International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(6): 532-536

Received: 04-09-2017
Accepted: 05-10-2017

Sonali P Pawaskar
Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. - Ratnagiri, M.S., India

CD Pawar
Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. - Ratnagiri, M.S., India

AV Bhuwad
Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. - Ratnagiri, M.S., India

SS Tendulkar
Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. - Ratnagiri, M.S., India

RD Dhumal
Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. - Ratnagiri, M.S., India

MC Kasture
Department of Soil science and Agril Chemistry, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. - Ratnagiri, M.S., India

Correspondence
Sonali P Pawaskar
Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. - Ratnagiri, M.S., India

Effect of Calcium Chloride, Polyethylene Packaging and Storage Conditions on Chemical Parameters of Kokum (*Garcinia indica* choisy) Fruits

Sonali P Pawaskar, CD Pawar, AV Bhuwad, SS Tendulkar, RD Dhumal and MC Kasture

Abstract
The experiment was laid out in Factorial completely randomized design with four treatments of calcium chloride + polyethylene bag packaging with two storage conditions and replicated four times. The changes in physical parameters were studied at an interval of 5 days. Among the different interactions tried, at 5th day storage interaction T_2S_2 recorded minimum increase in T.S.S., reducing sugars, total sugars, pH, anthocyanin and minimum decrease in titratable acidity. Hence, among the different interactions under study, interaction T_2S_2 was found to be best, as fruit quality is concerned.

Keywords: Kokum, Calcium chloride, Polyethylene bag, Storage conditions, Chemical parameters

Introduction
Kokum (*Garcinia indica* Choisy) a tropical fruit is a native of India and has myriad of health benefits. It is an Indian spice used in many parts of the country for making several vegetarian and non-vegetarian 'curry' preparations, chutneys, pickles and the popular 'Solkadhi', 'Amrutkokum'- a healthy soft drink, Amsul (dry rind used for garnishing), Agal i.e. salted juice etc. Kokum seed is a good source of fat called kokum butter that is used in confectionary pharmaceutical as well as cosmetic industry.

Kokum fruit contains hydroxyl citric acid (HCA) is a potential anti-obesity agent, B-complex vitamins, and minerals like potassium, manganese and magnesium, that help in controlling heart rate and blood pressure, offering protection against stroke and coronary heart diseases. This versatile fruit has been used to counter digestive problems such as indigestion, flatulence, acidity and constipation. Kokum fruit possess useful antioxidant, chelating, anti-cancer, anti-fungal, anti-inflammatory, antibacterial, cardio protective and anti-ulcer activities. Life-enhancing antioxidant found in kokum pericarp is called Xanthone. The anthocyanin pigments obtained from it are used as natural colouring agents for food preservation. Anon [1].

Processing sector is very vital for this crop as unlike other fruits, kokum cannot be consumed as fresh fruit. It's utility start only after processing. Kokum fruits are perishable in nature and there are limitations for processing of these fruits. Hence, it is necessary to extend storage life of these fruits by giving postharvest treatments with packaging and using different storage conditions. This will maintain chemical composition of fruits for longer period, which will help in preparing quality processed products.

Material and Methods
The experiment, was laid out in Factorial completely randomized design with four treatments *viz*., T_1- 2% calcium chloride, T_2-2% calcium chloride + Polyethylene bag (200 gauge), T_3- 2% calcium chloride + Polyethylene bag (200 gauge) with 2% perforation, T_4-Control and two storage conditions, *viz*., ambient temperature (S_1) and cold storage (S_2) and replicated four times. For each treatment combination 95 freshly harvested ripe kokum fruits were selected per replication. Selected fruits were thoroughly washed with clean tap water to remove dirt and dust particles adhered to the pericarp of the fruit and then treated with calcium chloride (2% for 10 minutes) and packed in polyethylene bag as per the treatments.

The treated fruits were stored at two different storage conditions viz. ambient storage (27-30 ºC) and cold storage (12 ± 2 ºC) and were analyzed for chemical composition during storage.

Total soluble solids (T.S.S.) were determined with the help of Hand refractometer (Erma Japan, 0 to 32^0Brix) and value was corrected at 20 °C with the help of temperature correction chart. The pH of the fruit juice was determined with the help of pH meter. (Model Systronics µ pH system 361). Standard solutions of pH 4.0 and 7.0 were used as reference to calibrate. The titratable acidity (%), reducing sugars (%), total sugars (%), anthocyanin (mg/100 g) were estimated as per the methods suggested by Ranganna [2].

