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# Shelf-life enhancement of cowa (*Garcinia cowa* Roxb.)

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**SUMMARY :**

Cowa (*Garcinia cowa* Roxb.) locally known as *Kujithekera* belongs to the family Clusiaceae is one of the popular indigenous fruits of north eastern region of India. The fruit is having commercial and medicinal values. It is the source for a natural diet ingredient hydroxycitric acid (HCA) which is an anti obesity compound. *Kujithekera* fruits are highly perishable in nature having short shelf-life which reduces the commercial values of the fruit. Extension of shelf-life using 5 different treatments was studied. The treated fruits were packed in transparent perforated (0.2% ventilation) low density polyethylene bags (25µ). The physico-chemical qualities of the treated fruits were found to decrease significantly with the advancement of storage period. Fruits dipped in 1 per cent wax emulsion for 5 min, air dried and packed in transparent perforated (0.2% ventilation) LDPE bags (25µ) retained the highest ascorbic acid (7.95 mg and 5.27 mg/100g), total sugar (6.3% and 3.72%), total phenol (1.2g and 1.96g/ 100g), hydroxycitric acid (6.20g and 6.67g/100g), energy value (39.95Kcal and 27.37Kcal/ 100g) both in pulp and peel, respectively on 6 days after storage. The wax coated fruits remained firmer (1.66 kg/cm$^2$) and recorded the highest CIE lab parameters like L*, a*, b* and C* (45.73, 24.61, 13.02 and 27.84, respectively) with an extended shelf-life of 6 days at ambient conditions (29.8 ±1.1°C, RH 79.6 ± 3%).

**KEY WORDS :** *Kujithekera, Garcinia cowa* Roxb, Hydroxycitric acid, LDPE bags, Shelf life

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Cowa (*Garcinia cowa* Roxb.) commonly known as *Kujithekera* belongs to the family Clusiaceae is one of the important indigenous fruit of Assam. The sundried slices of the fruits are used for garnishing vegetable based curries and as folk medicine. Hydroxycitric acid (HCA) is the principle organic acid of some Garcinia species. HCA is an antiobesity compound present in the fruit and leaves of *Garcinia* and is known to inhibit lipid and fatty acid synthesis in living systems (Lewis and Neelakantan, 1965). The fruits and leaves are used for the improvement of blood circulation, as an expectorant for the treatment of coughs and indigestion and as a laxative, while the root is used for fever relief. The fruits are not palatable because of their acidic flavour. They can be made into jam or preserves. The fruits are highly perishable in nature having short shelf-life. Increased shelf-life would contribute in retaining the qualities like HCA for long distance transport.

However, information on shelf-life extension of *Kujithekera* are limited. Shelf-life extension of *Kujithekera* through various post harvest treatments are studied and discussed here.

## EXPERIMENTAL METHODS

Cowa is an evergreen medium sized tree upto 12m height with an oval crown and dark foliage. Mature fruits are opaque red, ovoid-globose and usually apiculate Fruits are juicy having sub-acid taste. Fruits of uniform maturity, size and colour were harvested from the experimental Orchard, Department of Horticulture, AAU, Jorhat. The fruits after proper cleaning were subjected to various post harvest treatments. $T_1$ : Dipping the fruits in 100 ppm sodium hypochlorite (NaOCl) solution for 5 min, air dried and packed, $T_2$ : Dipping the fruits in 2% Calcium chloride ($CaCl_2$) solution for 5 min, air dried and packed, $T_3$: Dipping the fruits in 1% wax emulsion for 5 min, air dried and packed, $T_4$ : Fruits kept in an open tray without packaging and chemical treatment, $T_5$ : Fruits packed without any chemical treatment. In all the treatments except $T_5$, fruits were packed in perforated (0.2% ventilation) LDPE (100 gauge) bags and stored at ambient conditions (29.8 ±1.1°C, RH 79.6 ± 3%). The experiment was conducted under factorial Completely Randomized Design with 4 replications. Fruits were analyzed for biochemical parameters at 3 days interval upto 9 days.

