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Effect of Post Harvest Application of Antioxidants and Polyamines on Chemical Parameters of Sapota (*Manilkara achras* (Mill) Fosberg) Cv. Kalipatti

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ABSTRACT: Sapota cultivation has gained area in the past couple of decades, but post harvest losses due to spoilage are very high due to lack of adequate post harvest handling facilities and proper infrastructure. To meet out the satisfactory results, several researchers applied some technologies to increase shelf life and quality of fresh fruits. Antioxidants are chemicals which prevent the damage of tissues by scavenging free radicals produced during ripening and there by extend the shelf life of fruits. Polyamines play important role in many plants physiological process such as cell growth, development and responses to environmental stresses. Many studies have shown that polyamines could delay senescence of plant tissues by inhibiting ethylene biosynthesis and there by improve postharvest life of several fruits. The present investigation was carried out at PG laboratory in College of Horticulture, Rajendranagar during 2016-2017 and 2017-2018. The experiment was carried out in Completely Randomized Design with three replications. The chemical parameters like Moisture (%), Total soluble solids (°Brix), Titrable acidity (%), TSS to acid ratio, Total sugars (%), Reducing sugars (%), Non reducing sugars (%), Ascorbic acid (mg/100g) were estimated at 3 days interval during ripening. Postharvest treatment of fruits with antioxidant BA @ 100 ppm (T_2) showed minimum physiological loss in weight (17.76 %), maximum number of days for ripening (8.50 days), firmness (1.95 kg/cm^2), shelf life (12.17 days), TSS (20.69^{o}Brix), TSS to acid ratio (132.64), total sugars (15.92 %), reducing sugars (7.04 %)and overall acceptability (7.89). There was significant influence of treatments on TSS, TSS to acid ratio, sugars, and non significant influence of treatments on parameters *i.e.*, acidity and ascorbic acid during both the years and in pooled data respectively. Maximum TSS, TSS to acid ratio, sugars were recorded with T_2 – BA @ 100 ppm fruits during both the years and in pooled data respectively.

Keywords: Antioxidants, Benzyl Adenine,Total soluble solids, Polyamines.

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. It is cultivated in Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Tamil Nadu, Telangana, West Bengal and others in the country (Chundawat, 1998). Considering the existing plantation and future scope for the cultivation, it is highly essential to study post harvest aspects of this crop, since only scanty work on these is reported so far. Post harvest losses in sapota due to spoilage are very high and is mainly due to damage during harvest, post harvest handling and transport, lack of improved storage facilities in the production areas, fungal infections and fast senescence. Past research efforts have boosted the production of sapota, but the purpose of obtaining increased production and maximum income will not serve good unless the increased production is preserved and supplemented with similar efforts to minimize the post harvest losses and extending the storage life without spoilage. Several researchers applied some technologies to increase shelf life and quality of fresh fruits. These includes post harvest application of antioxidants.

Antioxidants are chemicals which prevent the damage of tissues by scavenging free radicals produced during ripening and there by extend the shelf life of fruits (Sukumar *et al*., 2014).

Polyamines (PAS are low molecular weight, small aliphatic amines that are produced endogenously in plants (Galston, 1983). The important polyamines are putrescine (PUT), spermidine (SPD and spermine (SPM) (Kakkar and Rao 1993). Polyamines play important role in many plants physiological process such as cell growth, development and responses to environmental stresses (Ferriera *et al*., 2008). Many studies have shown that polyamines could delay senescence of plant tissues by inhibiting ethylene biosynthesis and there by improve postharvest life of several fruits (Khan *et al*., 2007).

Their anti-ethylene nature is being exploited to enhance the shelf life through exogenous application on fruits. Polyamines enhance the shelf life of fruits by reducing respiration rate, ethylene production, release, enhance firmness and quality attributes in fruits (Sharma *et al*., 2017). The research results suggested that spermidine (2 mM) had potential to improve firmness and delay deterioration processes of “Langra” mango after harvest. (Zahedi *et al*., 2019). The importance of the polyamineputrescine in extending tomato fruit shelf life has recently come into focus, together with spermidine and spermine (Gupta *et al*., 2019; Osorio *et al*., 2020). Notably, spermidine/spermine may regulate small nucleolar RNAs (snoRNAs) and ribosomal RNA (rRNA) expression directly or indirectly, which in turn will affect protein biosynthesis, metabolism, and other cellular activities in a positive manner (Shukla *et al*., 2020).

However, polyamines have not been tried for regulating the ripening of sapota fruits which is required. Keeping all this in view, present investigation is designed and proposed to study the effect of post-harvest treatments along with the use of antioxidants, polyamines on chemical parameters of sapota fruits.

MATERIAL AND METHODS

The experiment was carried out in PG lab in College of Horticulture, Rajendranagar during 2016-2017 and 2017-2018. The experiment was laid out in complete randomized design with three replications and seven treatments. The sapota fruits were harvested at mature stage and were dipped in three different antioxidants (Ascorbic acid, Benzyl adenine and sodium benzoate) concentrations, three different polyamine (Putrescine, spermine and spermidine) concentrations as post-harvest treatments *viz*., T_0 – Control (without packing), T_1– AA @ 1000 ppm, T_2 – BA @ 100 ppm, T_3 – SB @ 1000 ppm, T_4 – Putrescine @ 1mM, T_5 – Spermine @ 1.5mM, T_6 – Spermidine @ 2mM. After dipping, fruits were dried at room temperature. The fruits were assessed for Moisture (%), Total soluble solids (^{o}Brix), Titrable acidity (%), TSS to acid ratio, Total sugars (%), Reducing sugars (%), Non reducing sugars (%), Ascorbic acid (mg/100g) and sensory evaluation were assessed at 3rd, 6th, 9th and 12th day of storage. The data obtained were analysed statistically as per the method suggested by (Panse and Sukhatme 1985).

OBSERVATIONS RECORDED ON EVERY 3rd DAY

Chemical Parameters

1. Moisture (%)
2. Total soluble solids (°Brix)
3. Titrable acidity (%)
4. TSS to acid ratio
5. Total sugars (%)
6. Reducing sugars (%)
7. Non reducing sugars (%)
8. Ascorbic acid (mg/100g)
9. Sensory Evaluation (Scale: Hedonic scale)

1. Colour 2. Texture 3. Flavour 4. Taste 5. Overall acceptability

1. **Moisture content (%).** The data in the Table 1 indicated that there was non significant variation between different treatments in moisture content (%) of Kalipatti sapota fruits in both the years (2016-17 and 2017-18) and in pooled data. It was observed from the table that there was increasing trend of moisture content from 3rd day to 12th day after harvest. During ripening, carbohydrates are hydrolysed into sugars increasing osmotic transfer of moisture from peel to pulp.

