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**MS Shedge**

Assistant Professor, College of Horticulture, Mulde, Dr. B. S. Kokan Krishi Vidyapeeth, Dapoli, Maharashtra, India

**Dr. PM Haldankar**

Head and Associate Dean, College of Horticulture, Dapoli, Dr. B. S. Kokan Krishi Vidyapeeth, Dapoli, Maharashtra, India

**Dr. Ahammed Shabeer TP**

Senior Scientist, NRL Lab., NRC, Grapes, Pune, Maharashtra, India

**Dr. CD Pawar**

Professor, College of Horticulture, Dapoli, Dr. B. S. Kokan Krishi Vidyapeeth, Dapoli, Maharashtra, India

**Dr. MC Kasture**

Deputy Director (Agri.), Dr. B. S. Kokan Krishi Vidyapeeth, Dapoli, Maharashtra, India

**VV Dalvi**

Professor (CAS), Incharge, Agriculture Research Station Shirgaon, Ratnagiri, Dr. B. S. Kokan Krishi Vidyapeeth, Dapoli, Maharashtra, India

**Corresponding Author:**

**MS Shedge**

Assistant Professor, College of Horticulture, Mulde, Dr. B. S. Kokan Krishi Vidyapeeth, Dapoli, Maharashtra, India

## Variation in the shelf life of ripe fruit of different kokum accessions at ambient storage conditions under Konkan agroclimatic conditions

**MS Shedge, Dr. PM Haldankar, Dr. Ahammed Shabeer TP, Dr. CD Pawar, Dr. MC Kasture and VV Dalvi**

### Abstract

The study on "Variation in the shelf life of ripe fruit of different kokum accessions at ambient storage under Konkan agroclimatic conditions" was carried out at college of Horticulture, Dr. Balasaheb Sawant Kokan Krishi Vidyapeeth, Dapoli. Dist. Ratnagiri (Maharashtra) during the year 2020-21 and 2021-2022. For the present study, thirty-two kokum trees of full bearing stage (ten trees from each district and two released varieties viz., Konkan Amruta and Konkan Hatis) were selected randomly from three districts viz; Sindhudurg, Ratnagiri and Raigad of the Konkan region of Maharashtra. The experiment was laid out in randomized Block Design with thirty two treatments viz. T<sub>1</sub> (Accession 1) to T<sub>32</sub> (Accession 32) with three replications. The fresh ripe fruit of the thirty two accessions was harvested and kept at ambient storage conditions in the post-harvest laboratory. On the basis of physiological loss in weight the observation was recorded at every alternate day of ripe kokum fruits of different accessions; shelf life was calculated in days. The result indicated that significantly highest shelf life (7.58days) was recorded in T<sub>22</sub> and T<sub>24</sub> accessions and it was at par with T<sub>7</sub> (7.50 days). However, the significantly lowest shelf life of the fruit (3.75 days) was noticed in T<sub>28</sub> and T<sub>32</sub> under ambient storage conditions.

**Keywords:** Kokum accessions, Konkan agroclimatic, ambient storage

### Introduction

Kokum (*Garcinia indica* Choisy) belongs to the genus *Garcinia*, which is large genus of polygamous evergreen trees and shrubs native of Asia, Southern Africa and Polynesia (Anthony, 1997) [1]. It is considered to be superlative among the tropical fruits in its flavor and aroma. In Maharashtra it occurs widely over all the state but predominantly seen only in the low lying belt of the konkan region. It is locally known as "Ratamba" or "Bhirand" though common in Konkan its potential remained under exploited the trees are not generally cultivated on orchard scale and often found scattered over back yard, riverside, waste lands, natural forests and in coconut and are canut gardens. The tree flower in November to February and the fruits ripen in March to May. The fruits are spherical, un-furrowed and dark purple in colour, 1-1.25 inches in diameter, encasing 5 to 8 seeds (Shameer *et al.* 2016) [7]. Kokum fruit is not only nutritious but also a very healthy fruit that improves overall immunity.

It is well known as a fruit tree of culinary, pharmaceutical, nutraceutical and industrial significance in south India, especially in the konkan region. The fruit juice is much appreciated on health drink, while dried fruit rind (Kokum sole) is used as a spice and condiment. Kokum butter extracted from seeds is used in foods, cosmetics and medicine. Stearic acid and oleic acid are the major fatty acids in kokum butter. During fruiting season lot of fruit goes waste due to inadequate storage facility and there is paucity of information on the storage behavior of kokum fruits.

