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Effect of postharvest treatments and storage conditions on shelf life and vegetable quality of Brinjal

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Abstract
An experiment was conducted to study the effect of Enhanced freshness formulation at three different concentrations @1, 2, 3 per cent, water dipping and absolute control on extension of shelf life and quality of Brinjal var. CO_2. The experimental materials were stored under ambient condition (28 °C ± 2 °C, RH 60 ± 10%) and cold storage condition (13 °C ± 2 °C, RH 90 ± 5%). Observations on physical (Firmness), physiological loss in weight (PLW) biochemical parameters and color value of the vegetables were studied. The fruits treated with EFF at two and three per cent (T_2 and T_3) recorded minimum PLW with maximum fruit firmness and shelf life of the fruit was seven (10.40, 12.90 and 11.20% PLW) and eight days (3.80, 3.23 and 4.10% PLW) under ambient and cold storage. The EFF treated fruits delayed the rate of conversion of complex sugar to simple sugar, high firmness, minimum PLW (%) with less total colour difference from standard value stored were observed under ambient (28±2 ºC) and cold storage at 13±2 ºC condition.

Keywords: Postharvest, EFF, PLW, shelf-life, color value

Introduction
Eggplant or aubergine (*Solanum melongena* L.) is a common annual vegetable crops commercially cultivated in most parts of the world for immature fruits having 12 ± 2 days of anthesis. It has gained wider popularity in many parts of Asia and some Mediterranean countries such as Greece, Italy and regions of similar cultural traditions (Concellon *et al.* 2012) [3]. Eggplants are rich sources of vitamins, minerals and antioxidant capacity. Eggplant is also a natural source of vitamin A; thus, it plays an important role for vision and eye health (Igwe *et al.* 2003) [5]. Furthermore, eggplants are also known to have hepato protective properties which have shown to inhibit protein activated receptor 2 inflammation associated with atherosclerosis (Akanitapichat *et al.* 2010) [2] and Tan *et al* (2010) [19].

Eggplants have limited shelf life of 3 days during ambient storage temperature (Singh *et al.* 2016) [17]. The increase in water loss and rapid shrinkage of peel due to physiological disorders during storage are most common adverse effects during storage of eggplants (Jha *et al.* 2002) [6]. A number of methods such as low temperature storage modified atmospheric storage and gamma irradiation are practiced for increasing the shelf life in eggplant. However, the wholesalers, retailers or producers are seldom to afford the above-mentioned practices for increasing the shelf life of eggplants after harvest. Traders many times use fraudulent unhygienic practices such as application of petroleum based oil to make eggplants surface shiny and attractive. Such malpractices are harmful to human health (Singh *et al.* 2016) [17]. There is an urgent need for safer technology to reduce the transpiration and physiological loss in water during storage.

Specialised postharvest handling practices and treatment methods are needed in order to extend the shelf life of the crop after harvest. Failure to adhere to these specialised handling practices and treatment methods will result in high amount of loss. Losses of up to 50% can be recorded in tomatoes between the harvesting and consumption stages of the distribution chain in tropical countries It is therefore important to know the appropriate handling practices and treatment methods needed for harvested tomatoes in order to reduce postharvest losses thereby increasing profitability for handlers in developing countries (Nasrin *et al.*, 2008). Fruits and vegetables are extremely perishable products that require to be dealt with much care to reduce losses. Even though research efforts have been made to increase the production of tomato to some extent, the purpose of obtaining maximum profit will be served only if the increased production is supplemented with similar efforts to minimize the post-harvest losses and

enhance the shelf life (Nandhini, 2017).

Hexanal is an aldehyde, produced during the termination phase of fat oxidation in plant materials, known to extend shelf life of many horticultural commodities by inhibiting enzyme phospholipase D activity, which hydrolyzes the phospholipid to phosphatidic acid and a free head group. Phospholipase D enzyme gradually stimulated during the fruit ripening process in an autocatalytic manner, which results in membrane degradation and destabilization. Hexanal is highly volatile and had antifungal properties against *Alternaria alternata*, *Botrytis cinerea* and *Penicillium expansum* (Sharma *et al*., 2010) [16].

