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Effect of Naturally Available Materials on Ripening Behaviour of Sapota Cv. Kalipatti

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation entitled "Studies on the effect of naturally available materials on ripening behaviour of Sapota (*Manilkara achras* (Mill) Fosberg) Cv. Kalipatti." was carried out at PG laboratory in College of Horticulture, Rajendranagar during 2016 – 2017 and 2017 - 2018. Four different treatments involving sapota leaves, Paddy straw, Paper shreds and gunny bags were used for getting uniform ripening in sapota in completely randomized design with four replications. Each treatment consisted of 20 fruits per replication. Various physical parameters like physiological loss in weight, number of days for ripening, firmness, ripening, shelf life and spoilage were recorded. Among naturally available materials for ripening of fruits, the use of gunny bags (T_4) recorded minimum physiological loss in weight (13.77 %), number of days taken for ripening (5.50 days) and maximum shelf life (11.50 days). Maximum ripening percent (73.70 %) was recorded with fruits ripened in paddy straw (T_2).

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1. INTRODUCTION

"Sapota (*Manilkara achras* (mill) Fosberg) also called Chikko, chiku, chico, Sapodilla, Zapota or Sapodilla plum, is an important tropical fruit. It belongs to the family Sapotaceae and is native to Mexico in tropical (central) America. Sapota gained popularity in recent decades due to its high productivity, continuous cropping throughout the year, hardy nature, longevity and comparative freedom from pests and diseases. The sapota fruits (berry) globose or egg shaped, fleshy greyish to brown with yellowish brown soft pulp" [1] "Sapota fruits are highly nutritious, good source of sugars and minerals" [2]. "The fruit pulp is useful in the preparation of jam, jelly, sharbat, pectin, glucose and sweets" (Das and Das, 2003). "It is cultivated in Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Tamil Nadu, Telangana, West Bengal and others in the country" [1]. "Considering the existing plantation and future scope for the cultivation, it is highly essential to study the ripening and post harvest aspects of this crop, since only scanty work on these is reported so far. The post harvest problems are slow and uneven ripening, corky tissue, physiological loss of weight, decay and post harvest losses. After harvest, fruits undergo many physiological and biochemical changes because of its living entity and high water content". [3]. "The respiration rate and ethylene production significantly increase during ripening, which happens quickly" [4]. All these lead to economic loss to growers, traders, processors and finally consumers. Therefore, suitable method for uniform ripening and for extending the shelf life of fruits at ambient temperature condition is of great concern in sapota production, marketing and processing.

Being climacteric in nature, sapota fruits need ripening treatments after full maturity. Further ripening in sapota is not uniform [1] and it stores poorly at ambient condition. Traditionally sapota fruits are ripened in paddy straw and gunny bags, though fruits ripened fast in such media, the spoilage of fruits is higher. But organoleptic score of fruits ripened in paddy straw was higher than those ripened in other ripening media [5]. Hence there is a need to identify a suitable ripening medium for sapota.

2. MATERIALS AND METHODS

2.1 Cultivar

Kalipatti is popular in Maharashtra, Gujarat & North Karnataka. It is a popular table purpose variety, leaves broad, thick and green in colour, fruits oblong/round, borne in single, fruit quality high with soft sweet pulp, main picking season is winter. Fully grown tree yields 350-400 fruits/tree.

Four different treatments involving sapota leaves, Paddy straw, Paper shreds and gunny bags were used for getting uniform ripening in sapota in completely randomized design with four replications. Each treatment consisted of 20 fruits per replication. Various physical parameters like physiological loss in weight, number of days for ripening, firmness, ripening, shelf life and spoilage were recorded.

2.2 Observations Recorded

2.2.1 Physiological loss in weight (%)

Physiological loss in weight (PLW) was determined by recording the initial weight of fruits on the day of initiating experiment and subsequently at three days interval. The reduction in weight was expressed on percentage basis. The loss in weight was calculated from the initial weight as

$$PLW\ (\%) = (Wi - Ws / Wi) \times 100$$

where,

Wi = Initial weight
Ws = Weight at sampling period

2.2.2 Number of days for ripening (days)

Number of days taken by fruits to get ripened is measured in number of days.