The results were analyzed statistically as per the methods suggested by Panse and Sukhatme (1967). The above observations were recorded at 5 days interval up to end of shelf life i.e. 0, 5, 10, 15, 20 and 25 days.

Results and Discussion

In this experiment, from 5th day onwards only cold storage fruits were kept for further study as the fruits stored at ambient temperature loss the shelf life. From 15th day onwards due to spoilage the fruits of interaction T_3S_2 were discarded and T_1S_2, T_2S_2 and T_4S_2 were kept for further study. On 25th day observations of interaction T_2S_2 was taken as the other interactions showed end of shelf life.

The chemical composition of kokum fruits i.e. T.S.S., reducing sugar and total sugar content (Table 1 to 3) of kokum fruits increased throughout the storage period and it was found to be decreased at the end of shelf life, irrespective of chemical treatments at cold storage. Increase in T.S.S. reducing sugars and total sugars during cold storage might be associated with the transformation of pectic substances, starch, hemi cellulose or other polysaccharides into soluble sugars and also due to dehydration of fruits and decrease was due to fermentation of sugar at the end of the shelf life due to spoilage of fruits. At ambient temperature T.S.S., reducing sugars and total sugars was found to decrease on 5th day of storage i. e. at the end of the shelf life. It is due to higher rate of microbial fermentation as high temperature favourable for microbial growth was available at ambient temperature. This might have converted sugars into alcohol. Results similar to these findings were obtained by Naik [3] in mango and Jadhav [4] in kokum and Mahajan *et al*. [5] in guava. Interaction T_2S_2 was found to be best with respect to T.S.S. and reducing sugars, as it showed minimum increase throughout the storage period. While in case of total sugars minimum increase was found in T_3S_2 followed by T_2S_2. The titratable acidity (Table 4) showed a continuous decline during storage. Maximum retention of acidity was found in cold storage as compared to ambient storage. The reduction in acidity during storage might be associated with the conversion of organic acids into sugars and their derivatives or their utilization in respiration. The slower decrease in acidity of kokum fruits at cold storage could be possibly due to slower degradation of organic acids due to low temperature and high humidity in cold storage. These results are in conformity to the observations reported by Joshi [6] and Raorane [7] in kokum fruits. The pH was increased throughout the storage period (Table 5). The continuous increase in pH during storage could be attributed to corresponding decrease in acidity (degradation of organic acids). Similar results were found by Jadhav [4] in kokum. Anthocyanin of fruits was increased upto certain period then afterward decreased slowly at end of shelf life, in case of cold storage (Table 6). Fouad *et al*. [8] and Bhandari [9] recorded similar results in blueberry and jamun fruits, respectively. At ambient condition it was found to be increased till the end of shelf life i.e. 5th day of storage. In case of the treatments, T_2 showed minimum increase in pH and anthocyanin under both storage conditions. Among different interactions, maximum retention of acidity, pH and anthocyanin during storage period was recorded in T_2S_2.

From the present findings it can be concluded that calcium chloride treatments, polyethylene packaging and storage conditions helps to maintain the chemical composition of fruits for longer period. Considering chemical composition interaction T_2S_2 (2 % of calcium chloride + 200 gauge polyethylene bag and cold storage) was found to be best.

Table 1: Effect of calcium chloride treatments and polyethylene packaging on T.S.S. (^{0}Brix) of kokum fruits during storage

Treatments	0 days			5 days			10 days			15 days			20 days			25 days		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	11.75	11.55	11.65	11.23 (-4.47)	11.85 (2.60)	11.54 (-0.93)	-	12.15 (5.19)	-	-	12.45 (7.79)	-	-	11.85 (2.60)	-	-	-	-
T_2	11.25	11.65	11.45	10.45 (-7.11)	11.88 (1.93)	11.16 (-2.59)	-	12.05 (3.43)	-	-	12.30 (5.58)	-	-	12.45 (6.87)	-	-	11.90 (2.15)	-
T_3	11.63	11.43	11.53	10.43 (-10.32)	11.68 (2.19)	11.05 (-4.06)	-	11.93 (4.38)	-	-	11.55 (1.09)	-	-		-	-	-	-
T_4	11.55	11.65	11.60	11.30 (-2.16)	11.98 (2.79)	11.64 (0.31)	-	12.30 (5.58)	-	-	12.63 (8.37)	-	-	12.05 (3.43)	-	-	-	-
Mean	11.54	11.57	11.56	10.85 (-6.02)	11.84 (2.38)	11.35 (-1.82)	-	12.11 (4.65)	-	-	12.23 (5.71)	-	-		-	-	-	-

	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%
T	0.173	NS	0.583	2.308	-	-	-	-	-	-	-	-
S	0.122	NS	0.413	1.632	-	-	-	-	-	-	-	-
T×S	0.245	NS	0.825	3.263	-	-	-	-	-	-	-	-

Figures in parenthesis indicates percent increase in T.S.S., however minus value indicates percent decrease.