Ascorbic acid content was determined by using 2, 6-Dichlorophenol indophenol dye visual titration method as per the method of Ranganna (1986) and expressed as mg $100g^{-1}$. The amount of total sugars was estimated by using Anthrone method (Sadasivam and Manickam, 1992). Total phenol were assayed by the method of Malik and Singh (1980). *Hydroxy Citric Acid (HCA)* content of *Kujithekera* was determined by spectrophotometric method (Benny *et al.*, 1999). The gross food energy was estimated using the following equation and expressed as Kcal/100g dry basis (Osborn and Voogt,1978).

Food energy = (% Carbohydrate × 4) + (% crude fat × 9) + (% crude protein × 4)

Texture of the samples was measured using a texture analyzer (SMS-TAXT2 Stable Microsystems Ltd., Godalming, Surrey, United Kingdom) with a 100 kg load cell which was equipped with a blade set with guillotine.

**Colour (CIE Lab parameters):**

CIE Lab parameters, *i.e.*, L*, a* and b* values for the fruit samples were determined by Hunter Lab Colour Quest XE Colorimeter and the H* and C* values were calculated by the following equations:

Hue (H*) = $Tan^{-1}$ b/a

Chroma (C*) = $\sqrt{a^2+b^2}$

**Shelf-life of fruits:**

Shelf-life was evaluated based on the visual quality (colour) of the fruit sample following the method suggested by Bhowmick and Pan (1992).

## EXPERIMENTAL FINDINGS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

**Ascorbic acid:**

Ascorbic acid content of the *Kujithekera* fruits decreased significantly till the end of storage (Table 1). This decreasing trend might be due to rapid conversion of ascorbic acid into dehydro ascorbic acid in the presence of enzyme ascorbinase (Gohlani and Bisen, 2012). The lowest ascorbic acid content in $T_5$ may be due to the fact that ascorbic acid is susceptible to oxidative deterioration (Piga *et al.,* 2003) which occurred at accelerated rate in open condition due to the presence of higher concentrations of $O_2$ as compared to polyethylene packages. The findings are in conformity with Akhtar *et al.* (2012) in loquats. Similarly, packaged fruits showed more ascorbic acid content than the control *i.e.* $T_5$. This could be due to the reduced rate of respiration in the polyethylene bags that retards aging as well as depletion of acids (Azene *et al*., 2014). On the other hand, ample $O_2$ increased enzymatic catalysis that leads to biochemical breakdown of compounds in the fruits (Yoshida *et al*., 1984). Furthermore, possible reduction in internal $O_2$ and a decrease in ethylene concentration might explain the presence of higher value of ascorbic acid in packaged fruits through delay in respiration and ripening of the packaged fruit (Kader, 1985).

**Total sugar:**

The total sugar content was found decrease with the storage period (Table 1). The increased level of total

sugars was probably due to conversion of starch and pectin into simple sugar, and the declining trend might be due to their rate of consumption for respiration and other energy sources. Similar results have been reported by Patel *et al*. (2011) in custard apple.

**Total phenol:**

The lowest level of total phenol content at the end of storage in the non treated fruit, as observed in the present instance could be due to oxidization by polyphenol oxidase, which converts the phenol to quinines (Li *et al*., 2008). Modified atmosphere packaging acts as a barrier to control the reduction of total phenol content by reducing the co substrate ($O_2$) availability. The decreasing trend was observed by Kopjar *et al.* (2009). Gangwar and Tripathi (1972) viewed that the decrease in total phenol content might be due to their dilution by other treatments and hydrolysis into sugars and components. The reduction in total phenol content could also be explained by the conversion between free and bound phenolic substances (Ferrante and Maggiore, 2007). Wax coated fruits had decreased PPO activity which resulted in the least deterioration of phenols till the end of the storage.