2.2.3 Fruit firmness (kg/cm2)

Fruit firmness at random was measured on five fruits from each replicate by measuring the penetration force with a penetrometer.

2.2.4 Ripening (%)

Ripening was judged by softening and characteristic odour of the fruits.

The number of fruits ripened on the day of sampling was counted and percentage was worked out.

Ripening percent (%) = Number of fruits ripened / Total number of fruits x 100

2.2.5 Shelf life of fruits (days)

The end of shelf life was noted when the spoilage was initiated.

2.2.6 Spoilage (%)

Spoilage of fruits due to over ripening and fungal infections were recorded at regular intervals in each replication of treatments and were expressed as percentage. Any fruit showing signs of soft rot or mould was considered as 100% spoilage. The spoilage % calculated as

Spoilage (%) = (ND/NI) x 100

where, ND = Number of decayed fruits
NI = Initial number of fruits

3. RESULTS AND DISCUSSION

3.1 Physiological Loss in Weight (PLW) (%)

The data pertaining to PLW (%) in fruits of sapota Cv. Kalipatti as influenced by different treatments are presented in Table 1. The data indicated that there was significant effect of all the treatments on PLW (%) in both the years (2016-17, 2017-18) and in pooled data. On 3rd day of storage, during 2016-17, significantly lowest PLW (%) was noted with the T_4 - Gunny bags (5.67 %) which was followed by T_3 – Paper shreds (6.10 %) and T_3 was on par with T_2 – Paddy straw (6.13 %). Significantly highest PLW (%) was recorded with T_2 - Paddy straw (6.13 %) and it was on par with T_3 - Paper shreds (6.10 %).

On 3rd day of storage, during 2017-18, the lowest PLW (%) was noted with the T_4 - Gunny bags (4.82%) and it was on par with T_0 – control (4.88 %). Significantly highest PLW (%) was recorded with T_2 - Paddy straw (5.23 %) and it was on par with T_3 - Paper shreds (5.13 %), T_1 - Sapota leaves (5.11 %). On 3rd day of storage, in pooled data, significantly lowest PLW (%) was noted with the T_4 - Gunny bags (5.25 %) followed by T_1 - Sapota leaves (5.57 %) which was on par with T_3 - Paper shreds (5.61 %). Significantly highest PLW (%) was recorded with T_2 - Paddy straw (5.68 %).

On 6th day of storage, during 2016-17, significantly lowest PLW (%) was noted with the T_4 - Gunny bag (10.66 %). Significantly highest PLW (%) was recorded with the application of T_2 - Paddy straw (13.26 %). On 6th day of storage, during 2017-18, significantly lowest PLW (%) was recorded with the T_4 - Gunny bag (9.67 %). Significantly highest PLW (%) was recorded with T_2 - Paddy straw (12.30 %). On 6th day of storage, in pooled data, significantly lowest PLW (%) was recorded with the T_4 - Gunny bag (10.16 %). Significantly highest PLW (%) was recorded with T_2 - Paddy straw (12.78 %).

On 9th day of storage, during 2016 -17, significantly lowest PLW (%) was noted with the T_4 - Gunny bag (14.23 %). Significantly highest PLW (%) was recorded with the application of T_2 - Paddy straw (16.85 %). On 9th day of storage, during 2017-18, significantly lowest PLW (%) was noted with the T_4 - Gunny bag (13.32 %). Significantly highest PLW was recorded with the T_2 - Paddy straw (15.89 %).

On 9th day of storage, in pooled data, significantly lowest PLW (%) was noted with the T_4 - Gunny bag (13.77 %). Significantly highest PLW was recorded with the T_2 - Paddy straw (16.37 %).

On 12th day all the treatments showed end of shelf life in both the years (2016-17, 2017-18) and in pooled data.