Materials and Methods

The present investigation was carried out at Dept. of Floricultre and Land scape Architecture, Horticultural College and Research Institute, TNAU Periyakulam, during the 2019-2021with the aim to extend the shelf life brinjal var. CO_2 through postharvest application of Enhanced Freshness Formulation (EFF). The treatments included EFF at three different concentrations *ie*., 1% (T_1), 2% (T_2), 3% (T_3), water dip (T_4) and control (T_5 without treatment). Brinjal fruits were treated with EFF for 5 minutes and the treated produce were air-dried. Treated and untreated samples (vegetables) were stored under ambient condition (28 °C ± 2 °C, RH 60 ± 10%) and cold room condition (13 °C ± 2 °C, RH 90 ± 5%).

During storage period observations were recorded on Physiological loss in weight (PLW (%)), Firmness and quality parameters *viz.*, acidity, ascorbic acid, TSS, crude fiber chlorophyll a, b, total chlorophyll and total iron were determined using standard operational protocols. Ten fruits in each treatment were used for PLW estimation. Design of experiment followed in the study was Completely randomized design (CRD) with four replications consisting of five treatments tested under ambient and cold storage condition.

The color value of the vegetables were measured in Food Quality Testing Laboratory, CPHT, TNAU, CBE and colour difference was identified using L* a* b*coordinates and found that the sample value match with standard colour value (Hunter Lab 2012, Hunter Associates Laboratory Inc, USA.

Physiological loss in Weight (%): It was determined by periodical weighing of fruits and expressed as percentage of original weight. Damaged (rotting or chilling injury) fruits were also included with it.

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

Fruit firmness

Fruit firmness was measured on opposite sides of the equatorial axis using fruit pressure tester model FT 27 (1227 lbs) with a plunger 5/16 inches was used for the determination of rupture force and the readings were expressed as kg/cm^3.

Shelf life (day): The fruits were stored under ambient storage (27± 2 ºC) and cold storage (13± 2 ºC) conditions. The shelf life of fruits was determined by recording the number of days the fruits were remained in good condition in storage at both room and cold temperature. The stage where in more than 25-30 per cent moisture loss and 35 per cent spoilage was noted and expressed as number of days of shelf life (Padmalatha, 1993) [11].

Ascorbic acid

Ascorbic acid content of the sapota fruit flesh was estimated using 2, 6-dichlorophenol indophenols dye visual titration method and expressed in mg/100g (Rangana,1986) [14].

Statistical analysis

Effect of post-harvest dip of EFF on the observed parameters were analysed in a Completely Randomized Design at 5% significance level using AGRESS software (Panse and Sukhatme, 1967) [13].

Results and Discussions

Brinjal var. CO_2 fruits were treated with EFF at 1, 2 and 3 per cent concentration, water dipping and control (untreated) was stored under room condition and physiological loss in weight (PLW) was recorded and expressed in per cent. The treatment T_1 (EFF@ 1%) recorded PLW of 2.40, 2.80, 3.60, 8.0, 10.80 and 13.20 per cent on 2nd to 7th day after storage. The treatment T_2 (EFF@ 2%) recorded 2.40, 2.25, 3.34, 4.60, 8.0, 10.40 and 12.40 per cent PLW during the storage period. The treatment T_3 (EFF@3%) accounted 2.60, 3.40, 4.40, 7.20, 10.50 and 12.90per cent weight loss from 2nd to 7th DAS. Among the treatment T_2 (EFF @2%) recorded minimum PLW of 2.40 per cent on 2nd DAS and it was 10.40 per cent on 6th DAS (End of the storage period) followed by T_4 (Water dip) 2.60, 3.20, 4.20, 6.80, 9.0 and 11.20. However there were no significant differences among the three levels of EFF (1,2 and 3%). In control (T_5) recorded maximum PLW of 2.80, 4.20, 5.30, 7.40, 8.60 and 14.0 per cent during the storage period (Table 1).

