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Physico-chemical changes of *Kujithekera* (*Garcinia cowa* Roxb.) fruit during storage

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SUMMARY :

Kujithekera (*Garcinia cowa* Roxb), commonly known as Cowa is a sub-tropical minor fruit grows well in Assam. Fruits are juicy having sub-acid taste and suitable for preparation of jam and pickles, sundried slices given in dysentery as medicine. An attempt was made to understand the changes in physico-chemical qualites of *Kujithekera* fruit during storage at ambient temperature (Mean temp 29.8°C, Mean RH 79.6%) for 6 days at an interval of two days. The physico-chemical changes of the fruit during storage using five different treatments were studied. There was significant increase in physiological loss in weight with advancement of storage period. The bio-chemical qualities of the treated fruits like TSS, crude protein, fat, ash were found to decrease significantly with the advancement of storage period. The fruits treated with 1 per cent wax emulsion retained the highest TSS, both in pulp and peel on 6 days after storage. The fruit pulp qualities like crude protein, fat, ash, total phenl were almost same in wax coated fruits and $CaCl_2$ treated fruits on 6 days after storage.

KEY WORDS : *Kujithekera, Garcinia cowa* Roxb, Physico-chemical, Wax emulsion

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Kujithekera (*Garcinia cowa* Roxb), commonly known as Cowa belongs to the family Clusiaceae is one of the important indigenous fruits of Assam. Fruits are globose but slightly tapering and somewhat oblique towards the apex, dull red outside and orange inside when ripe. Fruits are juicy having sub-acid taste and suitable for preparation of jam and pickles. Garcinia is the source for a natural diet ingredient hydroxycitric acid (HCA) which is an anti obesity compound and is known to inhibit lipid and fatty acid synthesis in living systems.Information on physico-chemical changes in *Kujithekera* fruit across storage is lacking. The present study was undertaken to study the physico-chemical changes of *Kujithekera* fruit during storage.

EXPERIMENTAL METHODS

Kujithekera (*Garcinia cowa* Roxb.) belongs to the family Clusiaceae is an evergreen middling sized tree with an oval crown and dark brown green foliage. Fruits are drupe, globuse but slightly tapering and somewhat oblique towards apex, dull red outside, orange inside when ripe, 4-6 seeded crowned by the persistent stigma. Fruits are juicy having sub-acid taste. *Kujithekera* fruits of uniform maturity, size and colour were harvested from the experimental Orchard, Department of Horticulture, Assam Agricultural University, Jorhat.

The harvested fruits were subjected to various post harvest treatments and the treated fruits were packed in perforated (0.2% ventilation) LDPE (100 gauge) bags and kept at ambient conditions (29.8 ±1.1°C, RH 79.6 ± 3%). The treatment regimes included: 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 per cent calcium chloride (CaCl2) solution for 5 min, air dried and packed, T_3: Dipping the fruits in 1 per cent 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, The experiment was carried out under Factorial Completely Randomized Design with 4 replications. Physico-chemical qualities were analysed at 3 days interval upto 9 days.

Moisture content:

The moisture content of the selected fruit species was determined by using moisture analyzer (A.O.A.C, 1999).

Physiological loss in weight (PLW):

The PLW was determined using the following formula (Song and Kumar, 1995) and the results were expressed in percentage.

$$\text{PLW}(\%) = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

Titratable acidity :

The titrable acidity (TA) of the fresh juice was estimated by volumetric method (AOAC, 2000).

$$\%\ \text{acidity as citric acid} = \frac{\text{Titre value x Normality x Equivalent wt. of acid x Vol. made up x 100}}{\text{Valume of sample taken for estimation x Wt. or vol. of sample taken x 1000}}$$

TSS-acid ratio:

The TSS-acid ratio was calculated by dividing the total soluble solid (TSS) by titrable acidity of the respective fruit sample.

$$\text{TSS} - \text{acid ratio} = \frac{\text{TSS}}{\text{Titrable acidity}}$$

pH :

The pH of the flesh juice was determined by a glass electrode pH meter.

Crude protein :

The total nitrogen was estimated by Micro-Kjeldahl (A.O.A.C., 1965).

$$\text{Total nitrogen}(\%) = \frac{(a-b) \text{ x normality x 14 x valume made up x100}}{\text{g of sample x aliquot taken}}$$

where,

a = Volume (ml) of standard acid required for the sample

b = Volume (ml) of standard acid required for the blank.

The volume of total nitrogen content was multiplied by a factor 6.25 to attain the value of crude protein content. The estimation of crude protein content was thus expressed in percentage.