It was evident from Table 1 that higher PLW (%) was observed in T_2 -Paddy straw. This might be due to reason that the physiological loss in weight indicates the progress of ripening in climacteric fruits. Higher the PLW, more is the concentrated ripening. [6]. Higher PLW (%) in T_2 -Paddy straw might be due to rise in temperature in the environment due to which respiratory rate was increased and thereby increase in ethylene concentration, which evolved through the fruit surface and accumulated in the environment. And there by the uniform ripening was induced. This is in conformity to the earlier findings of Ingle et al. [5] and Geetharani et al. [6] in sapota.

3.2 Number of Days for Ripening (Days)

The data related to number of days taken for ripening in fruits of sapota Cv. Kalipatti as effected by different treatments are depicted in Table 2. The data indicated that there was

Table 1. Effect of naturally available materials on physiological loss in weight (%) of fruits in sapota Cv. Kalipatti

Treatments	Physiological loss in weight (%)											
	3rd day			6th day			9th day			12th day		
	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled
T_0- Control (Ripened naturally)	5.83	4.88	5.35	11.26	10.27	10.76	14.53	13.57	14.05	--	--	--
T_1- Sapota leaves	6.03	5.11	5.57	12.45	11.44	11.94	15.63	14.73	15.18	--	--	--
T_2- Paddy straw	6.13	5.23	5.68	13.26	12.30	12.78	16.85	15.89	16.37	--	--	--
T_3 - Paper shreds	6.10	5.13	5.61	12.51	11.81	12.16	15.25	14.33	14.79	--	--	--
T_4 - Gunny bags	5.67	4.82	5.25	10.66	9.67	10.16	14.23	13.32	13.77	--	--	--
Mean	**5.03**	**5.49**	**12.03**	**11.10**	**11.56**	**15.30**	**14.37**	**14.83**	**5.03**			
SE.m.±	**0.03**	**0.06**	**0.03**	**0.01**	**0.11**	**0.06**	**0.03**	**0.07**	**0.04**			
CD at 5%	**0.08**	**0.18**	**0.08**	**0.04**	**0.33**	**0.17**	**0.01**	**0.21**	**0.11**			

Table 2. Effect of naturally available materials on number of days for ripening (days) in fruits of sapota Cv. Kalipatti

Treatments	Number of days for ripening (days)		
	2016-2017	2017-2018	Pooled
T_0- Control (ripened naturally)	8.25	7.25	7.75
T_1- Sapota leaves	7.25	7.00	7.13
T_2- Paddy straw	6.50	5.75	6.13
T_3 - Paper shreds	7.50	7.25	7.38
T_4–Gunny bags	5.25	5.75	5.50
Mean	**6.95**	**6.60**	**6.78**
SE.m.±	**0.27**	**0.29**	**0.22**
CD at 5%	**0.81**	**0.88**	**0.66**

Table 3. Effect of naturally available materials on fruit firmness (kg/cm^2) in fruits of sapota Cv. Kalipatti

Treatments	Firmness(kg/cm^2)											
	3rd day			6th day			9th day			12th day		
	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled
T_0- Control (ripened naturally)	6.58	7.74	7.16	5.16	6.27	5.71	2.79	3.91	3.35	--	--	--
T_1- Sapota leaves	5.71	6.70	6.21	3.84	4.83	4.33	1.71	2.87	2.29	--	--	--
T_2- Paddy straw	5.34	6.34	5.84	3.24	4.35	3.79	1.20	2.29	1.75	--	--	--
T_3 - Paper shreds	5.61	6.65	6.13	4.50	5.54	5.02	2.07	3.16	2.62	--	--	--
T_4 –Gunny bags	5.32	6.31	5.82	3.37	4.45	3.91	1.54	2.76	2.15	--	--	--
Mean	**5.71**	**6.75**	**6.23**	**4.02**	**5.09**	**4.55**	**1.86**	**3.00**	**2.43**			
SE.m.±	**0.01**	**0.03**	**0.02**	**0.04**	**0.03**	**0.03**	**0.03**	**0.09**	**0.05**			
CD at 5%	**0.04**	**0.08**	**0.05**	**0.12**	**0.08**	**0.09**	**0.09**	**0.26**	**0.15**			