Brinjal fruits were stored for seven days under cold storage. During the storage period the weight loss was recorded. The results showed that here were no significant differences was observed among the treatments. The treatment T_1 (EFF @1%) recorded 0.50, 0.50, 0.71, 0.71, 1.41, 2.68 and 3.80 per cent loss from 2nd to 8th days after storage. The treatment T_2 (EFF@2%) recorded 0.40, 0.90, 1.11, 1.12, 1.36, 1.71 and 3.23per cent weight loss from 2nd to 8th days after storage. The treatment T_3 (EFF at 3%) recorded 0.80, 1.20, 1.56, 1.80, 2.35, 2.98 and 4.10 per cent PLW during the storage period. The fruits dipped in water (T_4), registered 0.48, 0.96, 3.13, 1.30, 1.48, 2.56 and 3.10 per cent weight loss. Whereas, control (T_5) recorded 0.40, 1.24, 2.67, 3.38, 4.07, 4.95 and 5.09 per cent weight loss during the storage period. Among the treatments, T_4 (water dip) recorded minimum PLW followed by T_2 (EFF @ 2%) and T_1 (EFF @1%) However, T_4 was on par with T_1, T_2, T_3 (EFF @ 1,2 and 3%) (Table2). The physiological loss in weight might be due to the water loss, respiration and transpiration of tomato even after the harvest. Fresh produce continues to lose water even after harvest due to transpiration resulting in wilting or shrivelling of the produce. Above five per cent moisture loss is enough to make the produce shrivel and making it unattractive for marketing. (Relative humidity and temperature are the important factors that influence the loss of moisture from fresh produce Water loss will also be high with increase in storage temperature. Fresh produce transpire more at high temperatures and low humidity. (Somu and Patel, 2014) [18]. In the present study, EFF treatment reduced the microbial load and moisture loss thus extends shelf life by reduce the weight and moisture loss. The same finding was reported by Nasrin *et al.* (2008) [10] in tomato fruits were dipped in 200ppm chlorine solution for 5 minutes. The hexanol treated fruits may be attributed to the

thickening of cell wall as a consequence of lipoygenase inhibition. Biochemical changes induced after the application of the hexanol formulation may have helped preserve the membrane integrity and cell structure resulting in reduced catabolic process and quality losses (Paliyath and Subramanian,2008[12]; Tiwari and Paliyath, 2011) [20] **(**Table 2).

The data pertaining to firmness of the of the fruit values ranged from 2.65 kg/cm^3 in T_5 (Control) to 3.32 kg/cm^3 in T_2 (EFF @ 2%).Significantly highest firmness was recorded in T_2 (EFF @2%) which was on par with T_3 (EFF@ 3%) and T_1 (EFF @ 1%) which registered maximum firmness of 3.15 and 3.10 kg/cm^3, while the lowest fruit firmness (2.65 kg/cm^3) was recorded inT_5 (control). Ascorbic acid content values ranged from 9.41mg /100g in T_4 (water dip) to 10.94mg/ 100g in T_5 (control) under ambient condition.

In cold storage, maximum fruit firmness was recorded in T_2, T_3 and T_1 (EFF @ 1,2 and 3%) was 5.80,5.72 and 5.60 kg/cm^3 whereas, control recorded minimum firmness of 4.90kg/cm3.Ascorbic acid content was ranged from 9.70mg /100g in T_5 (control) to 11.09 mg / 100g in T_3 (EFF @3%) which is on par with $T_1$and T_2 (EFF@ 1 and 2%) and T_4 (water dip) (Table 3). The hardness in eggplant fruits decreased due to moisture loss. However, firmness was retained higher in coated eggplant fruits as compared to uncoated eggplant fruits during storage. The restriction in metabolic activities is associated with less activity of cell wall degrading enzymes in tomatoes which subsequently resulted in retention of firmness for longer time (Nandhini *et al*. 2018) [9].