T : Treatments
T1 : 2 % Calcium chloride
T2 : 2 % Calcium chloride + Polyethylene bag (200 gauge)
T3 : 2 % Calcium chloride + Polyethylene bag (200 gauge) with perforation (2 %)
T4 : Control

S : Storage conditions
S1 : Ambient temperature (27-300C)
S2 : Cold storage (12 + 10C)
T×S : Interactions (Treatment × Storage condition)
NS : Non Significant

Table 2: Effect of calcium chloride treatments and polyethylene packaging on reducing sugars (%) of kokum fruits during storage

Treatment	0 days			5 days			10 days			15 days			20 days			25 days		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	4.98	4.74	4.86	4.49 (-9.82)	4.89 (3.09)	4.69 (-3.36)	-	5.04 (6.26)	-	-	5.20 (9.63)	-	-	5.02 (5.73)	-	-	-	-
T_2	4.79	4.68	4.74	4.53 (-5.48)	4.79 (2.33)	4.66 (-1.58)	-	4.90 (4.62)	-	-	5.00 (6.81)	-	-	5.11 (9.11)	-	-	4.99 (6.55)	-
T_3	4.63	4.98	4.80	4.40 (-4.94)	5.10 (2.38)	4.75 (-1.28)	-	5.21 (4.76)	-	-	5.06 (1.72)	-	-		-	-	-	-
T_4	4.70	4.75	4.72	4.28 (-8.86)	4.89 (3.04)	4.59 (-2.91)	-	5.03 (5.84)	-	-	5.18 (9.01)	-	-	5.0 (5.26)	-	-	-	-
Mean	4.77	4.79	4.78	4.43 (-7.27)	4.92 (2.71)	4.67 (-2.28)	-	5.05 (5.37)	-	-	5.11 (6.79)	-	-		-	-	-	-
	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%
T	0.164		NS	0.048		0.189	-		-	-		-	-		-	-		-
S	0.116		NS	0.034		0.134	-		-	-		-	-		-	-		-
T×S	0.232		NS	0.068		0.267	-		-	-		-	-		-	-		-

Figure in parenthesis indicates percent increase in reducing sugars, however minus value indicates percent decrease.

T : Treatments
T1 : 2 % Calcium chloride
T2 : 2 % Calcium chloride + Polyethylene bag (200 gauge)
T3 : 2 % Calcium chloride + Polyethylene bag (200 gauge) with perforation (2 %)
T4 : Control

S : Storage conditions
S1 : Ambient temperature (27-300C)
S2 : Cold storage (12 + 10C)
T×S : Interactions (Treatment × Storage condition)
NS : Non-Significant

Table 3: Effect of calcium chloride treatments and polyethylene packaging on total sugars (%) of kokum fruits during storage

Treatment	0 days			5 days			10 days			15 days			20 days			25 days		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	5.78	5.77	5.78	5.51 (-4.67)	6.25 (8.36)	5.88 (1.85)	-	6.84 (18.50)	-	-	7.00 (21.36)	-	-	6.86 (18.93)	-	-	-	-
T_2	5.76	5.81	5.79	5.50 (-4.51)	6.25 (7.49)	5.87 (1.49)	-	6.75 (16.22)	-	-	6.86 (18.07)	-	-	6.95 (19.66)	-	-	6.57 (13.12)	-
T_3	5.81	5.67	5.74	5.53 (-4.82)	6.04 (6.52)	5.79 (0.85)	-	6.62 (16.75)	-	-	6.68 (17.81)	-	-	-	-	-	-	-
T_4	5.71	5.89	5.80	5.44 (-4.73)	6.29 (6.79)	5.86 (1.03)	-	6.91 (17.41)	-	-	7.06 (19.92)	-	-	6.90 (17.11)	-	-	-	-
Mean	5.77	5.79	5.78	5.50 (-4.68)	6.21 (7.29)	5.85 (1.31)	-	6.78 (17.22)	-	-	6.90 (19.29)	-	-	-	-	-	-	-
	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%
T	0.108		NS	0.042		0.166	-		-	-		-	-		-	-		-
S	0.076		NS	0.030		0.118	-		-	-		-	-		-	-		-
T×S	0.152		NS	0.059		0.235	-		-	-		-	-		-	-		-

Figures in parenthesis indicates percent increase in total sugars, however minus value indicates percent decrease.