Table 1: Effect of antioxidants and polyamines on moisture (%) in fruits of sapota Cv. Kalipatti.

Treatments	Moisture (%)											
	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 (without spray)	69.70	68.27	68.98	71.77	70.70	71.22	72.27	74.67	73.47	--	--	--
T_1-AA @ 1000 ppm	69.20	68.40	68.80	71.87	70.67	71.28	72.40	74.50	73.45	--	--	--
T_2- BA @ 100 ppm	69.70	68.30	69.03	71.90	70.77	71.33	72.37	74.50	73.43	74.77	75.39	75.08
T_3 - SB @ 1000 ppm	69.30	68.37	68.80	71.80	70.73	71.27	72.30	74.27	73.28	--	--	--
T_4 - Putrescine @ 1mM	69.53	68.27	68.90	71.85	70.67	71.26	72.27	74.40	73.33	74.67	--	--
T_5–Spermine @ 1.5mM	69.77	68.33	69.05	71.93	70.73	71.33	72.33	74.50	73.42	--	--	--
T_6 - Spermidine @ 2mM	69.20	68.43	68.82	71.82	70.73	71.28	72.43	74.47	73.45	--	--	--
Mean	69.49	58.57	68.91	71.85	60.61	71.28	72.34	74.47	73.40			
SE.m.±	0.23	0.04	0.13	0.13	0.04	0.08	0.04	0.11	0.07			
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS			

--Fruits spoiled, NS – Non significant

2. TSS (^{o} Brix). The data on effect of antioxidants and polyamines on TSS (^{o}brix) content of sapota Cv. Kalipatti are illustrated in Table 2. The data indicated that there was significant variation between different treatments in TSS (^{o}brix) of Kalipatti sapota fruits in both the years (2016-17, 2017-18) and in pooled data.

On 3rd day of storage, during 2016 – 2017, Significantly highest TSS was noted with the T_2- BA @ 100 ppm (20.37 ^{o}brix) and it was on par with T_4 - Putrescine @

1mM (20.10 ^{o} brix), T_3 - SB @ 1000 ppm (19.95^{o}brix), T_5–Spermine @ 1.5mM(19.82 ^{o}brix). Treatment T_5 – Spermine @ 1.5mM (19.82 ^{o}brix) was on par with T_6 - Spermidine @ 2mM (19.70^{o}brix), T_1-AA @ 1000 ppm (19.23 ^{o}brix). Significantly lowest TSS was recorded with T_0– control (18.16 ^{o}brix).

Table 2: Effect of antioxidants and polyamines on total soluble solids (°Brix) of sapota Cv. Kalipatti.

Treatments	Total soluble solids (^{0}Brix)											
	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 (without spray)	18.16	19.41	18.79	20.19	20.46	20.33	19.45	19.37	19.41	--	--	--
T_1-AA @ 1000 ppm	19.23	19.68	19.46	21.14	21.30	21.22	20.11	20.39	20.25	--	--	--
T_2- BA @ 100 ppm	20.37	20.49	20.44	22.55	22.66	22.61	21.47	21.70	21.59	20.89	20.49	20.69
T_3 - SB @ 1000 ppm	19.95	19.92	19.94	21.31	21.53	21.42	20.49	20.48	20.49	--	--	--
T_4 - Putrescine @ 1mM	20.10	19.64	19.87	22.77	21.29	22.03	21.61	20.20	20.91	20.88	--	--
T_5–Spermine @ 1.5mM	19.82	19.76	19.79	21.97	21.20	21.59	20.78	20.41	20.60	--	--	--
T_6 - Spermidine @ 2mM	19.70	20.00	19.85	22.29	21.57	21.93	21.82	20.57	21.20	--	--	--
Mean	19.62	19.84	19.73	21.75	21.43	21.59	20.82	20.45	20.64			
SE.m.±	0.19	0.20	0.12	0.23	0.19	0.17	0.20	0.23	0.16			
CD at 5%	0.59	0.61	0.35	0.70	0.57	0.51	0.61	0.70	0.49			

--Fruits spoiled

On 3rd day of storage, during 2017 – 2018, significantly highest TSS was noted with the T_2 - BA @ 100 ppm (20.49^{o}brix) and it was on par with T_6 - Spermidine @ 2mM (20.00^{o}brix), T_3 - SB @ 1000 ppm (19.92^{o}brix). Significantly lowest TSS was recorded with T_0 – control (19.41^{o}brix) which was on par with T_4 - Putrescine @ 1mM (19.64^{o}brix), T_1- AA @ 1000 ppm (19.68^o brix), T_5 – Spermine @ 1.5mM (19.76^o brix), T_3 - SB @ 1000 ppm (19.92^o brix).

On 3rd day of storage, in pooled data, significantly highest TSS was noted with the T_2 - BA @ 100 ppm (20.44^{o}brix). Treatment T_3 - SB @ 1000 ppm (19.94^{o}brix) was on par with T_4 - Putrescine @ 1mM (19.87^{o}brix), T_6 - Spermidine @ 2mM (19.85 ^{o}brix), T_5 – Spermine @ 1.5mM (19.79^{o}brix). Treatment T_5 was on par with T_1- AA @ 1000 ppm (19.46^{o}brix). Significantly lowest TSS was recorded with T_0 – control (18.79^{o}brix).

On 6th day of storage, during 2016 – 2017, Significantly highest TSS was noted with the T_4 - Putrescine @ 1mM (22.77 ^{o} brix) and this was on par with T_2- BA @ 100 ppm (22.55^o brix), T_6- Spermidine @ 2mM (22.29^{o}brix). Treatment T_6 was on par with T_5– Spermine @ 1.5mM (21.97^{o}brix) and T_5 – Spermine @ 1.5mM (21.97^{o}brix) was on par withT_3 - SB @ 1000 ppm (21.31^{o}brix). Treatment T_3 was on par with T1-AA @ 1000 ppm (21.14^{o}brix). Significantly lowest TSS was recorded with T_0– control (20.19^{o}brix).

On 6th day of storage, during 2017 – 2018, significantly highest TSS was noted with the T_2- BA @ 100 ppm (22.55 ^{o}brix) followed by T_6- Spermidine @ 2mM (21.57^{o}brix) and T_6 was on par with T_3- SB @ 1000 ppm (21.53^{o}brix), T_4- Putrescine @ 1mM (21.29^{o}brix) T_5 – Spermine @ 1.5mM (21.20^{o}brix). Significantly lowest TSS was recorded with T_0– control (20.46 ^{o}brix).

On 6th day of storage, in pooled data, significantly highest TSS was noted with the T_2 - BA @ 100 ppm (22.61^o brix). Treatment T_4 - Putrescine @ 1mM (21.29 ^{o} brix) was on par withT_5 – Spermine @ 1.5mM (21.59^o brix), T_6 - Spermidine @ 2mM (21.93^o brix). T_5 was on par with T_3 - SB @ 1000 ppm (21.42^o brix), T_1-AA @ 1000 ppm (21.22 ^{o}brix). Significantly lowest TSS was recorded with T_0– control (20.33^o brix).