Enhanced Freshness Formulation recorded higher firmness under ambient and cold storage. This is due to action of hexanol that reduces the activities of enzymes promoting pectin and hemicellulose degradation. Softening of fruit is caused either by breakdown of insoluble protopectin into soluble pectin in most fruit, or by hydrolysis of starch as in banana (Lohani *et al*., 2004) [7]. The loss of pectic substances in the middle lamella of the cell wall is a key step in the fruit ripening process that leads to the loss of cell wall integrity resulting in fruit ripening EFFtreated tomatoes, transcript levels of polygalacturonase involved in pectin degradation were down regulated resulting in enhanced firmness and keeping quality (Tiwari and Paliyath, 2011) [12]. Similar finding of increase in firmness when treated with hexanal was also reported by Gill *et al.* (2016) [4] and Nandhini (2017) [9] in Guava fruits.

The present investigation results revealed that the decreasing trend on ascorbic acid content during the storage period in control fruits (untreated with EFF) than treated fruits showed higher ascorbic acid content owning to hexanal reduce the rate of respiration and conversion of ascorbic acid to dehydro ascorbic acid. The gradual decline in ascorbic acid in EFF treated fruits might be due to increased biosynthesis, or decreased oxidation during storage Similar finding was also reported by Ajith (2016) [1] in mango var. Neelum and Alphonso, showed higher ascorbic acid content in response to post-harvest application of hexanal formulation (EFF) than the control and Nandhini (2017) [9] in Guava (Table3).

In treatment T_1 (EFF @ 1%) samples recorded more lighter (L=72.70), red (a=3.95) and more yellow (b=14.23) and the difference in L showed that (ΔL=3.52) lighter, Δa=0.63(less red) and Δb is 4.13(yellow) and total colour difference ΔE is 4.29. In treatment T_2 (EFF @ 2%) samples recorded more lighter (L=84.56), more red (a=6.76) and less yellow (b=24.61) a total colour difference ΔE is 24.31. In treatment T_3 (EFF at 3%) samples recorded more lighter (L=80.02), more red (a=7.2) and more yellow (b=24.20) the difference in L showed that (ΔL=16.84) more lighter, Δa=3.88(red) and Δb is 12.34 (yellow) and total colour difference ΔE is 21.23. In treatment T_4 (water dip) samples recorded lighter (L=74.83), red (a=3.82) and less yellow (b=10.58), the difference in L showed that ΔL=5.65 (darker), Δa=0.5 (move towards green colour) and Δb is -1.28 (blue colour) and total colour difference ΔE is 5.81. The samples from T_5 (control**)** recorded more lighter (L=85.1), red (a=4.65) and more yellow (b=24.63, the difference in L showed that ΔL=-15.92, Δa=1.33 (red colour) and Δb is 12.77 (yellow colour) and total colour difference ΔE is 20.45. The standard values showed that L=69.38, a=3.32, b=24.63 (Table 5). Changes in colour intensity and quality are important indicators of maturity and quality for fresh tomatoes and development of red colour is considered as an index of maturity (Lopez Camelo and Gomez, 2004) [8]. Effectiveness of EFF on slowing down senescence was also reflected in postharvest dip applications. Tomatoes dipped in EFF showed higher L values, hue angle, and reduced red colour intensity than control fruit during storage, suggesting a delay in ripening. These results are in agreement with our earlier observations (Tiwari and Paliyath, 2011) [20]. (Table4&5).