**Hydroxycitric acid (HCA):**

HCA is the principal organic acid present in *Garcinia*

**Table 1: Effect of post harvest treatments on biochemical parameters**

| Storage period (S), days | Treatments (T) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pulp | | | | | Peel | | | | |
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ |
| | Total sugar content (%) (IV: Pulp=6.47, Peel=3.49) | | | | | | | | | |
| 2 | 6.50 | 6.50 | 6.51 | 6.49 | 6.48 | 3.90 | 3.90 | 3.91 | 3.89 | 3.89 |
| 4 | 6.22 | 6.28 | 6.42 | 6.20 | 6.20 | 3.73 | 3.77 | 3.80 | 3.71 | 3.70 |
| 6 | 6.19 | 6.25 | 6.30 | 6.18 | 6.17 | 3.61 | 3.65 | 3.72 | 3.62 | 3.59 |
| Mean | 6.31 | 6.34 | 6.41 | 6.29 | 6.28 | 3.74 | 3.78 | 3.81 | 3.74 | 3.73 |
| | C.D. (P=0.05), T=NS,S=0.17,TxS=NS | | | | | C.D. (P=0.05), T=0.05,S=0.04,TxS=NS | | | | |
| | Ascorbic acid content (mg/100g) (IV: Pulp=8.73, Peel=5.83) | | | | | | | | | |
| 2 | 8.42 | 8.47 | 8.60 | 8.35 | 8.37 | 5.50 | 5.62 | 5.72 | 5.27 | 5.25 |
| 4 | 8.22 | 8.35 | 8.37 | 8.22 | 8.00 | 5.37 | 5.42 | 5.52 | 5.27 | 5.12 |
| 6 | 7.59 | 7.87 | 7.95 | 7.59 | 7.57 | 4.87 | 5.10 | 5.27 | 4.82 | 4.70 |
| Mean | 8.08 | 8.23 | 8.31 | 8.05 | 7.99 | 5.25 | 5.39 | 5.50 | 5.13 | 5.03 |
| | C.D. (P=0.05), T=0.09,S=0.07,TxS=NS | | | | | C.D. (P=0.05), T=0.10,S=0.08,TxS=NS | | | | |
| | Energy (Kcal/100g) (IV: Pulp=41.51, Peel=28.56) | | | | | | | | | |
| 2 | 41.33 | 41.40 | 41.52 | 40.57 | 40.19 | 28.46 | 28.55 | 28.64 | 28.40 | 28.31 |
| 4 | 39.92 | 40.16 | 40.94 | 39.19 | 38.69 | 27.48 | 27.81 | 28.02 | 27.29 | 26.74 |
| 6 | 39.23 | 39.71 | 39.95 | 38.79 | 38.30 | 26.91 | 27.00 | 27.37 | 26.20 | 26.47 |
| Mean | 40.16 | 40.42 | 40.80 | 39.51 | 39.06 | 27.61 | 27.79 | 28.01 | 27.30 | 27.17 |
| | C.D. (P=0.05), T=0.86,S=0.67,TxS=NS | | | | | C.D. (P=0.05), T=0.32,S=0.25,TxS=0.NS | | | | |
| | Total Phenol content (g/100g) (IV: Pulp=1.27, Peel=2.23) | | | | | | | | | |
| 2 | 1.22 | 1.23 | 1.24 | 1.21 | 1.21 | 1.96 | 2.01 | 2.20 | 1.93 | 1.94 |
| 4 | 1.19 | 1.21 | 1.22 | 1.20 | 1.21 | 1.86 | 1.94 | 2.13 | 1.77 | 1.69 |
| 6 | 1.18 | 1.20 | 1.20 | 1.15 | 1.10 | 1.63 | 1.72 | 1.96 | 1.59 | 1.59 |
| Mean | 1.19 | 1.21 | 1.22 | 1.18 | 1.17 | 1.82 | 1.89 | 2.10 | 1.77 | 1.75 |
| | C.D. (P=0.05), T=0.10,S=0.08,TxS=0.16 | | | | | C.D. (P=0.05), T=0.04,S=0.03,TxS=0.07 | | | | |
| | Hydroxycitric acid content (g/100g) (IV: Pulp=6.97, Peel=8.17) | | | | | | | | | |
| 2 | 6.19 | 6.34 | 6.34 | 5.90 | 5.89 | 7.80 | 7.69 | 8.06 | 7.31 | 6.34 |
| 4 | 6.16 | 6.18 | 6.29 | 5.68 | 5.26 | 6.68 | 6.99 | 7.15 | 6.41 | 6.24 |
| 6 | 5.84 | 6.01 | 6.20 | 5.67 | 5.21 | 6.16 | 6.18 | 6.67 | 5.67 | 5.55 |
| Mean | 6.07 | 6.18 | 6.28 | 5.75 | 5.45 | 6.88 | 6.96 | 7.29 | 6.46 | 6.05 |
| | C.D. (P=0.05), T=0.05,S=0.04,TxS=0.09 | | | | | C.D. (P=0.05), T=0.06,S=0.05,TxS=0.11 | | | | |