On 9th day of storage, during 2016 – 2017, significantly highest TSS was noted with the T_6 - Spermidine @ 2mM (21.82^o brix) and this was on par with T_4 - Putrescine @ 1mM (21.61^{o}brix), T_2 - BA @ 100 ppm (21.47^{o}brix). Treatment T_5 – Spermine @ 1.5mM (20.78^o brix) was on par with T_3 - SB @ 1000 ppm (20.49^{o}brix) and T_3 was on par with T1- AA @ 1000 ppm (20.11o brix). Significantly lowest TSS was recorded with T_0– control (19.45 ^{o} brix).

On 9th day of storage, during 2017 – 2018, significantly highest TSS was noted with the T_2 - BA @ 100 ppm (21.70^{o}brix). T_6 - Spermidine @ 2mM (20.57^{o}brix) was on par with T_3 - SB @ 1000 ppm (20.48^{o}brix), T_5 – Spermine @ 1.5mM (20.41^o brix), T_1- AA @ 1000 ppm (20.39^{o}brix), T_4- Putrescine @ 1mM (20.20 ^{o}brix). Significantly lowest TSS was recorded with T_0 – control (19.37^{o}brix).

On 9thday of storage, in pooled data, significantly highest TSS was noted with the T_2 - BA @ 100 ppm (21.59^{o}brix) and this was on par with T_6 - Spermidine @ 2mM (21.20^{o}brix). Treatment T_4 - Putrescine @ 1mM (20.91^{o}brix) was on par with T_3 - SB @ 1000 ppm (20.49^o brix), T_5 – Spermine @ 1.5mM (20.60^o brix). Treatment $T_3$was on par with T_1- AA @ 1000 ppm (20.25^{o}brix). Significantly lowest TSS was recorded with T_0 – control (19.41^{o}brix).

On 12th day of storage, during 2016 – 2017, except treatments T_2- BA @ 100 ppm (20.89^{o}brix), T_4 - Putrescine @ 1mM (20.88^{o}brix), all other treatments showed end of shelf life. During 2017 – 2018, except treatments T_2- BA @ 100 ppm (20.49^{o}brix) all other treatments showed end of shelf life. In pooled data, except treatments T_2- BA @ 100 ppm (20.69 ^{o}brix) all other treatments showed end of shelf life.

The data in the Table 2 shows that benzyl adenine 100 ppm recorded higher total soluble solids among all other treatments. The marked increase in total soluble solids in treated fruits indicates the possible role of benzyl adenine in delaying the rapid metabolic activity of the fruits. TSS value increased initially during storage up to 6^{th} day and later on decreased as the storage progressed. The increase in TSS during the initial stages may be attributed to the conversion of starches and other polysaccharides into soluble forms of sugars (Mukherjee and Dutta 1967). The subsequent decrease in TSS at advanced stage is owing to the increased rate of respiration in later stages of storage resulting in its faster utilization in oxidation process through Kreb's cycle (Singh, 1980). Similar results were obtained by Deepthi *et al*. (2015) in guava when treated with BA 50 ppm.

3. Acidity (%). The data on effect of antioxidants and polyamines on acidity of sapota Cv. Kalipatti are depicted in Table 3. The data indicated that there was non significant variation between different treatments in acidity (%)of Kalipatti sapota fruits in both the years (2016–17, 2017–18) and in pooled data.

4. TSS to acid ratio. The data in the Table 4 indicated that there was significant variation between different treatments in TSS to acid ratio (%) of Kalipatti sapota fruits in both the years (2016-17, 2017-18) and in the pooled data.

Table 3: Effect of antioxidants and polyamines on titrableacidity (%)of sapota Cv. Kalipatti.

	Titrable acidity (%)											
	3^{rd} day			6^{th} day			9^{th} day			12^{th} day		
	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled
T_0- Control (without spray)	0.22	0.21	0.22	0.19	0.21	0.20	0.19	0.17	0.18	--	--	--
T_1-AA @ 1000 ppm	0.22	0.21	0.22	0.19	0.21	0.20	0.18	0.18	0.18	--	--	--
T_2- BA @ 100 ppm	0.23	0.20	0.21	0.18	0.20	0.19	0.18	0.16	0.17	0.15	0.17	0.16
T_3 - SB @ 1000 ppm	0.22	0.20	0.21	0.18	0.20	0.19	0.19	0.17	0.18	--	--	--
T_4 - Putrescine @ 1mM	0.22	0.21	0.21	0.19	0.21	0.20	0.17	0.17	0.17	0.15	--	--
T_5–Spermine @ 1.5mM	0.22	0.20	0.21	0.18	0.20	0.19	0.18	0.16	0.17	--	--	--
T_6 - Spermidine @ 2mM	0.22	0.20	0.21	0.18	0.20	0.19	0.17	0.18	0.18	--	--	--
Mean	0.22	0.20	0.21	0.18	0.20	0.19	0.18	0.17	0.18			
SE.m.±	0.01	0.003	0.00	0.003	0.003	0.002	0.004	0.007	0.005			
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS			

--Fruits spoiled, NS – Non significant

Table 4: Effect of antioxidants and polyamines on TSS to acid ratio of sapota Cv. Kalipatti.

Treatments	TSS to acid ratio											
	3^{rd} day			6^{th} day			9^{th} day			12^{th} day		
	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled
T_0- Control (without spray)	81.42	93.97	87.69	97.73	109.69	103.70	104.24	114.20	109.22	--	--	--
T_1-AA @ 1000 ppm	86.13	95.23	90.68	102.34	114.15	108.25	109.74	116.04	112.89	--	--	--
T_2- BA @ 100 ppm	90.19	104.27	97.22	110.98	128.36	119.67	121.57	135.85	128.71	121.57	139.82	132.64
T_3 - SB @ 1000 ppm	92.10	101.31	96.70	104.89	121.91	113.39	109.86	123.58	116.72	--	--	--
T_4 - Putrescine @ 1mM	91.49	95.07	93.28	106.75	114.15	110.45	124.76	121.86	123.31	124.76	--	--
T_5–Spermine @ 1.5mM	91.51	100.57	96.04	108.10	120.11	114.10	117.64	127.88	122.76	--	--	--
T_6 - Spermidine @ 2mM	90.96	98.43	94.69	109.66	117.79	113.72	128.64	114.57	121.60	--	--	--
Mean	89.11	98.41	93.76	105.78	118.02	111.90	116.64	122.00	119.32			
SE.m.±	1.95	1.89	1.39	2.00	2.32	1.49	2.30	5.14	3.09			
CD at 5%	5.98	5.78	4.26	6.13	7.10	4.58	7.05	NS	9.46			

--Fruits spoiled

On 3^{rd} day of storage, during 2016 – 2017, Significantly highest TSS to acid ratio was noted with the T_3 - SB @ 1000 ppm (92.10) and it was on par with T_5 – Spermine @ 1.5mM (91.51), T_4 - Putrescine @ 1mM (91.49), T_6 - Spermidine @ 2mM (90.96), T_2 - BA @ 100 ppm (90.19). Treatment T_2 was on par with T_1- AA @ 1000 ppm (86.13). Significantly lowest TSS to acid ratio was noted withT_0 – control (81.42) which was on par with T_1.

