared bilimbi pickles mixture is filled into sterilized glass bottle and then labeled.

## RESULTS AND DISCUSSION

When producing formulated bilimbi pickled according to the procedure, well matured fruits should be harvested in to wood, glass or stainless steel vessel because aluminum and vessels reacts with acetic fruits like bilimbi as shown in *Figure 04*.



Figure 4: harvested bilimbi fruits

The harvested fruits should be free from damages. Birds and some insects like animals are damaged bilimbi fruits, therefore these damaged fruits must be removed. When harvesting, matured fruits should be picked carefully without brushing. Then 1 kg of damaged free bilimbi fruits should be weighed by using table balance and cleaned thoroughly by portable water as shown in *Figure 05*. When cleaning of weighed fruits, stalk particles should be removed from fruits, cleaning process is extremely important to remove adhering dust and other contaminates. Running water is the best option when producing pickles in large scale because

recontamination can happen when using same washing vessel for all batches. The cleaning vessel should also be a wooden or stainless vessel to inhibit chemical reaction with acid and vessel surface that can be chemical contamination to prepared product. The effluent after washing fruits is shown in *Figure 6*.



Figure 5: cleaning of harvested bilimbi fruits



Figure 6: Remaining effluent

The washed fruits should be allowed to drain the remaining water prior to give heat treatments because, when the fruits allow to heat with remaining water on surfaces, extra heat energy should be supplied to evaporate that water. If product is made in industry scale perforated metal conveyer belts can be used to drain off all remaining water while transferring cleaning place to other unit operation. The next unit operation is heat processing. In here, bilimbi fruits contained high amount of water is evaporated by using mild heat of flame. Temperature should be between 40-70 °C of range because; high amount of temperature can destroyed the nutrients within the fruits. Generally heating time goes around three hours. In this stage, 30-50% of water is removed from fruits. Stainless steel or clay vessel is extremely suitable for heating because this material does not react with fruit containing acids. When, the product is produce in large scale LP gas can be applied as burning source, other than LP gas, wood can be also be used but some kinds of wood's smoke generates off flavors to the product, therefore this can affect to consumer retention on the product. When preparing product, heat should be given in two stages. Stage 01 starts with beginning of the heat process to 1 1/2 hours. The portion of weighted salt is added which according to ingredients formulation so, according to procedure 50 g of salt should be added from 100g of salt. Salt gives osmotic pressure on fruit surfaces and drags water outside. It helps to easily remove fruit containing water by evaporation. Second stage of heating starts with addition of salt to the vessel. Then again heating should be done around an hour. Mixing is extremely important while heat processing because it helps to water evaporation and mixed added to salt all around the surfaces of fruit surfaces. The light green color of fruits gradually changes to light brown to brown color in heating. That can be shown in *Figure 07*



to 13.



Figure 7: Fruits before heating



Figure 8: Fruits after heating 30 minutes



Figure 9: Fruits after heating 60 minutes



Figure 10: adding of salt to fruits after heating 120 minutes



Figure 11: fruits after heating 150 minutes



Figure 12: fruits after heating 180 minutes and end point of heat



Figure 13: wholesome bilimbi fruit after giving heat process

After evaporating water, the product containing vessel should be placed in a dry and cool place to reduce the temperature to room temperature. Next remaining 50g of salt from measured 100g of salt is added and mixed which helps to further remove water from product. When reduce the water activity of product, it obtains long shelf life.

Heat processed bilimbi fruits are placed on a stainless steel flat vessel for sun drying. When vessel is flat product can be laid widely that speeds up the sun drying process. There should be a place where free from pest and bird attacks and physical contaminations like dust. If product is drying in industry scale large size sola drying yards can be used.

Sun drying helps to reduced water content in product. As heat process previously done, the major objective of sun drying is also removal of remaining water. When water content of the product is low, the product can be store longer time period. Generally product should be dried under sun shine around the three days. But this can vary due to climate condition and intensity of the sun light. There are some disadvantages, in the rain seasons product cannot be dry and various contaminations can happen. The best option is vacuum drying instead of sun drying. It consume short time period as well, to drying process. The product after sun drying can be shown in *figure 14 to 15*.



Figure 14: product after sun drying



Figure 15: wholesome bilimbi fruit after sun drying

The powdered spices of 11g of cinnamon, 11g of cardamom, 11g of cloves, and 11g of pepper are mixed to dried bilimbi pickles. These amounts according to weight after drying of product. The product should be mixed well, to added spices distribute all around the product, otherwise taste can differ place to place when product will be bottled. Finally prepared product can be filled into pre sterilized glass bottles. In here glass bottles are used due to its non-reactivity with high acidic food items. Spices used for product can be shown in *Figure 16 to 19* and the packed product are shown in *Figure 20*.