Considering the importance of kokum cultivation in near future the present investigation was undertaken on Variation in the shelf life of ripe fruit of different kokum accessions at ambient storage under Konkan agroclimatic conditions"

### Material and Methods

The experiment on "Variability in the shelf life of ripe kokum fruit at ambient storage conditions under Konkan agroclimatic conditions" was conducted at College of Horticulture, Dapoli, Dist. Ratnagiri under Dr. Balasaheb Sawant Kokan Krishi Vidyapeeth, Dapoli (Maharashtra) during the year 2020-21 and 2021-22.

For the present study, thirty-two kokum trees of full bearing stage were selected randomly from three districts viz; Sindhudurg, Ratnagiri and Raigad of the Konkan region of Maharashtra. The thirty two treatment viz., T<sub>1</sub> (Accession -1) to T<sub>32</sub> (Accession -32). T<sub>1</sub> to T<sub>10</sub> -, T<sub>11</sub> to T<sub>22</sub>. Ratnagiri and T<sub>23</sub> to T<sub>32</sub>. Raigad were studied as kokum accessions. The Randomized Block Design was used for statistical analysis with three replications (Panse and Sukhatme, 1995) [4]. The fresh ripe fruit of the thirty two accessions was harvested and kept at ambient storage conditions in the post-harvest laboratory. The observations of fully ripe kokum fruits of thirty two accessions were recorded and calculated physiological loss in weight (PLW) at ambient storage conditions. The shelf life of fruit was recorded at ambient temperature storage on the basis of extent of physiological loss in weight up to 15%. The progressive loss in weight (PLW) was noted at interval of two days and % loss in weight was calculated by using formula.

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

## Results and Discussion

### Physiological loss in weight (PLW)

Data pertaining to the physiological loss in weight are presented in the Table 1A to 1B. It was revealed from the data that PLW increased continuously till the end of storage period.

During the first year (2020-21), the physiological loss in weight was in ranged between 2.16 to 4.06% after 2 days of storage. Significantly the lowest physiological loss in weight (2.16%) was recorded in T<sub>23</sub>. It was at par with T<sub>24</sub> (2.19). Significantly the highest physiological loss in weight (4.06%) was recorded in T<sub>19</sub>.

During the second year (2021-22), the physiological loss in weight was in the ranged from 2.19 to 3.93%. The lowest physiological loss in weight (2.19%) was recorded in T<sub>23</sub> and T<sub>24</sub> and was significantly superior over the other accession of kokum, significantly the highest physiological loss in weight (3.93%) was noticed in T<sub>19</sub>. Pooled data revealed that physiological loss in weight was varied significantly and with ranged between 2.17 to 3.99%. Significantly the lowest physiological loss in weight (2.17%) was observed in T<sub>23</sub> and was at par with T<sub>24</sub> (2.19). Significantly the highest physiological loss in weight (3.99%) was recorded in the same genotype i.e., T<sub>19</sub>.

At 4 days after storage the physiological loss in weight was found varied from 3.53 to 6.83% with an average of 5.08% during the first year. Significantly the lowest physiological loss in weight (3.53%) was recorded in T<sub>21</sub> and was at par with T<sub>6</sub>, T<sub>7</sub>, T<sub>22</sub>, T<sub>23</sub>, T<sub>24</sub> and T<sub>25</sub> accessions. However, the significantly highest physiological loss in weight (6.83%) was recorded in T<sub>32</sub> and significantly superior over the all other accessions. Similar trend was observed during the second year investigation at 4 days after storage. With regards to the pooled data physiological loss in weight was varied from 3.52 to 6.83% with an average of 5.07%. Significantly the lowest physiological loss in weight (3.52%) was observed in T<sub>22</sub>. It was significantly superior over the all other accession except T<sub>6</sub>, T<sub>7</sub>, T<sub>22</sub>, T<sub>23</sub>, T<sub>24</sub> and T<sub>25</sub>. However, the significantly highest physiological loss in weight (6.83%) was recorded in T<sub>32</sub>.

More or similar trend was observed at 6 days after storage. At

6 days after storage data indicated that the physiological loss in weight was varied from 8.61 to 15.52% with an average of 13.01% among the different accessions of kokum during the first year. The significantly lowest physiological loss in weight (8.61%) was recorded in T<sub>22</sub> and it was at par with T<sub>24</sub> (8.77%). Also it was followed by T<sub>7</sub>, T<sub>21</sub> and T<sub>25</sub> accessions. It was significantly superior over the all other accessions. However, the significantly highest physiological loss in weight (15.52%) was recorded in T<sub>32</sub>.