On 3^{rd} day of storage, during 2017 – 2018, significantly highest TSS to acid ratio was noted with the T_2 - BA @ 100 ppm (104.27) and it was on par with T_5 – Spermine @ 1.5mM (100.57), T_3 - SB @ 1000 ppm (101.31). Treatment T_3 was on par with T_1- AA @ 1000 ppm (95.23), T_4 - Putrescine @ 1mM (95.07), T_6 - Spermidine @ 2mM (98.43). Significantly lowest TSS to acid ratio was noted with T_0 – control (93.97) which was on par with T_4 - Putrescine @ 1mM (95.07).

On 3rd day of storage, in pooled data, significantly highest TSS to acid was noted with the T_2 - BA @ 100 ppm (97.22) which was on par with T_4 - Putrescine @ 1mM (93.28), T_5 – Spermine @ 1.5mM (96.04) and T_6- Spermidine @ 2mM (94.69). Treatment T_6 was on par with T_1- AA @ 1000 ppm (90.68). Significantly lowest TSS to acid ratio was noted with withT_0 – control (87.69) and it was on par with T_1.

On 6^{th} day of storage, during 2016 – 2017, significantly highest TSS to acid ratio was noted with the T_2 - BA @

100 ppm (110.98) and it was on par with T_6 - Spermidine @ 2mM (109.66), T_5 – Spermine @ 1.5mM (108.10), T_4 - Putrescine @ 1mM (106.75), T_3 - SB @ 1000 ppm (104.89). Treatment T_3 was on par with T_1- AA @ 1000 ppm (102.34). Significantly lowest TSS to acid ratio was noted with T_0 – control (97.73) and it was on par with T_1.

On 6th day of storage, during 2017 – 2018, significantly highest TSS to acid ratio was noted with the T_2 - BA @ 100 ppm (128.36) and it was on par with T_3 - SB @ 1000 ppm (121.91). Treatment T_3 was on par withT_4 - Putrescine @ 1mM (114.15) & T_1- AA @ 1000 ppm (114.15), T_5 – Spermine @ 1.5mM (120.11), T_6 - Spermidine @ 2mM (117.79). Significantly lowest TSS to acid ratio was noted with T_0 – control (109.69) and it was on par with T_1&T_4.

On 6th day of storage, in pooled data, significantly highest TSS to acid ratio was noted with the T_2 - BA @ 100 ppm (119.67). Treatment T_6 - Spermidine @ 2mM (113.72) was on par withT_3 - SB @ 1000 ppm (113.39), T_5 – Spermine @ 1.5mM (114.10), T_4 - Putrescine @ 1mM (110.45), T_1- AA @ 1000 ppm (108.25). Significantly lowest TSS to acid ratio was noted with T_0 – control (103.70) and it was on par with T_1.

On 9th day of storage, during 2016 – 2017, significantly highest TSS to acid ratio was noted with the T_6 - Spermidine @ 2mM (128.64) and this was on par with T_4 - Putrescine @ 1mM (124.76). Significantly lowest TSS to acid ratio was noted with T_0 – control (104.24) which was on par with T_1 (109.74) and T_3 (109.86).On 9thday of storage, during 2017–2018, there was nonsignificant variation between different treatments. On 9th day of storage, in pooled data, significantly highest TSS to acid ratio was noted withT_2 - BA @ 100 ppm (128.71) and this was on par with T_4 - Putrescine @ 1mM (123.3), T_5 – Spermine @ 1.5mM (122.76), T_6 - Spermidine @ 2mM (121.60). Treatment T_6 - Spermidine @ 2mM (121.60) was on par with T_3 - SB @ 1000 ppm (116.72), T_1- AA @ 1000 ppm (112.89). Significantly lowest TSS to acid ratio was noted with T_0 – control (109.22) and it was on par with T_1 (112.89).

On 12th day of storage, during 2016 – 2017, except treatments T_2- BA @ 100 ppm (121.57), T_4 - Putrescine @ 1mM (124.76), all other treatments showed end of shelf life. On 12th day of storage, during 2017 – 2018, except treatments T_2- BA @ 100 ppm (139.82) all other treatments showed end of shelf life. On 12th day of storage, in pooled data, except treatments T_2- BA @ 100 ppm(132.64) all other treatments showed end of shelf life.

The data in the Table 4 shows that there was increase in ratio with prolongation of storage which may be attributed to decrease in acidity during respiration. And highest TSS to acid ratio was noted with BA @ 100 ppm, as it recorded higher TSS. Lowest TSS to acid ratio was recorded with untreated fruits as these recorded lower TSS and higher acidity compared to treated fruits. These results were in confirmation with results of Sukumar *et al*. (2014) in guava.

5. Total sugars (%). The data in the Table 5 indicated that there was significant variation between different treatments in total sugars content (%) of Kalipatti sapota fruits in both the years (2016-17, 2017-18) and in pooled data.

Table 5: Effect of antioxidants and polyamines on total sugars (%) of sapota Cv. Kalipatti.

Treatments	Total sugars (%)											
	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 (without spray)	16.94	17.18	17.06	20.03	21.45	20.74	17.97	17.98	17.98	--	--	--
T_1-AA @ 1000 ppm	17.46	18.28	17.87	21.17	21.67	21.42	20.27	21.10	20.68	--	--	--
T_2- BA @ 100 ppm	18.32	19.09	18.70	22.68	23.50	23.10	21.68	22.23	21.96	16.29	15.55	15.92
T_3 - SB @ 1000 ppm	17.85	18.39	18.13	21.66	21.95	21.81	20.45	21.26	20.86	--	--	--
T_4 - Putrescine @ 1mM	18.41	18.74	18.58	22.05	23.04	22.55	21.79	22.14	21.97	16.19	--	--
T_5–Spermine @ 1.5mM	18.27	18.17	18.22	21.35	21.36	21.36	21.10	20.25	20.67	--	--	--
T_6 - Spermidine @ 2mM	18.46	18.23	18.35	21.13	22.22	21.68	20.40	21.54	20.97	--	--	--
Mean	17.96	18.30	18.13	21.44	22.17	21.81	20.52	20.93	20.73			
SE.m.±	0.14	0.12	0.10	0.20	0.29	0.18	0.27	0.29	0.20			
CD at 5%	0.42	0.37	0.30	0.62	0.89	0.56	0.83	0.87	0.61			

--Fruits spoiled

On 3rd day of storage, during 2016–2017, significantly highest total sugars was noted with the T_6 - Spermidine @ 2mM (18.46 %) and this was on par with T_4 - Putrescine @ 1mM (18.41 %), T_2 - BA @ 100 ppm (18.32 %), T_5 – Spermine @ 1.5mM (18.27 %). T_5 was on par with T_3 - SB @ 1000 ppm (17.85 %), T_3 was on par with T_1- AA @ 1000 ppm (17.46 %). Significantly lowest total sugars was noted with T_0 – control (16.94 %).