Crude fat:

The crude fat as ether extract was determined from oven dried sample using a Soxhlet apparatus (A.O.A.C., 1980).

$$\text{Crude fat}(\%) = \frac{\text{Weight of ether extract (g)}}{\text{Weight of the sample (g)}} \times 100$$

Ash content :

The ash content was determined by dry ashing method described by (A.O.A.C., 1965).

$$\text{Per cent ash} = \frac{\text{Weight of ash}}{\text{Weight of the sample}} \times 100$$

EXPERIMENTAL FINDINGS AND ANALYSIS

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

Physiological loss in weight (PLW):

Physiological loss in weight (PLW) was found to increase with the advancement of storage period, recording 0.79 per cent on 6 days of storage in the present instance (Table 1). Chaudhury and Banerjee (1959) also reported that at room temperature, the fruits lost about 15 per cent of their weight within 5 days of storage. Polyethylene packaging significantly checked the PLW over control under all the treatments. Polyethylene packaging might checked direct evapotranspiration and maintained restricted gaseous exchange inside the bags (Gaur *et al.*, 1978).

Moisture content:

The moisture content of the fruits decreased significantly with increase in storage period (Table 1). The highest moisture content (92.65%) was recorded in wax treated fruits (T_3) and the lowest was in fruits kept in open condition (T_5). This might be due to the reason that wax coating blocked the stomata and lenticels and checked direct evapotranspiration as reported by Gaur *et al.* (1978) . Fruits kept in an open condition had higher evaporation rate.

TSS:

The TSS of the fruits was found to decrease significantly throughout the storage period (Table 2). The decrease in TSS may be due to the fact that these treatments in the polyethylene bags retarded the respiration and conversions of polysaccharides into disaccharides and monosaccharides. But, the slight initial increase in wax coated fruits may be due to the hydrolysis of polysaccharides into simple sugars (Akhtar *et al.*, 2012). These results also support the findings of Munoz *et al.* (2006) who reported that the soluble solids content decreased under cold storage as a result of respiration in strawberries. However, in case of the non treated fruits it is possible that the fruit held in open condition had decreased TSS due to a higher respiration rate. Similar studies have also been reported by Tariq *et al.* (2001).

Titrable acidity:

There was a significant decrease in titrable acidity during storage both in pulp and peel (Table 2). This might be due to the conversion of acids into salts and sugars by enzymes particularly invertase (Kumar *et al.*, 1992). The lowest titrable acidity was recorded in T_5 which could be due to depletion of organic acids as a result of relatively faster respiration and ripening rate of fruits at ambient storage (Wills *et al.*, 1989). In general, the fruits packed in polyethylene bags showed higher level of titrable acidity. The atmospheric modification created when fruits are packaged with polyethylene bags may delay respiration and as a direct effect, the consumption of respiration substrates such as organic acids and sugars is retarded. Consequently, as the fruit respires, the O_2 level could decrease and the CO_2 level increases in the bags (Kader, 1985). Under these atmospheric conditions, the respiration rate of the fruit decrease which is helpful

Table 1: Changes in physical parameters of *Kujithekera* fruit across storage

	Treatments (T)					
	T_1	T_2	T_3	T_4	T_5	Mean
Storage period (S), days	Physiological loss in weight (%) [Initial value (0 day): 0]					
2	0.43	0.42	0.25	0.55	0.60	0.45
4	0.60	0.58	0.34	0.69	0.81	0.60
6	0.80	0.69	0.49	0.91	1.07	0.79
Mean	0.61	0.56	0.36	0.72	0.83	-
	C.D. (P=0.05), T = 0.08, S = 0.06, T x S = 0.14					
	S.E.±, T = 0.04, S = 0.03, T x S = 0.07					
	Moisture content (%) [Initial value (0 day): 0]					
2	93.26	93.69	94.45	93.72	93.04	93.63
4	92.34	92.47	92.92	92.14	92.23	92.42
6	89.87	90.49	90.57	90.74	90.05	90.34
Mean	91.82	92.22	92.65	92.20	91.77	-
	C.D. (P=0.05), T = 0.10, S = 0.08, T x S = NS					
	S.E.±, T = 0.05, S = 0.04, T x S = NS					

NS= Non-significant

since high acidity in fruit has been suggested to contribute in part to the flavour retention of ripened fruit (Bron and Jacomino, 2006).