Table 4. Effect of naturally available materials on fruit ripening (%)in fruits of sapota Cv. Kalipatti

Treatments	Ripening (%)		
	2016-2017	2017-2018	Pooled
T_0- Control (ripened naturally)	69.93	70.13	70.03
T_1- Sapota leaves	71.28	72.24	71.76
T_2- Paddy straw	73.88	73.53	73.70
T_3 - Paper shreds	70.87	71.25	71.06
T_4 –Gunny bags	72.69	72.00	72.35
Mean	**71.73**	**71.83**	**71.78**
SE.m.±	**0.30**	**0.23**	**0.23**
CD at 5%	**0.91**	**0.69**	**0.70**

Table 5. Effect of naturally available materials on shelf life (days) in fruits of sapota Cv. Kalipatti

Treatment	Shelf life (days)		
	2016-2017	2017-2018	Pooled
T_0- Control (ripened naturally)	9.75	9.25	9.50
T_1- Sapota leaves	10.50	10.00	10.25
T_2- Paddy straw	11.25	11.75	11.50
T_3 - Paper shreds	11.00	10.50	10.75
T_4 –Gunny bags	11.75	11.25	11.50
Mean	**10.85**	**10.55**	**10.70**
SE.m.±	**0.23**	**0.30**	**0.22**
CD at 5%	**0.71**	**0.90**	**0.68**

Table 6. Effect of naturally available materials on spoilage (%) in fruits of sapota Cv. Kalipatti

Treatments	Spoilage (%)											
	3rd day			6th day			9th day			12th day		
	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled
T_0- Control (ripened naturally)	5.24	10.41	10.62	35.58	30.85	30.47	68.35	69.17	68.76	--	--	--
T_1- Sapota leaves	4.74	3.63	4.13	28.52	28.83	28.31	62.28	62.65	62.48	--	--	--
T_2- Paddy straw	4.22	3.46	3.95	25.63	27.63	27.13	59.39	59.81	59.60	--	--	--
T_3 - Paper shreds	4.81	3.71	4.18	28.23	29.30	25.06	61.28	62.03	60.54	--	--	--
T_4 -Gunny bags	4.31	4.14	4.62	30.60	36.91	36.25	62.58	61.61	61.94	--	--	--
Mean	**4.66**	**5.07**	**5.50**	**29.71**	**30.70**	**29.44**	**62.78**	**63.05**	**62.66**			
SE.m.±	**0.01**	**0.11**	**0.32**	**0.02**	**0.03**	**0.05**	**0.12**	**0.11**	**0.20**			
CD at 5%	**0.03**	**3.16**	**3.06**	**5.20**	**5.19**	**5.41**	**5.82**	**4.60**	**5.23**			

significant effect of all the treatments on number of days taken for ripening (days) in 2016-17, 2017-18 and in pooled data.

During 2016-17, significantly lowest number of days for ripening was noted with the T_4 - Gunny bag (5.25 days) followed by T_2 - Paddy straw (6.50 days) and T_2 was on par with T_1 - Sapota leaves (7.25 days). Treatment T_1 - Sapota leaves was on par with T_3 - Paper shreds (7.50 days). Significantly highest number of days for ripening was recorded with the fruit ripened naturally T_0 - control (8.25 days) and this was on par with T_3 - Paper shreds (7.50 days).

During 2017-18, significantly lowest number of days for ripening was noted with the T_2 - paddy straw and T_4 - Gunny bag (5.75 days). Significantly highest number of days for ripening was recorded with the fruits ripened naturally T_0 - control and T_3 - Paper shreds (7.25 days) which were on par with T_1 – Sapota leaves (7.00 days).

In pooled data, significantly the lowest number of days for ripening was noted with the T_4 - Gunny bag (5.50 days) and this was on par with T_2 – paddy straw (6.13 days). Significantly highest number of days for ripening was recorded with the fruit ripened naturally T_0 - control (7.75 days) and this was on par with and T_3 - Paper shreds (7.38 days), T_1 - Sapota leaves (7.13 days).