On 3rd day of storage, during 2017–2018, significantly highest total sugars was noted with the T_2 - BA @ 100 ppm (19.09 %) and this was on par with T_4 - Putrescine @ 1mM (18.74 %). T_4 was on par withT_3 - SB @ 1000 ppm (18.39 %). T_3 was on par with T_1- AA @ 1000 ppm (18.28 %), T_6 - Spermidine @ 2mM (18.23 %), T_5 – Spermine @ 1.5mM (18.17 %). Significantly lowest total sugars was noted with T_0 – control (17.18 %).

On 3rd day of storage, in pooled data, significantly highest total sugars was noted with the T_2 - BA @ 100 ppm (18.70 %) and this was on par with T_4 - Putrescine @ 1mM (18.58 %). T_4 was on par with T_5 - Spermine @ 1.5mM (18.22 %), T_6 - Spermidine @ 2mM (18.35

%). T5 – Spermine @ 1.5mM (18.22 %) was on par withT_3 - SB @ 1000 ppm (18.13 %). T_3 was on par withT1- AA @ 1000 ppm (17.87 %). Significantly lowest total sugars was noted with T_0 - control (17.06 %).

On 6th day of storage, during 2016 – 2017, significantly highest total sugars was noted with the T_2 - BA @ 100 ppm (22.68 %) and this was on par with T_3 - SB @ 1000 ppm (21.66 %). T_3 was on par with T_5 – Spermine @ 1.5mM (21.35 %), T_6 - Spermidine @ 2mM (21.13 %), T_1- AA @ 1000 ppm (21.17 %). Significantly lowest total sugars was noted with T0 – control (20.03 %).

On 6th day of storage, during 2017 – 2018, significantly highest total sugars was noted with the T_2 - BA @ 100 ppm (23.50 %)and this was on par with T_4 - Putrescine @ 1mM (23.04 %). T_4 was on par with T_6 - Spermidine @ 2mM (22.22 %). T_3 - SB @ 1000 ppm (21.95 %) was on par withT_5 – Spermine @ 1.5mM (21.36 %),T_1- AA @ 1000 ppm (21.67 %), T_0 – control (21.45 %). Significantly lowest total sugars was noted with T_5 – Spermine @ 1.5mM (21.36 %).

On 6th day of storage, in pooled data, significantly highest total sugars was noted with the T_2 - BA @ 100 ppm (23.10 %) and this was on par withT_4 - Putrescine @ 1mM (22.55 %). T_3 - SB @ 1000 ppm (21.81 %) was on par with T_5 – Spermine @ 1.5mM (21.36 %), T_6 - Spermidine @ 2mM (21.68 %), T_1- AA @ 1000 ppm (21.42 %). Significantly lowest total sugars was noted with T_0 – control (20.74 %).

On 9th day of– storage, during 2016 - 2017, significantly highest total sugars was noted with the T_4 - Putrescine @ 1mM (21.79 %) and this was on par with T_2 - BA @ 100 ppm (21.68 %), T_5 – Spermine @ 1.5mM (21.10 %). T_5 was on par with T_1- AA @ 1000 ppm (20.27 %), T_6 - Spermidine @ 2mM (20.40 %),T_3 - SB @ 1000 ppm (20.45 %). Significantly lowest total sugars was noted with T_0 – control (17.97 %).

On 9th day of storage, during 2017–2018, significantly highest total sugars was noted with the T_2 - BA @ 100 ppm (22.23 %) and this was on par withT_6 - Spermidine @ 2mM (21.54 %), T_4 - Putrescine @ 1mM (22.14 %). T_6 was on par with T_1- AA @ 1000 ppm (21.10 %), T_3 - SB @ 1000 ppm (21.26 %), T_1- AA @ 1000 ppm (21.10 %). T_1 was on par with T_5 – Spermine @ 1.5mM (20.25 %). Significantly lowest total sugars was noted with T_0 – control (17.98 %).

On 9th day of storage, in pooled data, significantly highest total sugars was noted with the T_4 - Putrescine @ 1mM (21.97 %)and this was on par withT_2 - BA @ 100 ppm (21.96 %). T_6 - Spermidine @ 2mM (20.97 %)was on par withT_5 – Spermine @ 1.5mM (20.67 %), T_3 - SB @ 1000 ppm (20.86 %), T_1- AA @ 1000 ppm (20.68 %). Significantly lowest total sugars was noted with T_0 – control (17.98 %).

On 12th day of storage, during 2016 - 2017, except treatments T_2 - BA @ 100 ppm (16.29 %) and T_4 - Putrescine @ 1mM (16.19 %), all other treatments showed end of shelf life. On 12th day of storage, during 2017 - 2018, except treatments T_2 - BA @ 100 ppm (15.55 %), all other treatments showed end of shelf life.

On 12th day of storage, in pooled data, except treatments T_2 - BA @ 100 ppm (15.92 %), all other treatments showed end of shelf life.

The data in the Table 5 depicts that total sugars increased with increasing the storage period up to 6th day of storage, and then reduced. It may be due to break down of physiological process. Highest total sugars were recorded with BA @ 100 ppm. The reason may be that benzyl adenine quenches free radicals and inhibit ethylene synthesis and thus might have reduced the rate of ripening, resulting in retardation of senescence and gradual buildup of sugars (Ahmed, 1998). Similar results were obtained by Deepthi *et al.* (2015) in guava when treated with BA 50 ppm.

Table 6: Effect of antioxidants and polyamines on reducing sugars (%)of sapota Cv. Kalipatti.