Similar trend was observed during the second year investigation at 6 days after storage. It was revealed from the data, physiological loss in weight varied 8.61 to 15.53% with an average of 13.00% among the different accessions of kokum during the second year (2021-22). The significantly lowest physiological loss in weight (8.63%) was recorded in T<sub>22</sub> and it was significantly superior over all other accession. Also, it was followed by T<sub>7</sub>, T<sub>21</sub> and T<sub>25</sub> accessions. However, the significantly highest physiological loss in weight (15.53%) was recorded in T<sub>32</sub> accession.

With regards to the pooled data indicated that physiological loss in weight was varied significantly among the different accessions in range between 8.62 to 15.53% with an average of 13.01%. The significantly lowest physiological loss in weight (8.62%) was observed in T<sub>22</sub> followed by T<sub>24</sub> (8.81%), T<sub>7</sub> (9.17%), T<sub>21</sub> (9.26%) and T<sub>25</sub> (9.59%) accessions. It was significantly superior over the all other accession. However, the significantly highest physiological loss in weight (15.53%) was recorded in T<sub>32</sub> accessions.

At 8 days storage, the fruits of the most of the accession were found unmarketable quality. However, the only four accessions was marketable quality. Among the four different accessions the lowest physiological loss in weight (14.18%) was recorded in T<sub>7</sub> followed by T<sub>22</sub> (14.27), T<sub>24</sub> (14.62), T<sub>21</sub> (14.86) and T<sub>13</sub> (15.02) accessions during the first year. While, the second year data was more or less similar to the first year data. It could be observed that the lowest physiological loss in weight (14.29%) was recorded in T<sub>22</sub> followed by T<sub>7</sub>, T<sub>21</sub>, T<sub>24</sub> and T<sub>13</sub> accessions.

With regards to pooled data the lowest physiological loss in weight (14.28%) was recorded in T<sub>22</sub> followed by T<sub>7</sub> (14.32%), T<sub>21</sub> (14.74%), T<sub>24</sub> (14.63%) and T<sub>13</sub> (15.03%) accessions.

Similar trend was reported at 10 days of storage. During storage study the moisture loss was continuous process in the all the accessions of kokum. The highest physiological loss in weight at ambient storage condition might be due to high temperature.

### Shelf life

On the basis of physiological loss in weight recorded at every alternate days; shelf life was calculated in days. Data related to shelf life of kokum fruit are presented in Table 2B. It is revealed from the data there was significant variation for the shelf life in all the accessions of kokum under study.

During the first year (2020-21) of investigation the shelf life of the fruit was ranged from 3.83 to 7.67 days with an average of 5.53 days. Significantly the highest shelf life 7.67 days was recorded in T<sub>22</sub> and T<sub>24</sub> and it was at par with T<sub>7</sub> i.e. 7.50 days. However, significantly the lowest shelf life 3.83 days was recorded in T<sub>28</sub> and T<sub>32</sub> and at par with T<sub>3</sub>, T<sub>5</sub>, T<sub>9</sub> and T<sub>29</sub> accessions. The kokum accessions T<sub>6</sub> (5.67), T<sub>13</sub> (7.00), T<sub>14</sub> (5.67), T<sub>15</sub> (5.67), T<sub>16</sub> (6.33), T<sub>20</sub> (6.00), T<sub>21</sub> (7.00), T<sub>25</sub> (6.00), T<sub>26</sub> (6.00), T<sub>27</sub> (6.00) and T<sub>30</sub> (5.67) were showed the shelf life

in days above the mean.

The second year (2021-22) data also indicated more or less same trend. With regards to pooled data, shelf life of the fruit was also varied significantly among the different accessions with ranged from 3.75 to 7.58 days with an average of 5.55 days. The highest shelf life (7.58 days) was recorded in T<sub>22</sub> and T<sub>24</sub> and it was at par with T<sub>7</sub> (7.50 days). However, the significantly lowest shelf life of the fruit (3.75 days) was noticed in T<sub>28</sub> and T<sub>32</sub> and at par with T<sub>3</sub>, T<sub>5</sub> and T<sub>9</sub> accessions. The shelf life in days above mean was showed in the accessions T<sub>13</sub> (7.08), T<sub>15</sub> (5.83), T<sub>16</sub> (6.33), T<sub>20</sub> (5.83), T<sub>21</sub> (6.83), T<sub>25</sub> (6.17), T<sub>26</sub> (5.83), T<sub>27</sub> (6.00) and T<sub>30</sub> (5.58).

The present results are corroborated with observation made by Joshi (1994) [2]. He reported 5 days shelf life of kokum fruits stored at ambient temperature conditions. However, Sawant *et al.* (1997) [6] reported that the 5-8 type of kokum had longest shelf life ranged from 10 to 15 days in different genotypes under study. While Kore *et al.* (2005) [3] reported that the most of the genotype had the maximum PLW (15%) on 5<sup>th</sup> and 6<sup>th</sup> day of storage at ambient storage conditions and the shelf life was found varied from 4 to 8.5 days among the 22 genotype under study. Similar results was reported by Raorane *et al.* (2012) [5].