Figure 16: Cinnamon



Figure 17: Cardamom



Figure 18: Cloves



Figure 19: Black pepper



Figure 20: bilimbi pickle after bottling

There is a mixture of preservations in the product. These preservations help to keep the product around one two years without spoiling. There is no any chemically added preservative in bilimbi pickles. Naturally added substances contribute for preservation actions. Bilimbi is a tropical fruit that contain high amount of oxalic acid, which is a natural organic acid. Due to oxalic acid, the product creates acidic environment naturally therefore most of food spoiling microorganisms cannot survive within the product. Heating and sun drying remove the excess amount of free water within bilimbi fruits. Due to absence of free water microorganisms cannot survive within product. Specially added salt produces osmotic pressure; this osmotic pressure is used to drag water



while heating and sun drying. Other than dragging water from bilimbi fruits, this added salt gives osmotic protection against microorganisms. Added spices are largely responsible for taste and preservation of product. They have anti-microbial properties and antioxidant properties. These properties directly involve with shelf life of the product.

Final product has 4.3 p H and 1.3% of titratable acidity value. According to these physical parameters, product's acidity and sourness can be understood well.

## Results of storage study

As above mentioned prepared product was subjected to one week storage study. Same weight of normal matured Bilimbi fruits were used as controlled sample.

### Color

Any change of color of the Bilimbi pickle has not been observed throughout the storage period. The color of the product was light brown. The color of the controlled sample has changed to light green to brownish yellow. Results of samples are given in *Table 1* and *Table 2* respectively.

Table 1: Results of the color changes of product

Storage life (days)	Changes of color
01	Light brown
02	Light brown
03	Light brown
04	Light brown
05	Light brown
06	Light brown
07	Light brown

Table 2: Results of the color changes of controlled sample

Storage life (days)	Changes of color
01	Light green
02	Light green
03	Light green
04	Slightly reduced the green color

05	Slightly reduced the green color relative to day 04
06	Light yellow color
07	Brownish yellow color

## Odor

Sample of product and controlled sample had an initial, same Bilimbi odor. There was any change of odor in product, at the end of the storage. Odor was same till the fourth day in controlled sample. Then it was distinct bad odor. Aroma changes in controlled sample due to natural senescence of fruits and microbial activities because there was no any preservation action as prepared product. Odor changes of the product and controlled sample are given in the *Table 3* and *Table 4* respectively.

Table 3: Results of odor changes of product

Storage life (days)	Changes of odor
01	Bilimbi odor
02	Bilimbi odor
03	Bilimbi odor
04	Bilimbi odor
05	Bilimbi odor
06	Bilimbi odor
07	Bilimbi odor

Table 4: Results of odor changes of controlled sample

Storage life (days)	Changes of odor
01	Bilimbi odor
02	Bilimbi odor
03	Bilimbi odor
04	Bilimbi odor
05	Slightly bad odor
06	Bad odor
07	Very distinct bad odor

## Taste

Taste of the product had sour Bilimbi taste with salty and spicy taste from initial to end of the storage study. Taste of the controlled sample had been changed during storage study. Sourness of the controlled one slightly decreased. Reduction of the quality of the taste of controlled sample due to different reactions on added fruits by growing microorganisms and their metabolites.

Taste changes of the product and controlled sample are given bellow in *Table 5* and *Table 6* respectively.

Table 5: Results of taste changes of product

Storage life (days)	Results
01	Sour with salty and spicy taste
02	Sour with salty and spicy taste
03	Sour with salty and spicy taste
04	Sour with salty and spicy taste
05	Sour with salty and spicy taste
06	Sour with salty and spicy taste
07	Sour with salty and spicy taste

Table 6: Results of taste changes of controlled sample

Storage life (days)	Results
01	High sour taste
02	Sour taste
03	Slightly reduced the sourness
04	Bad taste
05	Bad taste
06	Bad taste
07	Bad taste

Results of storage study indicates some quality parameters of product with comparing controlled sample. Color, odor, and taste of the product were observed within a week and those all quality factors of product have not been changed. This indicates the product has good quality form those parameters. Development of bilimbi pickle processing plant, which can produce to decrease the post-harvest loss in bilimbi while preserving. There

was no artificial ingredients and preservatives. Salt has been done presentation, draining the excess water from product, together with acid of the fruit contains, and spices. And also enzymatic and chemical reactions are inactivated by heat processing.

## CONCLUSION

The present study related to palatable preservation of *Averrhoa bilimbi* L. The product can be prepared by removing excess water from heating and sun drying with other additional ingredients. The product has good shelf life without addition of artificial food preservatives. Product is improved the shelf life by osmotic dehydration, in use of salt, by natural acidic environment within bottle, by antimicrobial and antioxidant properties due to added spices and heat and sun drying treatments as well. The study reveals that the product is having a high potential for commercialization and marketability due to rich in storage life and nominal cost.

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