The data in the Table 2 confirms that ripening was closely associated with climacteric peak in all the treatments including control. The ripening percentage increased with advancement of storage period. Among the natural ripening media, lowest number of days taken for ripening was recorded with fruits ripened in gunny bag (T_4) and paddy straw (T_2). “This might be due to the increased temperature in these treatments which led to break down of insoluble substances to soluble ones” [7]. This might have increased respiratory rate and advanced ripening of fruits. This is in conformity to the earlier findings of Geetha rani et al. [6] in sapota.

3.3 Firmness (kg/cm^2)

The data pertaining to firmness in fruits of sapota Cv. Kalipatti as influenced by different treatments are presented in Table 3.

The data indicated that there was significant effect of all the treatments on firmness (kg/cm^2**)** in 2016-17, 2017-18 and in pooled data.

On 3rd day of storage, during 2016-17, significantly lowest firmness was noted with the T_4 - Gunny bags (5.32 kg/cm^2) and it was on par with T_2 – Paddy straw (5.34 kg/cm^2). Significantly highest firmness was recorded with the fruits ripened naturally T_0 - control (6.58 kg/cm^2). On 3rd day of storage, during 2017-18, significantly lowest firmness was recorded with T_4 - Gunny bags (6.31 kg/cm^2) and it was on par with T_2 – Paddy straw (6.34 kg/cm^2) followed by T_3 - Paper shreds (6.65 kg/cm^2) and T_3 was on par with T_1 - Sapota leaves (6.70 kg/cm^2). Significantly highest firmness was recorded with the fruits ripened naturally T_0 - control (7.74 kg/cm^2). On 3rd day of storage, in the pooled data, significantly lowest firmness was recorded with T_4 - Gunny bags (5.82 kg/cm^2) and it was on par with T_2 – Paddy straw (5.84 kg/cm^2). Significantly highest firmness was recorded with the fruits ripened naturally T_0 - control (7.16 kg/cm^2).

On 6th day of storage, during 2016-17, significantly lowest firmness was recorded with the T_2 - Paddy straw (3.24 kg/cm^2). Significantly highest firmness was recorded with the fruits ripened naturally T_0 - control (5.16 kg/cm2). On 6th day of storage, during 2017-18, significantly lowest firmness was noted with the T_2 - Paddy straw (4.35 kg/cm2). Significantly highest firmness was recorded with the fruits ripened naturally T_0 - control (6.27 kg/cm^2). On 6th day of storage, in pooled data, significantly lowest firmness was noted with the T_2 - Paddy straw (3.79 kg/cm^2). Significantly highest firmness was recorded with the fruits ripened naturally T_0 - control (5.71 kg/cm^2).

On 9th day of storage, during 2016-17, significantly lowest firmness was noted with the T_2 - Paddy straw (1.20 kg/cm^2). Significantly highest firmness was recorded with the fruits ripened naturally T_0 - control (2.79 kg/cm^2). On 9th day of storage, during 2017-18, significantly lowest firmness was noted with the T_2 - Paddy straw (2.29 kg/cm^2). And T_4 - Gunny bag (2.76 kg/cm^2) was on par with T_1 - Sapota leaves (2.87 kg/cm^2). Significantly highest firmness was recorded with the fruits ripened naturally T_0 - control (3.91 kg/cm2). On 9th day of storage, in pooled data, significantly lowest firmness was noted with the T_2 - Paddy straw (1.75 kg/cm^2). And T_4 - Gunny bag (2.15 kg/cm^2) was on par with T_1 - Sapota leaves (2.29 kg/cm^2). Significantly highest firmness was recorded with the fruits ripened naturally T_0 - control (3.35 kg/cm^2).

On 12th day all the treatments showed end of shelf life in both the years (2016-17, 2017-18) and in pooled data.