Treatments	Reducing sugars (%)											
	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 (without spray)	7.35	7.28	7.32	8.78	9.36	9.07	7.34	7.87	7.61	--	--	--
T_1- AA @ 1000 ppm	8.09	8.20	8.15	9.52	9.86	9.69	8.19	8.09	8.14	--	--	--
T_2- BA @ 100 ppm	8.38	8.48	8.43	10.30	10.09	10.20	8.22	8.42	8.32	7.23	6.85	7.04
T_3 - SB @ 1000 ppm	8.16	8.14	8.15	9.73	9.62	9.68	8.32	8.19	8.25	--	--	--
T_4 - Putrescine @ 1mM	8.25	8.55	8.40	10.05	9.84	9.95	8.31	8.17	8.24	7.21	--	--
T_5–Spermine @ 1.5mM	8.11	8.29	8.20	9.99	9.66	9.82	8.19	8.36	8.28	--	--	--
T_6 - Spermidine @ 2mM	8.19	8.17	8.18	9.87	9.69	9.78	8.15	8.32	8.24	--	--	--
Mean	8.08	8.16	8.12	9.75	9.73	9.74	8.10	8.20	8.15			
SE.m.±	0.05	0.09	0.05	0.14	0.10	0.08	0.05	0.10	0.05			
CD at 5%	0.14	0.27	0.16	0.43	0.30	0.25	0.15	0.32	0.16			

--Fruits spoiled

6. Reducing sugars (%). The data in the Table 6 indicated that there was significant variation between different treatments in reducing sugars (%) of Kalipatti sapota fruits in both the years (2016-17, 2017-18) and in pooled data.

On 3rd day of storage, during 2016 – 2017, significantly highest reducing sugars was noted with T_2 - BA @ 100 ppm (8.38 %) and this was on par with T_4 - Putrescine @ 1mM (8.25 %). $T_4$was on par withT_5 – Spermine @ 1.5mM (8.11 %), T_3 - SB @ 1000 ppm (8.16 %),T_6 - Spermidine @ 2mM (8.19 %). T_5 – Spermine @ 1.5mM (8.11 %) was on par withT_1- AA @ 1000 ppm (8.09 %). Significantly lowest reducing sugars was noted with T_0 – control (7.35 %).

On 3rd day of storage, during 2017 – 2018, significantly highest reducing sugars was noted with T_4 - Putrescine @ 1mM (8.55 %). T_4 was on par withT_5 – Spermine @ 1.5mM (8.29 %),T_2 - BA @ 100 ppm (8.48 %). T_5 was on par withT_6 - Spermidine @ 2mM (8.17 %), T_3 - SB @ 1000 ppm (8.24 %),T_1- AA @ 1000 ppm (8.20%). Significantly lowest reducing sugars was noted with T_0 – control (7.28 %).

On 3rd day of storage, in pooled data, significantly highest reducing sugars was noted with T_2 - BA @ 100 ppm (8.43 %) and this was on par with T_4 - Putrescine @ 1mM (8.40 %).T_5 – Spermine @ 1.5mM (8.20 %)was on par withT_6 - Spermidine @ 2mM (8.18 %), T_1- AA @ 1000 ppm (8.15 %), T_3 - SB @ 1000 ppm (8.15 %). Significantly lowest reducing sugars was noted with T_0 – control (7.32 %).

On 6thday of storage, during 2016 – 2017, significantly highest reducing sugars was noted with T_2 - BA @ 100 ppm (10.30 %) and this was on par with T_4 - Putrescine @ 1mM (10.05 %), T_5 – Spermine @ 1.5mM (9.99 %), T_6 - Spermidine @ 2mM (9.87 %). T6 was on par with T_1- AA @ 1000 ppm (9.52 %) and T_3 - SB @ 1000 ppm (9.73 %). Significantly lowest reducing sugars was noted with T_0 – control (8.78 %).

On 6th day of storage, during 2017 – 2018, significantly highest reducing sugars was noted with T_2 - BA @ 100 ppm (10.09 %) and this was on par with T_4 - Putrescine @ 1mM (9.84 %), T_1- AA @ 1000 ppm (9.86 %). T_4 was on par withT_5 – Spermine @ 1.5mM (9.66%), T_6 - Spermidine @ 2mM (9.69%), T_3 - SB @ 1000 ppm (9.62 %). T_3 was on par with T_0 – control (9.36 %). Significantly lowest reducing sugars was noted with T_0 – control (9.36 %).

On 6th day of storage, in pooled data, significantly highest reducing sugars was noted with T_2 - BA @ 100 ppm (10.20 %) and this was on par with T_4- Putrescine @ 1mM (9.95 %). T_4 was on par with T_6 - Spermidine @ 2mM (9.78 %), T_5 – Spermine @ 1.5mM (9.82 %).T_6 was on par with T_3 - SB @ 1000 ppm (9.68 %), T_1- AA @ 1000 ppm (9.69 %). Significantly lowest reducing sugars was noted with T_0 – control (9.07 %).

On 9th day of storage, during 2016 – 2017, significantly highest reducing sugars was noted with T_3 - SB @ 1000 ppm (8.32 %) and this was on par with T_4 - Putrescine @ 1mM (8.31 %), T_5 – Spermine @ 1.5mM (8.19 %), T_2 - BA @ 100 ppm (8.22 %), T_1- AA @ 1000 ppm (8.19 %).T_5 – Spermine @ 1.5mM (8.19 %) was on par withT_6 - Spermidine @ 2mM (8.15 %). Significantly lowest reducing sugars was noted with T_0 – control (7.34 %).

On 9th day of storage, during 2017 – 2018, significantly highest reducing sugars was noted with T_2 - BA @ 100 ppm (8.42 %) and this was on par with T_3 - SB @ 1000 ppm (8.19 %), T_4 - Putrescine @ 1mM (8.17 %), T_5 – Spermine @ 1.5mM (8.36 %), T_6 - Spermidine @ 2mM (8.32 %). T_4 - Putrescine @ 1mM (8.31 %) was on par withT_1- AA @ 1000 ppm (8.09 %), T_0 – control (7.87 %). Significantly lowest reducing sugars was noted with T_0 – control (7.87 %).

On 9th day of storage, in pooled data, significantly highest reducing sugars was noted with T_2 - BA @ 100 ppm (8.32 %) and this was on par with T_3 - SB @ 1000 ppm (8.25 %), T_4 - Putrescine @ 1mM (8.24 %), T_5 – Spermine @ 1.5mM (8.28 %), T_6 - Spermidine @ 2mM (8.24 %). T_4&T_6 were on par withT_1- AA @ 1000 ppm (8.14 %). Significantly lowest reducing sugars was noted with T_0 – control (7.61 %).

On 12th day of storage, during 2016 - 2017, except treatments T_2 - BA @ 100 ppm (7.232 %) and T_4 - Putrescine @ 1mM (7.21 %), all other treatments showed end of shelf life. On 12th day of storage, during 2017 - 2018, except treatments T_2 - BA @ 100 ppm (7.23 %), all other treatments showed end of shelf life. On 12th day of storage, in pooled data, except treatments T_2 - BA @ 100 ppm (7.23 %), all other treatments showed end of shelf life.