Table 1: Effect of Enhanced freshness formulation and water dip on physiological loss in weight (PLW) per cent in Brinjal var. CO_2 under ambient condition

Treatments	Day 2	Day 3	Day 4	Day 5	Day6	Day7
T_1	2.40	2.80	3.60	8.00	10.80	13.20
T_2	2.40	2.25	3.45	4.60	8.00	10.40
T_3	2.60	3.40	4.40	7.20	10.50	12.90
T_4	2.60	3.20	4.20	6.80	9.00	11.20
T_5	2.80	4.20	5.30	7.40	8.60	14.00
S.Ed	0.57	0.67	0.64	0.643	1.047	0.26
CD (0.05)	NS	NS	1.40	1.75	2.46	0.57

Table 2: Effect of Enhanced freshness formulation and water dip on physiological loss in weight (PLW) *per cent* in Brinjal var. CO_2 under cold storage condition

Treatments	DAY2	DAY3	DAY4	DAY5	DAY6	DAY7	DAY8
T_1	0.50	0.50	0.71	0.71	1.41	2.68	3.80
T_2	0.40	0.90	1.11	1.12	1.36	1.71	3.23
T_3	0.80	1.20	1.56	1.80	2.35	2.98	4.10
T_4	0.48	0.96	3.13	1.30	1.48	2.56	3.10
T_5	0.40	2.67	1.24	3.38	4.07	4.95	5.09
S.Ed	0.19	0.59	0.93	0.57	0.76	1.77	2.53
CD (0.05)	NS	NS	NS	1.25	1.66	NS	NS

Table 3: Effect of Enhanced freshness formulation and water dip on fruit firmness and ascorbic acid content of Brinjal var. CO_2 stored under ambient and cold storage condition

Treatments	Cold storage (Seven days after storage (13±2 ºC)		Ambient storage (Six days after storage) (28±2 ºC)	
	Firmness Kg/cm3	Ascorbic acid (mg/100g)	Firmness Kg/cm3	Ascorbic acid (mg/100g)
T_1	5.60	10.09	3.10	9.80
T_2	5.80	10.88	3.32	9.55
T_3	5.72	11.09	3.15	10.05
T_4	5.30	10.72	2.80	9.41
T_5	4.90	9.70	2.65	10.94
S.Ed	0.12	0.097	0.09	0.094
CD (0.05)	0.36	0.212	0.22	0.205

Table 4: Effect of Enhanced freshness formulation and water dip on colour value of Brinjal var. CO_2 under ambient storage

Treatments	L*	ΔL	a*	Δa	b*	Δb	ΔE
T_1	72.70	3.52	3.95	0.63	14.23	2.37	15.30
T_2	84.56	15.38	6.76	3.49	24.61	12.75	14.29
T_3	86.02	16.84	7.20	3.88	24.20	12.34	21.39
T_4	74.83	5.65	3.82	0.50	10.58	-1.28	19.81
T_5 (Control)	85.10	15.92	4.65	1.33	24.63	12.17	20.45
Fresh vegetables (standard)	69.38		3.2		11.86		

Table 5: Effect of Enhanced freshness formulation and water dip on colour value of Brinjal var. CO_2 under cold storage

Treatments	L*	ΔL	a*	Δa	b*	Δb	ΔE
T_1	68.96	-0.22	4.98	1.66	13.48	2.12	2.70
T_2	67.99	-1.19	5.56	2.24	11.66	-0.2	2.35
T_3	68.13	-1.05	6.25	2.93	11.74	-0.07	3.11
T_4	69.53	0.35	5.53	2.21	11.14	-0.72	3.23
T_5 (Control)	64.82	-4.36	3.88	0.56	12.74	0.88	4.48
Fresh vegetables(standard)	69.38		3.2		11.86		

Summary

The treatment T_2 (EFF@2%) recorded shelf life of six days and seven days under ambient (28±2 ºC) and cold storage @13±2 ºC condition respectively with minimum PLW of 10.40 and 3.23 per cent, maximum fruit firmness of 3.32 and 5.80 kg/cm^3 and ascorbic acid content of 10.88and 11.09 mg/100g (EFF @ 2&3%), minimum total colour difference was observed in T_1 and T_2(EFF @ 1&2%) and T_4 (water dip)under cold and ambient storage condition almost retains standard colour with minimum total colour difference was observed.