The data in the Table 3 confirms that ripening percentage increased with advancement of storage period. As ripening increases fruit firmness decreases. The lowest fruit firmness was noted with T_2 - Paddy straw. This is because fruits ripened in paddy straw has recorded highest ripening and fruit softening during ripening is attributed to increased solubilization of cell wall pectin by the action of pectin methyl esterase and polygalacturonase hydrolysis of starch to glucose and fructose which results in change in the texture of the fruit [8,6]. Similar results were obtained when paddy husk was used as ripening media for *Zizyphus mauritiana* fruits by Ezhilarasi and Tamilmani [9].

3.4 Ripening (%)

The data regarding ripening percent (%) in fruits of sapota Cv. Kalipatti as effected by different treatments are illustrated in Table 4. It is evident from the data that there was significant effect of all the treatments on ripening percent (%) in 2016-17, 2017-18 and in pooled data.

During 2016-17, results revealed that significantly highest ripening percent (%) was recorded with T_2 - Paddy straw (73.88 %) followed by T_1-Sapota leaves (71.28 %) and T_1 was on par with T_3 - Paper shreds (70.87 %). Significantly lowest ripening percent (%) was recorded with the fruit ripened naturally T_0 - control (69.93 %). During 2017-18, significantly highest ripening percent (%) was noted with T_2 - Paddy straw (73.53 %). Treatment T_1 - Sapota leaves (72.24 %) was on par with T_4 - Gunny bags (72.00 %). Significantly lowest ripening percent (%) was recorded with the fruit ripened naturally T_0 - control (70.13 %).

In pooled data, significantly highest ripening (%) was recorded with T_2 -Paddy straw (73.70 %). Treatment T_4 - Gunny bags (72.35 %) was on par with T_1- Sapota leaves (71.76 %). Significantly lowest ripening (%) was recorded with the fruit ripened naturally T_0 - control (70.03 %). The data in the Table 4 shows that highest ripening percent (%) was noted with T_2 - Paddy straw. This is due to reason that the paddy straw was found to hasten uniform and highest ripening percent (%). This is because of rise in temperature in the environment in paddy straw. Similar results were obtained when paddy husk was used as ripening media for *Zizyphus mauritiana* fruits by Ezhilarasi and Tamilmani [9].

3.5 Shelf Life (days)

The data related to shelf life (days) in fruits of sapota Cv. Kalipatti as effected by different treatments are depicted in Table 5.

Results revealed that all the treatments had significant effect on shelf life (days) in 2016-17, 2017-18 and in pooled data. During 2016-17, significantly highest shelf life was recorded with the T_4 - Gunny bags (11.75 days) and this was on par with T_2 - Paddy straw (11.25 days) and T_3 - Paper shreds (11.00 days). Treatment T_3 - Paper shreds (11.00 days) was on par with T_1 - sapota leaves (10.50 days). Significantly lowest shelf life (days) was recorded with the fruit ripened naturally T_0 - control (9.75 days).

During 2017-18, significantly highest shelf life was noted with T_2 – Paddy straw (11.75 days) and it was on par with T_4 - Gunny bags (11.25 days). Treatment T_4 was on par with T_3 - Paper shreds (10.50 days). Significantly lowest shelf life (days) was recorded with the fruit ripened naturally T_0 - control (9.25 days) and it was on par with T_1 - Sapota leaves (10.00 days). In pooled data, significantly highest shelf life was observed in T_2 – Paddy straw and T_4 - Gunny bags (11.50 days). Treatment T_3 - Paper shreds (10.75 days) was on par with T_1 - Sapota leaves (10.25 days). Significantly lowest shelf life (days) was recorded with the fruit ripened naturally T_0 - control (9.50 days).

The data in the Table 5 confirms that highest shelf life was observed in Paddy straw (T_2) and T_4 - Gunny bags. This might may be due to reason that, they were found to cause uniform ripening with medium spoilage and long shelf life. Similar results were obtained by Geetharani et al. [6] in sapota.