The data in the Table 6 depicts that there was initial rise in reducing sugars up to 6th day and then decreased. This may be due to conversion of starch to sugars, where as the subsequent decrease may be due to utilization of sugars in respiration (Pool *et al*., 1972). Highest reducing sugars were recorded with BA @ 100 ppm. The reason may be that benzyl adenine quenches free radicals and inhibit ethylene synthesis and thus might have reduced the rate of ripening, resulting in retardation of senescence and gradual buildup of sugars (Ahmed, 1998). Similar results were obtained by Deepthi *et al*. (2015) in guava when treated with BA 50 ppm.

7. Non Reducing sugars (%). The data in the Table 7 showed that there was significant variation between different treatments in non reducing sugars (%) of Kalipatti sapota fruits in both the years (2016-17, 2017-18) and in pooled data.

On 3rd day of storage, during 2016 – 2017, significantly highest non reducing sugars was noted with T_6 - Spermidine @ 2mM (10.27 %) and this was on par withT_4 - Putrescine @ 1mM, T_5 – Spermine @ 1.5mM (10.16 %), T_2 - BA @ 100 ppm (9.93 %). T_2 was on par withT_0 – control (9.59 %), T_3 - SB @ 1000 ppm (9.69 %). T_0 – control (9.59 %) was on par withT_1- AA @ 1000 ppm (9.37 %).Significantly lowest non reducing sugars was noted with T_1- AA @ 1000 ppm (9.37 %).

On 3rd day of storage, during 2017 – 2018, there was non significant variation between different treatments in non reducing sugars (%).

On 3rd day of storage, in pooled data, significantly highest non reducing sugars was noted with T_2 - BA @ 100 ppm (10.27 %)and this was on par with T_4 - Putrescine @ 1mM (10.18), T_3 - SB @ 1000 ppm (9.97 %), T_5 – Spermine @ 1.5mM (10.02 %),T_6 - Spermidine @ 2mM (10.17 %). T_3 - SB @ 1000 ppm was on par with T_0 – control (9.74 %), T1- AA @ 1000 ppm (9.73 %). Significantly lowest non reducing sugars was noted with T1- AA @ 1000 ppm (9.73 %).

On 6th day of storage, during 2016 – 2017, significantly highest non reducing sugars was noted with T_2 - BA @

100 ppm (12.38 %) and this was on par with T_3 - SB @ 1000 ppm (11.92 %), T_4 - Putrescine @ 1mM (12.00 %), T_1- AA @ 1000 ppm (11.65 %). $T_1$was on par withT_5 – Spermine @ 1.5mM (11.36 %),T_6 - Spermidine @ 2mM (11.26 %), T_0 – control (11.25 %). Significantly lowest non reducing sugars was noted with T_0 – control (11.25 %).

On 6th day of storage, during 2017 – 2018, significantly highest non reducing sugars was noted with T_2 - BA @ 100 ppm (13.41 %) and this was on par with T_4 - Putrescine @ 1mM (13.20 %), T_6 - Spermidine @ 2mM (12.54 %). T_6 was on par with T_5 – Spermine @ 1.5mM (11.70 %), T_0 – control (12.09 %), T_3 - SB @ 1000 ppm (12.33 %), T_1- AA @ 1000 ppm (11.81 %). Significantly lowest non reducing sugars was noted with T_0 – control (11.70 %).

On 6th day of storage, in pooled data, significantly highest non reducing sugars was noted with T_2 - BA @ 100 ppm (12.90 %) and this was on par with T_4 - Putrescine @ 1mM (12.60 %).$T_4$was on par with T_3 - SB @ 1000 ppm (12.13 %),$T_3$was on par with T_0 – control (11.67 %), T_1- AA @ 1000 ppm (11.73 %), T_5 – Spermine @ 1.5mM (11.54 %),T_6 - Spermidine @ 2mM (11.90 %). Significantly lowest non reducing sugars was noted with T_5 – Spermine @ 1.5mM (11.54 %).

On 9th day of storage, during 2016 – 2017, significantly highest non reducing sugars was noted with T_4 - Putrescine @ 1mM (13.48 %) and this was on par with T_2 - BA @ 100 ppm (13.46 %), T_5 – Spermine @ 1.5mM (12.91 %). T_5 was on par with T_3 - SB @ 1000 ppm (12.14 %), T_6 - Spermidine @ 2mM (12.24 %). T_6 was on par with T_1- AA @ 1000 ppm (12.08 %). Significantly lowest non reducing sugars was noted with T_0 – Control (10.63 %).

On 9th day of storage, during 2017– 2018, significantly highest non reducing sugars was noted with T_4 - Putrescine @ 1mM (13.97 %) and this was on par with T_2 - BA @ 100 ppm (13.81 %), T_3 - SB @ 1000 ppm (13.07 %), T_6 - Spermidine @ 2mM (13.22 %), T_1- AA @ 1000 ppm (13.01 %). T_1 was on par with T_5 – Spermine @ 1.5mM (11.89 %). Significantly lowest non reducing sugars was noted with T_0 – control (10.11 %).

On 9th day of storage, in pooled data, significantly highest non reducing sugars was noted with T_4 - Putrescine @ 1mM (13.73 %) and this was on par with T_2 - BA @ 100 ppm (13.64 %). T_6 - Spermidine @ 2mM (12.74 %) was on par with T_4 - Putrescine @ 1mM (12.61 %), T_1- AA @ 1000 ppm (12.55 %), T_5 – Spermine @ 1.5mM (12.40 %). Significantly lowest non reducing sugars was noted with T_0 – control (10.38 %).

On 12th day of storage, during 2016 - 2017, except treatments T_2 - BA @ 100 ppm (9.05 %) and T_4 - Putrescine @ 1mM (8.98 %), all other treatments showed end of shelf life. During 2017 - 2018, except treatments T_2 - BA @ 100 ppm (8.32 %), all other treatments showed end of shelf life. In pooled data, except treatments T_2 - BA @ 100 ppm (8.69 %), all other treatments showed end of shelf life.

The data in the Table 7 depicts that there was increase in non reducing sugars initially and then decreased. Lowest non reducing sugars was recorded with control fruits. As ripening progressed accumulation of total and reducing sugars increases and non reducing sugars increases. These results are in confirmation with results of Sukumar *et al*. (2014) in guava.

Table 7: Effect of antioxidants and polyamines on non reducing sugars (%)of sapota Cv. Kalipatti.