References

1. Ajith T. Enhanced shelf-life of mango (*Mangifera indica* L.) throughhexanal dipping. M.Sc., (Hort.) Thesis, Department of fruit crops, HC & RI, Periyakulam, 2016.
2. Akanitapichat P, Phraibung K, Nuchklang K, Prompitakkul S. Antioxidant and hepatoprotective activities of five eggplant varieties. Food Chem Toxicology. 2010;48:3017-3021.
3. Concellon A, Zaro MJ, Chaves AR, Vicente AR. Changes in quality and phenolic antioxidants in dark purple American egg plant (*Solanum melongena* L. cv, Lucia) as affected by storage at 0 °C and 10 °C. Postharvest Biol Technology. 2012;66:35-41.
4. Gill K, Dhaliwal H, Mahajan B, Paliyath G, Boora R. Enhancing postharvest shelf life and quality of guava (*Psidium guajava* L.) cv. Allahabad Safeda by pre-harvest application of hexanal containing aqueous formulation. Postharvest Biology and Technology. 2016;112:224-232.
5. Igwe SA, Akunyili DN, Ogbogu C. Effects of *Solanum melongena* (garden egg) on some visual functions of visually active Igbos of Nigeria. Journal Ethno pharmacol. 2003;86:135-138.
6. Jha SN, Matsuoka T, Miyauchi K. Surface gloss and weight of eggplant during storage. Biosyst Engenering. 2002;81:407-412.
7. Lohani S, Trivedi PK, Nath P. Changes in activities of cell wall hydrolases during ethylene-induced ripening in banana: effect of 1-MCP, ABA and IAA. Postharvest Biology and Technology. 2004;31(2):119-126.
8. Lópezcamelo AF, Gómez PA. Comparison of color indexes for tomato ripening. Horticulture Brasileira, Brasília. 2004;22(3):534-537.
9. Nandhini Effect of hexanol treatment to extend the shelf-life of Guava (*Psidium guajava*. L). M.Sc. Thesis submitted to Tamil Nadu Agricultural University, Periyakulam, 2017.
10. Nasrin TAA, Molla MM, Alamgir Hossaen M, Alam MS, Yasmin l. Effect of postharvest treatments on shelf life and quality of tomato Bangladesh Journal Agriculture Research. 2008;33(3):579-585.
11. Padmalatha V. Studies on post-harvest storage life of grapes (*Vitis vinifera* L.). 1993. M.Sc. Thesis, Acharya N. G. RangaAgr. Univ., Hyderabad, India.
12. Paliyath G, Subramanian J. Phospholipase D inhibition technology for enhancing shelf life and quality. Postharvest Biology and Technology of Fruits, Vegetables, and Flowers. 2008;28(4):240.
13. Panse VG, Sukhatme PV. Statistical methods for Agricultural workers. Edn 2, ICAR, New Delhi, 1967, 381p.
14. Ranganna S. Handbook of analysis and quality control for fruit and vegetable products 1986; Tata McGraw-Hill Education.
15. Rick CM, Butler L. Cytogenetics of the tomato, Advances in Genetics. 1956;8(1):267-382.
16. Sharma M, Jacob JK, Subramanian J, Paliyath G. Hexanal and 1-MCP treatments for enhancing the shelf life and quality of sweet cherry (*Prunus avium* L.). Scientia Horticulturae. 2010;125(3):239-247.
17. Singh S, Rao DS. Effect of modified atmosphere packaging (MAP) on the alleviation of chilling injury and dietary antioxidants levels in 'Solo' papaya during low temperature storage. European Journal of Horticultural Science. 2005;70(5):246-252.
18. Somu T, Patel H. Effect of post-harvest treatments of chemical and plant growth regulators on physical parameters of sapota fruit cv. Kalipatti. Journal of Food Processing Technology. 2014;5(7):58-67.
19. Tan HL, Thomas-Ahner JM, Grainger EM. Tomato-based food products for prostate cancer prevention: what have we learned? Cancer and Metastasis Reviews.

2010;29(3):553-568.
20. Tiwari K, Paliyath G. Microarray analysis of ripening-regulated gene expression and its modulation by 1-MCP and hexanal. Plant Physiology and Biochemistry. 2011;49(3):329-340.