3.6 Spoilage (%)

The data pertaining to spoilage (%) in fruits of sapota Cv. Kalipatti as influenced by different treatments are presented in Table 6.

Results revealed that all the treatments had significant effect on spoilage (%). On 3rd day of storage, during 2016-17, significantly lowest spoilage was noted with the T_2 - paddy straw (4.22%). Significantly highest spoilage wasrecorded with the application of T_0 - control (5.24 %).

On 3rd day of storage, during 2017-18, significantly lowest spoilage was noted with the T_2 - Paddy straw (3.46 %) and this was on par with T_1 – sapota leaves (3.63 %), T_3 - Paper shreds (3.71 %), T_4 - Gunny bags (4.14 %). Significantly highest spoilage was recorded with the application of T_0 – control (10.41%). On 3rd day of storage, in pooled data, significantly lowest spoilage was noted with the T_2 - Paddy straw (3.95 %) and this was on par with T_1 – sapota leaves (4.13 %), T_3 - Paper shreds (4.18 %), T_4 - Gunny bags (4.62 %). Significantly highest spoilage was recorded with the application of T_0 – control (10.62 %).

On 6th day of storage, during 2016-17, significantly lowest spoilage was noted with the T_2 - paddy straw (25.63 %) and this was on par with T_1 – sapota leaves (28.52 %), T_3 - Paper shreds (28.23 %), T_4 - Gunny bags (30.60 %). Significantly highest spoilage was recorded with the application of T_0 – control (35.58 %). On 6th day of storage, during 2017-18, significantly lowest spoilage was noted with the T_2 - paddy straw (27.63 %) and this was on par with T_1 – sapota leaves (28.83 %), T_3 - Paper shreds (29.30 %), T_0 - Gunny bags (30.85 %). Significantly highest spoilage was recorded with the application of T_4 – Gunny bags (36.91 %).

On 6th day of storage, in pooled data, significantly lowest spoilage was noted with the T_3 - Paper shreds (25.06 %) and this was on par with T_2 – Paddy straw (27.13 %), T_1 - sapota leaves (28.31 %), T_0- Gunny bags (30.47 %). Significantly highest spoilage was recorded with the application of T_4 – Gunny bags (36.25 %). On 9th day of storage, during 2016-17, significantly lowest spoilage was noted with the T_2 - Paddy straw (59.39 %) and this was on par with T_1 – sapota leaves (62.28 %), T_3 - Paper shreds (61.28 %), T_4 - Gunny bags (62.58 %). Significantly highest spoilage was recorded with the T_0 - control (68.35 %).

On 9th day of storage, during 2017-18, significantly lowest spoilage was noted with the T_2 - Paddy straw (59.81 %) and this was on par with T_1 – sapota leaves (62.65 %), T_3 - Paper shreds (62.03 %), T_4 - Gunny bags (61.61 %). Significantly highest spoilage was recorded with the T_0 - control (69.17 %). On 9th day of storage, in pooled data, significantly lowest spoilage was noted with the T_2 - Paddy straw (59.60 %) and this was on par with T_1 – sapota leaves (62.48 %), T_3 - Paper shreds (60.54 %), T_4 - Gunny bags (61.94 %). Significantly highest spoilage was recorded with the T_0 - Control (68.76 %). On 12th day all the treatments showed end of shelf life in both the years (2016-17, 2017-18) and in pooled data.

The data in the Table 6 shows that among natural ripening media the highest spoilage in control might be due to the presence of micro - organisms and lowest spoilage in paddy straw might be because of the lesser load of micro - organisms compared to others. [5]. These results are in confirmation with Geetharani et al. [6] in sapota.

4. CONCLUSION

The physical parameters were significantly influenced by the use of naturally available materials for uniform ripening in sapota. Minimum physiological loss in weight (%), number of days taken for ripening and maximum shelf life was recorded with fruits ripened in gunny bags (T_4). Maximum ripening percent, minimum spoilage and firmness were recorded with fruits ripened in paddy straw (T_2). Fruits ripened in paddy straw maintained fruit quality and found to be better treatment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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