Treatments	**Non reducing sugars (%)**											
	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 (without spray)	09.59	09.90	09.74	11.25	12.09	11.67	10.63	10.11	10.38	--	--	--
T_1-AA @ 1000 ppm	09.37	10.08	09.73	11.65	11.81	11.73	12.08	13.01	12.55	--	--	--
T_2- BA @ 100 ppm	09.93	10.60	10.27	12.38	13.41	12.90	13.46	13.81	13.64	9.05	8.70	8.87
T_3 - SB @ 1000 ppm	09.69	10.25	09.97	11.92	12.33	12.13	12.14	13.07	12.61	--	--	--
T_4 - Putrescine @ 1mM	10.16	10.19	10.18	12.00	13.20	12.60	13.48	13.97	13.73	8.98	--	--
T_5–Spermine @ 1.5mM	10.16	9.88	10.02	11.36	11.70	11.54	12.91	11.89	12.40	--	--	--
T_6 - Spermidine @ 2mM	10.27	10.06	10.17	11.26	12.54	11.90	12.24	13.22	12.74	--	--	--
Mean	9.88	10.14	10.01	11.69	12.44	12.07	12.42	12.73	12.58			
SE.m.±	0.15	0.19	0.12	0.25	0.34	0.21	0.25	0.33	0.20			
CD at 5%	0.45	NS	0.38	0.75	1.04	0.65	0.77	1.02	0.60			

--Fruits spoiled

8. Ascorbic acid (mg/100g). The data on effect of antioxidants and polyamines on ascorbic acid of sapota Cv. Kalipatti are presented in Table 8. The data indicated that there was non significant variation between different treatments in ascorbic acid (mg/100g) of Kalipatti sapota fruits at 3, 6, 9, 12 days in 2016-17 and 2017-18 and in pooled data.

9. Sensory evaluation. The data regarding effect of antioxidants and polyamines on sensory evaluation of Kalipatti and sapota fruits at ripe stage are presented in Table 9.

Sensory score rating 9- Like extremely, 6- Like slightly, 3- Dislike moderately, 8- Like very much, 5- Neither like nor dislike, 2- Dislike very much, 7- Like moderately, 4- Dislike slightly, 1- Dislike extremely. The data in the Table 9 indicated that there was significant variation between different treatments in sensory evaluation of Kalipatti sapota fruits during storage in both the years (2016 - 17 and 2017-18) and in pooled data. When colour of the pulp was observed, significantly highest score was observed in fruits treated with BA @ 100 ppm (T_2). Significantly lowest score was noted with control (T_0). When texture of the fruit was observed, significantly highest score was observed in fruits treated with BA @ 100 ppm (T_2). Significantly lowest score was noted with control (T_0). When flavour was observed, significantly highest score was observed in fruits treated with BA @ 100 ppm (T_2). Significantly lowest score was noted with control (T_0). When taste was observed, significantly highest score was observed in fruits treated with BA @ 100 ppm (T_2). Significantly lowest score was noted with control (T_0). When overall acceptability was observed, significantly highest score was observed in fruits treated with BA @ 100 ppm (T_2). Significantly lowest score was noted with control (T_0).

Table 8: Effect of antioxidants and polyamines on ascorbic acid (mg/100g) of sapota Cv. Kalipatti.

Treatments	Ascorbic acid (mg/100g)											
	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 (without spray)	21.57	22.75	22.16	19.20	18.13	18.67	17.27	17.34	17.30	--	--	--
T_1-AA @ 1000 ppm	21.57	22.75	22.16	19.21	18.14	18.68	17.25	17.34	17.30	--	--	--
T_2- BA @ 100 ppm	21.57	22.59	22.08	19.22	18.14	18.68	17.26	17.34	17.30	16.45	15.66	16.06
T_3–SB @ 1000 ppm	21.58	22.75	22.17	19.21	18.12	18.67	17.26	17.33	17.30	--	--	--
T_4–Putrescine @ 1mM	21.58	22.76	22.17	19.20	18.14	18.67	17.27	17.34	17.31	16.42	--	--
T_5–Spermine @ 1.5mM	21.59	22.74	22.17	19.21	18.13	18.68	17.26	17.33	17.30	--	--	--
T_6–Spermidine @ 2mM	21.57	22.73	22.15	19.21	18.13	18.67	17.25	17.33	17.30	--	--	--
Mean	21.58	22.72	22.15	19.21	18.13	18.67	17.26	17.34	17.30	--	--	--
SE.m.±	0.01	0.06	0.03	0.01	0.01	0.01	0.01	0.01	0.01	--	--	--
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	--	--	--

--Fruits spoiled, NS – Non significant

Table 9: Effect of antioxidants and polyamines on sensory score of sapota Cv. Kalipatti.

Treatments	Sensory score														
	Colour			Texture			Flavour			Taste			Overall acceptability		
	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled	2016-2017	2017-2018	Pooled
T_0- Control (without spray),	8.07	7.06	7.56	7.00	6.23	6.61	7.60	6.37	6.99	8.10	6.46	7.28	8.00	6.23	7.12
T_1-AA @ 1000 ppm	8.36	7.17	7.76	7.23	6.32	6.78	7.79	6.44	7.12	8.25	7.10	7.68	8.11	6.18	7.15
T_2- BA @ 100	8.52	7.26	7.89	7.46	7.61	7.54	7.94	7.23	7.58	8.35	7.21	7.78	8.24	7.54	7.89
T_3 - SB @ 1000 ppm	8.39	7.19	7.79	7.28	6.65	6.97	7.64	6.63	7.14	8.21	7.13	7.67	8.14	6.63	7.39
T_4 - Putrescine @ 1mM	8.29	7.19	7.74	7.38	7.15	7.26	7.62	7.13	7.38	8.35	7.19	7.77	8.19	7.39	7.79
T_5–Spermine @ 1.5mM	8.26	6.99	7.62	7.28	7.23	7.26	7.69	6.53	7.11	8.19	6.60	7.39	8.26	6.67	7.47
T_6 - Spermidine @ 2mM	8.25	7.11	7.68	7.22	7.26	7.24	7.61	6.46	7.03	8.21	6.75	7.48	8.19	6.78	7.49
Mean	8.31	7.14	7.72	7.26	6.92	7.09	7.70	6.68	7.19	8.24	6.92	7.58	8.16	6.77	7.47
SE.m.±	0.07	0.03	0.04	0.06	0.02	0.03	0.06	0.03	0.04	0.04	0.02	0.02	0.05	0.02	0.03
CD at 5%	0.21	0.09	0.11	0.19	0.05	0.10	0.18	0.10	0.11	0.12	0.06	0.06	0.14	0.07	0.08

CONCLUSION

—This study concluded that there was significant influence of treatments on TSS, TSS to acid ratio, sugars, organoleptic score and non significant influence of treatments on quality parameters *i.e.*, acidity and ascorbic acid during both the years and in pooled data respectively. Maximum TSS, TSS to acid ratio, sugars, sensory score were recorded with T_2 – BA @ 100 ppm fruits during both the years and in pooled data respectively.

FUTURE SCOPE

Further research on sapota on post harvest application of antioxidants and polyamines is still needed to understand the overall effect of postharvest treatments on shelf life of sapota for the exploitation of sapota fruit onto national and international markets.

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