TSS - acid ratio:

It is interesting to note that the TSS - acid ratio decreased with the advancement of storage period from

Table 2: Changes in biochemical qualities of *Kujithekera* fruit across storage

	Treatments (T)											
	Pulp						Peel					
Storage period (S), days	T_1	T_2	T_3	T_4	T_5	Mean	T_1	T_2	T_3	T_4	T_5	Mean
	Total soluble solids (°B) (Initial value (0 day): Pulp=19.13, Peel=9.70)											
2	18.55	19.00	19.38	16.45	15.35	17.75	9.42	9.65	9.85	9.20	9.12	9.45
4	16.15	16.90	17.35	14.30	14.00	15.74	8.90	9.20	9.32	8.75	8.80	8.99
6	12.93	13.20	14.60	12.83	12.70	13.25	8.50	8.80	9.18	8.27	8.38	8.63
Mean	15.88	16.37	17.11	14.52	14.02		8.94	9.22	9.45	8.74	8.77	
	C.D.(P=0.05), T=0.30, S=0.23, TxS=0.52						C.D.(P=0.05), T=0.10, S=0.08, TxS=NS					
	S.E.±, T=0.15, S=0.12, TxS=0.26						S.E.±, T=0.05, S=0.04, TxS=NS					
	Titrable acidity (%) (Initial value (0 day): Pulp=3.82, Peel=4.88)											
2	3.38	3.57	3.78	3.24	3.23	3.44	4.62	4.78	4.88	4.62	4.39	4.66
4	3.13	3.18	3.58	3.35	3.10	3.27	4.30	4.40	4.57	4.20	4.15	4.32
6	3.02	3.10	3.40	3.13	2.93	3.12	3.38	4.00	4.17	3.77	3.60	3.88
Mean	3.18	3.28	3.58	3.24	3.08		4.25	4.39	4.54	4.20	4.05	
	C.D.(P=0.05), T=0.10, S=0.08, TxS=0.17						C.D.(P=0.05), T=0. 10, S=0.08, TxS=NS					
	S.E.±, T=0.05, S=0.04, TxS=0.08						S.E.±, T=0.05, S=0.04, TxS=NS					
	TSS-acid ratio (Initial value (0 day): Pulp=5.01, Peel=1.99)											
2	5.49	5.33	5.13	5.09	4.75	5.16	2.03	2.02	2.02	1.99	2.08	2.03
4	5.17	5.32	4.85	4.43	4.51	4.85	2.06	2.09	2.035	2.08	2.11	2.08
6	4.27	4.26	4.29	4.10	4.34	4.25	2.22	2.20	2.19	2.19	2.32	2.22
Mean	4.98	4.97	4.76	4.54	4.54		2.10	2.10	2.08	2.08	2.17	
	C.D.(P=0.05), T=0.17, S=0.13, TxS=0.30						C.D.(P=0.05), T=0.05, S=0.04, TxS=NS					
	S.E.±, T=0.08, S=0.07, TxS=0.15						S.E.±, T=0.03, S=0.02, TxS=NS					
	pH (Initial value (0 day): Pulp=5.01, Peel=1.99)											
2	3.84	3.80	3.70	3.89	3.89	3.83	1.42	1.35	1.33	1.48	1.50	1.42
4	3.95	4.01	3.87	4.21	4.24	4.06	1.47	1.42	1.35	1.52	1.60	1.48
6	4.32	4.21	4.01	4.41	4.47	4.28	1.70	1.60	1.57	1.70	1.70	1.65
Mean	4.04	4.00	3.86	4.18	4.20		1.53	1.46	1.42	1.57	1.60	
	C.D.(P=0.05), T=0.06, S=0.04, TxS=0.10						C.D.(P=0.05), T=0.08, S=0.06, TxS=NS					
	S.E.±, T=0.03, S=0.02, TxS=0.05						S.E.±, T=0.04, S=0.03, TxS=NS					
	Crude protein (%) (Initial value (0 day): Pulp=2.15, Peel=2.65)											
2	2.11	2.12	2.13	1.94	1.87	2.03	2.64	2.65	2.65	2.64	2.62	2.64
4	2.06	2.06	2.10	1.92	1.85	1.99	2.61	2.63	2.65	2.59	2.50	2.60
6	1.99	2.00	2.00	1.88	1.84	1.94	2.61	2.61	2.63	2.47	2.58	2.58
Mean	2.05	2.06	2.08	1.91	1.85		2.62	2.63	2.65	2.57	2.56	
	C.D.(P=0.05), T=0.02, S=0.02, TxS=0.04						C.D.(P=0.05), T=0.04, S=0.03, TxS=0.07					
	S.E.±, T=0.01, S=0.01, TxS=0.02						S.E.±, T=0.02, S=0.02, TxS=0.04					

2 to 6 days in all the treatments in the pulp while the ratio registered an increasing trend in the peel during the storage period (Table 2). Though both TSS and titrable acidity individually showed a decreasing trend across storage in all the treatments under study, it might be plausible that the decrease in acidity in the peel was at a slower rate resulting in the higher ratio across storage in that part of the fruit.