T : Treatments
T1 : 2 % Calcium chloride
T2 : 2 % Calcium chloride + Polyethylene bag (200 gauge)
T3 : 2 % Calcium chloride + Polyethylene bag (200 gauge) with perforation (2 %)
T4 : Control

S : Storage conditions
S1 : Ambient temperature (27-300C)
S2 : Cold storage (12 + 10C)
T×S : Interactions (Treatment × Storage condition)
NS : Non Significant

Table 4: Effect of calcium chloride treatments and polyethylene packaging on titratable acidity (%) of kokum fruits during storage

Treatment	0 days			5 days			10 days			15 days			20 days			25 days		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	3.95	3.87	3.91	3.45 (-12.48)	3.62 (-6.46)	3.54 (-9.47)	-	3.37 (-13.11)	-	-	3.14 (-19.04)	-	-	2.94 (-24.21)	-	-	-	-
T_2	3.74	3.83	3.79	3.20 (-14.63)	3.61 (-5.81)	3.40 (-10.22)	-	3.34 (-12.92)	-	-	3.16 (-17.48)	-	-	3.02 (-21.33)	-	-	2.53 (-33.92)	-
T_3	3.76	4.15	3.96	3.24 (-13.83)	3.88 (-6.51)	3.56 (-10.17)	-	3.57 (-14.10)	-	-	3.30 (-20.48)	-	-		-	-	-	-
T_4	4.17	4.08	4.13	3.51 (-16.00)	3.82 (-6.55)	3.66 (-11.28)	-	3.53 (-13.47)	-	-	3.34 (-18.19)	-	-	3.07 (-24.80)	-	-	-	-
Mean	3.91	3.98	3.94	3.35 (-14.23)	3.73 (-6.33)	3.54 (-10.28)	-	3.45 (-13.40)	-	-	3.23 (-18.80)	-	-		-	-	-	-
	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%	S.Em +		C. D. at 1%
T	0.133		NS	0.241		0.955	-		-	-		-	-		-	-		-
S	0.094		NS	0.171		0.675	-		-	-		-	-		-	-		-
T×S	0.188		NS	0.341		1.350	-		-	-		-	-		-	-		-

Figures in parenthesis indicates percent decrease in titratable acidity

T : Treatments
T1 : 2 % Calcium chloride
T2 : 2 % Calcium chloride + Polyethylene bag (200 gauge)
T3 : 2 % Calcium chloride + Polyethylene bag (200 gauge) with perforation (2 %)
T4 : Control

S : Storage conditions
S1 : Ambient temperature (27-300C)
S2 : Cold storage (12 + 10C)
T×S : Interactions (Treatment × Storage condition)
NS : Non-Significant

Table 5: Effect of calcium chloride treatments and polyethylene packaging on pH of kokum fruits during storage

Treatment	0 days			5 days			10 days			15 days			20 days			25 days		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	2.15	2.03	2.09	2.20 (2.33)	2.10 (3.45)	2.15 (2.89)	-	2.14 (5.54)	-	-	2.33 (14.53)	-	-	2.34 (15.27)	-	-	-	-
T_2	2.13	2.10	2.11	2.18 (2.47)	2.13 (1.43)	2.15 (1.95)	-	2.15 (2.38)	-	-	2.32 (10.61)	-	-	2.38 (13.23)	-	-	2.40 (14.57)	-
T_3	2.08	2.13	2.10	2.15 (3.37)	2.17 (1.76)	2.16 (2.57)	-	2.19 (2.70)	-	-	2.32 (9.04)	-	-		-	-	-	-
T_4	2.14	2.08	2.11	2.21 (3.39)	2.14 (3.25)	2.18 (3.32)	-	2.18 (4.94)	-	-	2.33 (12.17)	-	-	2.35 (13.39)	-	-	-	-
Mean	2.12	2.08	2.10	2.18 (2.89)	2.14 (2.48)	2.16 (2.68)	-	2.16 (3.89)	-	-	2.32 (11.59)	-	-		-	-	-	-

	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%
T	0.016	NS	0.131	0.520	-	-	-	-	-	-	-	-
S	0.012	NS	0.093	0.368	-	-	-	-	-	-	-	-
T×S	0.023	NS	0.186	0.736	-	-	-	-	-	-	-	-

Figures in parenthesis indicate percent increase in pH.