NS=Non-significant, IV=Initial value

species. It inhibits adenosine triphosphate citrate lyase and has been used in the treatment of obesity. This enzyme catalyzes the extra mitochondrial cleavage of citrate to oxaloacetate and acetyl-CoA, the starting material for fatty acid biosynthesis. HCA can inhibit this enzyme thereby affecting the lipid metabolism.

At harvest, the fruit contained HCA 6.97g/100g in pulp and 8.17g/100g in the peel portion of the fruit (Table 1). Jena *et al.* (2002) found 2.3 per cent, and 12.7 per cent HCA in fruits and rinds, respectively of *G. cowa.*

**Table 2: Effect of post harvest treatments on colour parameters**

| Storage period (S), days | Treatments (T) | | | | |
|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ |
| | CIE b* (IV: 13.31) | | | | |
| 2 | 13.23 | 13.18 | 13.18 | 13.17 | 13.18 |
| 4 | 12.83 | 11.81 | 13.08 | 12.70 | 13.11 |
| 6 | 12.41 | 11.55 | 12.82 | 11.63 | 11.03 |
| Mean | 12.83 | 12.18 | 13.02 | 12.50 | 12.44 |
| | C.D. (P=0.05), T=0.19,S=0.15,TxS=0.34 | | | | |

*Table 2 contd..*

| Storage period (S), days | Treatments (T) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ |
| | CIE Hue (H*) (IV: 3.53) | | | | | CIE Chroma (C*) (IV: 27.67) | | | | |
| 2 | 3.48 | 3.49 | 3.45 | 3.51 | 3.50 | 27.89 | 27.81 | 28.09 | 27.68 | 27.70 |
| 4 | 3.55 | 3.54 | 3.47 | 3.57 | 3.58 | 27.23 | 26.72 | 27.90 | 27.07 | 27.28 |
| 6 | 3.62 | 3.59 | 3.50 | 3.67 | 3.68 | 26.34 | 26.32 | 27.54 | 26.37 | 25.59 |
| Mean | 3.55 | 3.54 | 3.47 | 3.58 | 3.59 | 27.15 | 26.95 | 27.84 | 27.04 | 26.85 |
| | C.D. (P=0.05), T=0.02,S=0.01,TxS=0.03 | | | | | C.D. (P=0.05), T=0.25,S=0.19,TxS=0.43 | | | | |

*Table 2 contd..*

| Storage period (S), days | Treatments (T) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ |
| | CIE L* (IV: 47.16) | | | | | CIE a* (IV: 24.26) | | | | |
| 2 | 46.75 | 46.55 | 46.70 | 46.14 | 46.16 | 24.55 | 24.50 | 24.80 | 24.36 | 24.36 |
| 4 | 45.87 | 45.25 | 45.49 | 45.10 | 44.99 | 24.02 | 23.98 | 24.65 | 23.91 | 23.93 |
| 6 | 40.94 | 43.33 | 45.00 | 40.21 | 40.09 | 23.37 | 23.65 | 24.37 | 23.12 | 23.25 |
| Mean | 44.52 | 45.05 | 45.73 | 43.82 | 43.75 | 23.98 | 24.04 | 24.61 | 23.80 | 23.85 |
| | C.D. (P=0.05), T=0.26,S=0.20,TxS=0.45 | | | | | C.D. (P=0.05), T=0.16,S=0.12,TxS=0.27 | | | | |