Pulp pH :

Pulp pH was found to increase during storage (Table 2). The rise in pH till the end of the storage might be possible due to oxidation of acid during storage resulting in higher pH. Islam *et al.* (2013) also inferred similar results in his studies on mango. The growing up trend of pulp pH was also observed elsewhere (Shahjahan *et al.*, 1994) . The pH both in pulp and peel were found to be significat with corresponding decrease in titrable acidity.

Crude protein:

The present study revealed decrease in protein values as the period of storage increased might be due to increased utilization of the nutrient by associated microflora (Olusegun *et al.*, 2011) . The low protein content found in fruit pulp may be attributed to decreased metabolic rate. Espinosa *et al.* (2013) and Hagenmaier (2005) found similar observations in sour sop fruit which showed a reduction in ethylene production rate and probably had a decreased protein synthesis including enzymes. The wax coated fruits acted as a barrier for the microflora to feed on it and it also restricted water loss which might result in the retention of the nutrients and proteins. The decrease in crude protein may also have been as a result of the breakdown of protein by endogenous proteinases (Osuji and Umezurike, 1985).

Fat:

The fat content of the *Kujithekera* fruits in the present study (Table 3) is found to follow a decreasing trend which might be because of volatilization of low molecular weight fatty materials. Similar trend was also observed by Wurochekke *et al.* (2013) in an indigenous and 'Kapoho solo' varieties of papaya.

Ash:

The ash content in both pulp and peel decreased across storage in all the treatments (Table 3). The decreasing trend of ash content both in the pulp and peel might be due to the softening of tissues. Similar trend was also found by Adetuyi *et al.* (2008) and Othman (2009). Moreover, the decreased ash value might be due to the leaching losses during the storage. The ash content is the constituent of minerals which also indicate that the mineral contents are also degrading with increase in

Table 3: Changes in biochemical qualities of *Kujithekera* fruit across storage

	Treatments (T)											
	Pulp						Peel					
Storage period (S),days	T_1	T_2	T_3	T_4	T_5	Mean	T_1	T_2	T_3	T_4	T_5	Mean
	Fat content (g/100g) in *Kujithekera* across storage (Initial value (0 day): Pulp=0.78, Peel=0.27)											
2	0.76	0.77	0.77	0.76	0.75	0.76	0.25	0.26	0.26	0.25	0.25	0.26
4	0.75	0.75	0.76	0.74	0.72	0.75	0.23	0.24	0.24	0.23	0.21	0.23
6	0.72	0.74	0.74	0.72	0.69	0.72	0.22	0.21	0.22	0.20	0.19	0.22
Mean	0.74	0.75	0.76	0.74	0.72		0.23	0.24	0.24	0.22	0.21	
	C.D.(P=0.05), T=0.005, S=0.003, TxS=0.008						C.D.(P=0.05), T=0.013, S=0.010, TxS=NS					
	S.E.±, T=0.002, S=0.002, TxS=0.004						S.E.±,T=0.02, S=0.02, TxS=0.04					
	Ash content (%) in *Kujithekera* across storage (Initial value (0 day): Pulp=1.26, Peel=1.81)											
2	1.19	1.20	1.23	1.17	1.18	1.20	1.66	1.71	1.76	1.61	1.58	1.67
4	1.14	1.16	1.18	1.12	1.10	1.14	1.65	1.68	1.73	1.57	1.55	1.64
6	1.12	1.16	1.16	0.78	0.95	1.04	1.60	1.64	1.68	1.53	1.55	1.60
Mean	1.15	1.17	1.19	1.02	1.08		1.64	1.68	1.73	1.57	1.57	
	C.D.(P=0.05), T=0.11, S=0.08, TxS=NS						C.D.(P=0.05), T=0.02, S=0.02, TxS=NS					
	S.E.±,T=0.05, S=0.04, TxS=NS						S.E.±, T=0.01, S=0.01, TxS=NS					

NS=Non-significant

storage.Similar results were also observed by Wurochekke *et al.* (2013) in the indigenous semi ripe papayas. Sharma *et al.* (2012) also reported 1.37 per cent ash in *G. pedunculata*. Onwuzulu *et al.* (1987) also found a decrease in the ash content of sweet orange as the period of storage increased. Moreover, for wax coated fruits, it could be attributed to the alterations in the structure of cell wall polysaccharides and their covalent cross-links with minerals, which could maintain higher levels of calcium in the fruit with the formation of calcium pectates resulting in more ash content (Onwuzulu *et al.*,1987)

Thus, it can be concluded 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 (25 µ), appeared to be the best treatment for retention of nutritional qualities like TSS, crude protein, fat and ash of *Kujithekera* fruits at six (6) days after storage.

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