T : Treatments
T1 : 2 % Calcium chloride
T2 : 2 % Calcium chloride + Polyethylene bag (200 gauge)
T3 : 2 % Calcium chloride + Polyethylene bag (200 gauge) with perforation (2 %)
T4 : Control

S : Storage conditions
S1 : Ambient temperature (27-300C)
S2 : Cold storage (12 + 10C)
T×S : Interactions (Treatment × Storage condition)
NS : Non-Significant

Table 6: Effect of calcium chloride treatments and polyethylene packaging on anthocyanin (mg/100g) of kokum fruits during storage

Treat-ment	0 days			5 days			10 days			15 days			20 days			25 days		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	2879.25	2915.00	2897.13	3081.88 (7.04)	3027.40 (3.86)	3054.64 (5.45)	-	3161.88 (8.47)	-	-	3206.00 (9.98)	-	-	3204.75 (9.94)	-	-	-	-
T_2	3157.00	3030.75	3093.88	3312.38 (4.92)	3107.63 (2.54)	3210.01 (3.73)	-	3170.00 (4.59)	-	-	3209.50 (5.90)	-	-	3228.75 (6.53)	-	-	3215.00 (6.08)	-
T_3	2978.75	3138.25	3058.50	3180.00 (6.76)	3232.62 (3.01)	3206.31 (4.88)	-	3315.00 (5.63)	-	-	3338.00 (6.37)	-	-		-	-	-	-
T_4	3039.50	3123.75	3081.63	3272.50 (7.67)	3242.50 ((3.80)	3257.50 (5.73)	-	3330.63 (6.62)	-	-	3388.75 (8.48)	-	-	3336.25 (6.80)	-	-	-	-
Mean	3013.63	3051.94	3032.78	3211.69 (6.60)	3152.54 (3.30)	3182.11 (4.95)	-	3244.38 (6.33)	-	-	3285.56 (7.68)	-	-		-	-	-	-

	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%	S.Em +	C. D. at 1%
T	59.980	NS	0.129	0.509	-	-	-	-	-	-	-	-
S	42.412	NS	0.091	0.360	-	-	-	-	-	-	-	-
T×S	84.824	NS	0.182	0.720	-	-	-	-	-	-	-	-

Figures in parenthesis indicates percent increase in anthocyanin

T : Treatments
T1 : 2 % Calcium chloride
T2 : 2 % Calcium chloride + Polyethylene bag (200 gauge)
T3 : 2 % Calcium chloride + Polyethylene bag (200 gauge) with perforation (2 %)
T4 : Control

S : Storage conditions
S1 : Ambient temperature (27-300C)
S2 : Cold storage (12 + 10C)
T×S : Interactions (Treatment × Storage condition)
NS : Non-Significant

References

1. Anonymous. Resource Book on Kokum (Garcinia indica Choisy). Western Ghats Kokum Foundation, Panaji – Goa, 2012.
2. Ranganna S. Manual of analysis of fruit and vegetable products. Tata Mc**.** Graw Hill Publishing Company Ltd., New Delhi, 1977, 9-82.
3. Naik SK. Studies on physic-chemical changes in Alphanso and Ratna mango (*Mangifera indica* L.) fruits during growth, development and storage. A. M.Sc. (Agri.) thesis (unpublished) submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.), 1985.
4. Jadhav SB. Studies on grading, storage and processing of kokum (*Garcinia indica* Choisy) and karonda (*Carissa carandas* Linn.). A M.Sc. (Agri) thesis (unpublished) submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.), 1996.
5. Mahajan BVC, Ghuman BS, Bons HK. Effect of postharvest treatment of calcium chloride and gibbrellic acid on storage behaviour and quality of guava fruits.

Journal of Horticulture Science & Ornamental Plants, 2011; 3(1):38-42.

6. Joshi AB. Studies on some aspect of postharvest handling and processing of kokum (*Garcinia indica* Choisy) fruits. A M.sc. (Agri) thesis (unpublished) submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.), 1994.
7. Raorane GP. Studies on growth, flowering, fruiting and some aspects of post harvest handling of kokum (*Garcinia indica* Choicy). A Ph.D. (Agri.) thesis (Unpublished) submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.), 2003.
8. Fouad M Basiouny, Chen Yuli. Effect of harvest date, maturity and storage interval on post harvest quality of Rabbitye Blueberry. Proc. Fla. State Hort. Soc. 1988; 101:281-284.
9. Bhandari SP. Studies on physcio – chemical composition, grading, storage and processing of jamun (*Syzygium cumini* (Linn.) Skeels). M.Sc. (Agri.) thesis (unpublished) submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, (M.S.), 2004