**Table 3 : Effect of post-harvest treatments on texture**

| Storage period (S), days | Treatments (T) | | | | |
|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ |
| | Texture (kg/cm$^2$) (IV: 2.28) | | | | |
| 2 | 2.02 | 2.13 | 2.19 | 1.94 | 1.90 |
| 4 | 1.87 | 1.92 | 1.93 | 1.78 | 1.78 |
| 6 | 1.59 | 1.64 | 1.66 | 1.59 | 1.59 |
| Mean | 1.83 | 1.90 | 1.91 | 1.77 | 1.76 |
| | C.D. (P=0.05), T=0.04, S=0.0.03,TxS=0.07 | | | | |

**Table 4 : Effect of post-harvest treatments on shelf-life (days) in '*Kujithekera*'.**

| Treatments | Shelf-life (days) |
|---|---|
| $T_1$ | 4 |
| $T_2$ | 5 |
| $T_3$ | 6 |
| $T_4$ | 3 |
| $T_5$ | 2 |

NS=Non-significant, IV=Initial value

HCA in *G. oblongifolia* dried rinds was 10.137 per cent (Vinh *et al*., 2011). The HCA content of *G. indica* (7.5%) was reported by Parthasarathy and Nandakishore(2014). The HCA content both in pulp and peel exhibited a declining trend during storage. The decreased HCA during storage was due to oxidation (Bafna, 2014). And the oxidation of acid enhances with the rapid availability of the $O_2$ supply. However, due to wax coating the $O_2$ supply is restricted and thus retained highest HCA content in the $T_3$ till the end.

**Energy value:**

In the present study, the energy values in *Kujithekera* are found to go down across storage in all the treatments for both pulp and peel (Table 1). The reduction in energy values across storage might be the resultant decrease in all the factors contributing to energy source like carbohydrates, fats and proteins.

**CIE Lab parameters:**

The L* and a* values of the samples were found to decrease (Table 2) which meant the fruit was getting darker and degradation of redness towards the end. This is due to the browning process which takes place due to the result of oxidation of phenolic substances present by the polyphenol oxidases (PPO) enzymes (McEvily *et al*., 1992). The b* value were also found to be decreasing which indicated that the yellow colour was degrading. At the same time the Hue angle which signifies the angle of combination of being redness or yellowness, was found to increase. The chroma of the fruit also decreased till the end of storage. Tembo *et al.* (2008) also found decreased chroma values in ber. Roongruangsri *et al*. (2013) also found similar trend for hue and chroma values in Tangerines.

**Texture:**

The texture of the fruits was found to decrease during storage which meant the fruit was getting softer and softer. The reason for decrease in firmness during storage of the fruits might be due to break down of enzymes, loss of water and degradation of pectic substances present in the fruits. Sanchez *et al.* (2003) and Drake *et al.* (2004) reported similar findings in pear fruits during storage. The wax coated fruits gave the hardest fruit (1.66kg/cm$^2$) on 6 days of storage.

**Shelf-life:**

The shelf-life of the fruit is concerned with spoilage microorganisms, loss of organoleptic qualities like colour, taste, texture and loss of nutrient value. Visual quality scoring 6.0 or more in the scale of 1-9 and less than 10 per cent rotting percentage were taken consideration for shelf-life extension. Table 4 indicates that the fruits giving no treatment had shelf-life of two days only. At room temperature, the fruits shrinked in size and became unmarketable and got fully spoiled. The wax coated fruits ($T_3$) had maximum shelf-life (6 days). Garg and Ram (1972) reported that when wax emulsion was combined with 0.5 per cent SoPP, it could extend the shelf-life upto 6 days.

Thus, it can be inferred that the fruits dipped in 1 per cent wax emulsion for 5 min, air dried and packed in transparent perforated (0.2% ventilation) LDPE bags (25µ), appeared to be the best treatment for shelf-life enhancement of Cowa fruits. Calcium chloride treatment ($T_2$) which gave the shelf-life of 5 days may alternatively be suggested for shelf-life enhancement of Cowa fruit.

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