**Table 1a:** Variation in Physiological loss in weight (PLW) among kokum (*Garcinia indica* Choisy) genotypes at ambient temperature storage

Kokum Genogenotypes	PLW(%) at 2days			PLW (%) at 4 days			PLW(%) at 6 days		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
T <sub>1</sub>	2.63	2.70	2.67	5.35	5.36	5.35	14.89	14.87	14.88
T <sub>2</sub>	2.87	2.76	2.82	5.03	5.05	5.04	15.23	15.21	15.22
T <sub>3</sub>	2.82	2.88	2.85	5.99	5.95	5.97	14.26	14.25	14.25
T <sub>4</sub>	3.33	3.36	3.35	5.05	5.04	5.05	14.09	14.09	14.09
T <sub>5</sub>	3.63	3.60	3.61	6.09	6.10	6.09	14.37	14.36	14.37
T <sub>6</sub>	2.53	2.55	2.54	3.61	3.62	3.61	12.05	12.10	12.08
T <sub>7</sub>	2.85	2.81	2.83	3.54	3.52	3.53	9.17	9.17	9.17
T <sub>8</sub>	3.54	3.51	3.52	6.26	6.25	6.26	14.67	14.52	14.60
T <sub>9</sub>	2.42	2.46	2.44	6.03	6.05	6.04	14.50	14.45	14.47
T <sub>10</sub>	2.49	2.59	2.54	5.63	5.66	5.65	13.11	13.11	13.11
T <sub>11</sub>	3.39	3.44	3.42	5.69	5.71	5.70	13.22	13.21	13.21
T <sub>12</sub>	2.57	2.55	2.56	5.93	5.93	5.93	13.25	13.22	13.24
T <sub>13</sub>	2.57	2.59	2.58	3.89	3.86	3.88	11.27	11.25	11.26
T <sub>14</sub>	3.40	3.41	3.41	4.89	4.90	4.90	12.32	12.29	12.31
T <sub>15</sub>	3.13	3.18	3.15	5.72	5.72	5.72	14.58	14.57	14.58
T <sub>16</sub>	2.41	2.47	2.44	5.87	5.88	5.88	12.32	12.30	12.31
T <sub>17</sub>	3.44	3.37	3.41	5.02	5.03	5.03	12.57	12.60	12.59
T <sub>18</sub>	3.50	3.50	3.50	5.10	5.10	5.10	14.52	14.51	14.51
T <sub>19</sub>	4.06	3.93	3.99	6.10	6.10	6.10	15.21	15.18	15.20
T <sub>20</sub>	2.65	2.64	2.64	5.14	5.12	5.13	14.27	14.24	14.26
T <sub>21</sub>	2.67	2.67	2.67	3.53	3.52	3.52	9.25	9.26	9.26
T <sub>22</sub>	2.58	2.52	2.55	3.60	3.58	3.59	8.61	8.63	8.62
T <sub>23</sub>	2.16	2.19	2.17	3.59	3.57	3.58	13.17	13.16	13.16
T <sub>24</sub>	2.19	2.19	2.19	3.59	3.56	3.58	8.77	8.84	8.81
T <sub>25</sub>	2.85	2.79	2.82	3.59	3.60	3.59	9.55	9.59	9.57
T <sub>26</sub>	3.03	3.01	3.02	4.88	4.86	4.87	10.47	10.50	10.49
T <sub>27</sub>	2.71	2.68	2.69	4.92	4.92	4.92	13.43	13.41	13.42
T <sub>28</sub>	2.98	2.93	2.96	5.01	5.04	5.03	14.48	14.50	14.49
T <sub>29</sub>	3.56	3.56	3.56	6.05	6.06	6.06	14.31	14.33	14.32
T <sub>30</sub>	2.77	2.80	2.79	5.14	5.15	5.14	14.29	14.29	14.29
T <sub>31</sub>	3.82	3.75	3.79	5.78	5.35	5.57	14.59	14.56	14.58
T <sub>32</sub>	3.83	3.79	3.81	6.83	6.84	6.83	15.52	15.53	15.53
Mean	2.98	2.98	2.98	5.08	5.06	5.07	13.01	13.00	13.01
Range	2.16-4.06	2.19-3.93	2.17-3.99	3.53-6.83	3.52-5.06	3.52-5.07	8.61-15.52	8.63-15.53	8.62-15.53
SEm±	0.04	0.02	0.02	0.05	0.04	0.03	0.05	0.03	0.03
CD@5%	0.11	0.05	0.06	0.15	0.11	0.10	0.15	0.08	0.09

**Table 1 b:** Physiological loss in weight (PLW) and shelf life of different genotypes of kokum (*Garcinia indica* Choisy) at ambient temperature storage

Kokum Genogenotypes	PLW (%) at 8 days			PLW (%) at 10days			Shelf life (days)		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
T <sub>1</sub>	0.00*	0.00	0.00	0.00	0.00	0.00	4.83	5.00	4.92
T <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.67	4.83	4.75
T <sub>3</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.00	4.17	4.08
T <sub>4</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.83	4.50	4.67
T <sub>5</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.00	4.00	4.00
T <sub>6</sub>	0.00	0.00	0.00	0.00	0.00	0.00	5.67	5.33	5.50
T <sub>7</sub>	14.18	14.46	14.32	16.83	16.73	16.78	7.50	7.50	7.50
T <sub>8</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.67	4.67	4.67

T <sub>9</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.00	4.17	4.08
T <sub>10</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.83	4.83	4.83
T <sub>11</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.83	5.17	5.00
T <sub>12</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.83	4.67	4.75
T <sub>13</sub>	15.02	15.04	15.03	15.76	15.24	15.17	7.00	7.17	7.08
T <sub>14</sub>	0.00	0.00	0.00	0.00	0.00	0.00	5.67	5.00	5.33
T <sub>15</sub>	0.00	0.00	0.00	0.00	0.00	0.00	5.67	6.00	5.83
T <sub>16</sub>	0.00	0.00	0.00	0.00	0.00	0.00	6.33	6.33	6.33
T <sub>17</sub>	0.00	0.00	0.00	0.00	0.00	0.00	5.00	4.83	4.92
T <sub>18</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.83	4.83	4.83
T <sub>19</sub>	0.00	0.00	0.00	0.00	0.00	0.00	5.00	4.83	4.92
T <sub>20</sub>	0.00	0.00	0.00	0.00	0.00	0.00	6.00	5.67	5.83
T <sub>21</sub>	14.86	14.61	14.74	16.43	16.51	16.47	7.00	6.67	6.83
T <sub>22</sub>	14.27	14.29	14.28	16.71	16.82	16.77	7.67	7.50	7.58
T <sub>23</sub>	0.00	0.00	0.00	0.00	0.00	0.00	5.83	6.00	5.92
T <sub>24</sub>	14.62	14.63	14.63	17.14	17.27	17.20	7.67	7.50	7.58
T <sub>25</sub>	15.41	15.25	15.33	17.04	17.18	17.11	6.00	6.33	6.17
T <sub>26</sub>	0.00	0.00	0.00	0.00	0.00	0.00	6.00	5.67	5.83
T <sub>27</sub>	0.00	0.00	0.00	0.00	0.00	0.00	6.00	6.00	6.00
T <sub>28</sub>	0.00	0.00	0.00	0.00	0.00	0.00	3.83	3.67	3.75
T <sub>29</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.50	5.00	4.75
T <sub>30</sub>	0.00	0.00	0.00	0.00	0.00	0.00	5.67	5.50	5.58
T <sub>31</sub>	0.00	0.00	0.00	0.00	0.00	0.00	4.67	4.33	4.50
T <sub>32</sub>	0.00	0.00	0.00	0.00	0.00	0.00	3.83	3.67	3.75
Mean	-	-	-	-	-	-	5.53	5.34	5.55
Range	14.18-15.41	14.29-15.25	14.28-15.33	15.76-17.14	16.82-17.27	15.17-17.20	3.83-7.67	3.67-7.50	3.75-7.58
SEm±	0.03	0.02	0.01	0.02	0.007	0.01	0.23	0.23	0.15
CD@5%	0.08	0.04	0.04	0.06	0.021	0.03	0.65	0.66	0.41

\*= Shelf life over.

## Conclusion

The ripe kokum fruit is not directly consumed as fresh fruit, it required processing before consumption. The kokum fruit deteriorate faster due to loss in weight, rotting, shriveling, injury during handling, transportation, etc. On the basis of physiological loss in weight and acceptability the significantly highest shelf life (7.58 days) was recorded in T<sub>22</sub> and T<sub>24</sub> and it was at par with T<sub>7</sub> (7.50 days). However, the significantly lowest shelf life of the fruit (3.75 days) was noticed in T<sub>28</sub> and T<sub>32</sub>. The shelf life was varied from 3.75 to 7.58 days among the kokum accession under study at ambient temperature storage.

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