



EVALUATION OF DIFFERENT EDIBLE COATINGS FOR QUALITY RETENTION AND SHELF LIFE EXTENSION OF BELL PEPPER (*CAPSIUM ANNUM L.*)

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Abstract

Bell pepper has high nutritional value, and nutritionally is a rich source of vitamin C, vitamin A, minerals and many other phytochemicals which aid in prevention of certain types of cancer, cardiovascular diseases, stroke, atherosclerosis and cataracts. Very high water content of the fruits however, makes them particularly susceptible to water loss and consequently shriveling, limiting their storage life and leading to postharvest and economic losses to the growers. In the present investigation various coatings of starlight wax emulsion, *Aloe vera*, garlic and mint leaf extract were used applied to freshly harvested fruits kept at 10 ± 2 °C for storage. Comparative mean analysis by Tukey's test ($P < 0.05$) revealed that the coated fruits exhibited lesser variations in various physico-chemical characteristics like PLW, ascorbic acid, titratable acidity, TSS, sugars, phenols and capsaicin content during storage. 50% and 25% starlight coating and 15% *Aloe vera* leaf extract resulted in restriction of metabolic activities and delayed senescence and were found most effective treatments in maintaining the postharvest quality of green bell pepper fruits.

Keywords: Bell pepper, plant extracts and waxing, refrigerated storage and storage quality

Introduction

Bell pepper (*Capsicum annum L.*) commonly known as Capsicum or Sweet pepper is a Solanaceous vegetable and is very popular for its delicious taste, pleasant flavor and nutritional quality. Bell pepper has high nutritional value and is a good source of vitamin C (150-180 mg/100g), vitamin E (Srinivas *et al.*, 2009), vitamin A (12 % of total pigment) (Litoriya *et al.*, 2014), phenolics and flavonoids (Bae *et al.*, 2012), carotenoids (Ha *et al.*, 2007), and alkaloids (Srinivas *et al.*, 2009), which beyond basic nutrition also provides functional and nutraceutical health benefits (Agrios, 2004) i.e. capsaicinoids and carotenoids exhibit anticancer (Aggarwal *et al.*, 2008 and Hwang *et al.*, 2009) and antioxidant activities (Matsufuji *et al.*, 1998 and Anandkumar *et al.*, 2008). Flavonoids have been shown to act as antioxidants and they possess anti-inflammatory (Johnson, 2009 and Loke *et al.*, 2008), antiallergic and antibacterial activities (Surh and lee, 1996). Like most of the horticultural commodities once harvested capsicum continue to respire and transpire leading to heavy loss of stored metabolites and moisture. Capsicum is especially prone to water loss due to their large surface to weight ratio and such losses lead to shrivelling of the fruits and ultimately making them unacceptable. Freshly harvested fruits have very high moisture content are also susceptible to fungal infections caused by *Botrytis cinerea* and *Alternaria alternata* (Edusei *et al.*, 2012). All these factors contribute to postharvest losses which results in huge economic losses to the growers.

Flaccidity, shrivelling, wilting and decay are major problems that reduce marketability and consumer acceptance of bell pepper fruit after harvest. Flaccidity is directly correlated with loss of water during storage (Lownds *et al.*,

1994). Since bell pepper is a non-climacteric fruit hence, respiration contributes only a little in water loss (Saltveit, 1977), the rate of deterioration however, depends on several external factors, including storage temperature, relative humidity, air speed, atmospheric composition (concentrations of oxygen, carbon dioxide, and ethylene) and sanitation procedures (Kader 2005; Ghidelli *et al.*, 2014 and Manolopoulou *et al.*, 2012). These losses can be overcome by the use of appropriate postharvest treatments that have the potential to reduce spoilage and respiratory and transpirational losses. In recent years an urge to eat healthy and chemical free food has impelled the researchers to think of better, natural and equally effective alternatives to prevent the post harvest losses and at the same time maintain the quality to the highest level. Plant extracts are known to contain some principle substances exhibiting growth regulating, fungicidal and insecticidal properties (Gniewosz and Synowiec, 2011; Agrios, 2004) and can be exploited for retaining freshness and enhancing the shelf life of fresh produce. Plant extracts are usually applied as post harvest coatings that adheres tightly to the pores on the skin of the fruits/vegetables and thereby impairs the exchange of gases. While, applying various coatings to the fruits and vegetables it is important to standardize concentration of the coating material so as to avoid excessive modification of the internal organic matter of the commodity. *Aloe vera*, garlic, mint leaf extracts and edible wax coatings have been reported to be effective in retaining freshness and enhancing the shelf-life in different fruits and may have beneficial effects on bell pepper also (Dhaliwal and Arora, 1996). Keeping in view these things the present study was proposed to test the applicability & potential of these coatings to retain storage quality of bell pepper fruits under refrigerated conditions.

Materials and Methods

Raw Material

Freshly harvested bell peppers were procured from the local farmers, properly packed in suitable containers and immediately transported to Laboratory. Only healthy, fresh, uniform sized and disease free fruits were selected for application of various postharvest treatments.

Plant Extracts Applications:

Freshly harvested healthy, disease free and uniform fruits were coated with different concentrations of undistracted mint leaf, garlic and *Aloe vera* gel extracts which were prepared as per the method described by Gakhukar (1996) and Sharma *et al.* (1997). Extract of mint leaves was prepared by drying the leaves under shade and grinding dried leaves, whereas *Aloe vera gel* and garlic extracts were prepared by grinding fresh leaves and cloves, respectively. Aqueous solutions were prepared by overnight soaking a known weight of each of them in an equal quantity of water. The extracts were separated with the help of a muslin cloth and subjected to magnetic stirring and allowed to be homogenized with moderate stirring. The extracts were further diluted to the required concentrations i.e mint leaf extract and Garlic extract (10, 20 and 30 %), *Aloe vera gel* (5, 10 and 15 %) and starlight wax (10, 25 and 50 %) manufactured by Pontes Industria de Cera Lida, Brazil for application as post harvest coating treatments. After the application of the coating materials fruits were air dried in shade and packed in corrugated fibre board (CFB) cartons for stored at $10 \pm 2^\circ\text{C}$ for periodic observations at an interval of 7 days.

Physico chemical analysis

Total soluble solids (TSS) were recorded with the help of an Erma hand refractometer. Ascorbic acid content was determined as per standard AOAC method (Ranganna, 1986) using 2, 6-dichlorophenol indophenol dye. Sugars (total & reducing) were estimated by Lane and Eynon method (Lane and Eynon, 1923). Total phenols were extracted in 80 per cent ethanol and estimated on the basis of their reaction with an oxidizing agent phosphomolybdate in Folin- Ciocalteu reagent under alkaline conditions (Bray and Thorpe, 1954). Capsaicin content was determined by the colorimetric method (Sadasivam and Manickam, 1978). Respiration rate was measured with the help of Gas data analyzer (GFM series 30-1/2/3, GAS Data Ltd. Coventry UK) and was expressed as ml $\text{CO}_2/\text{kg}/\text{hr}$.

Statistical analysis

The data for changes in physico chemical attributes was analyzed across treatments at each storage interval (7, 14, 21 and 28 days). Two-way analysis of variance (2-way ANOVA) was conducted to test the effects of treatment and storage intervals, on quality attribute using IBM SPSS Statistics program (Somers, NY, USA). The multiple least squares means comparisons were carried out using Tukey's test at $p = 0.05$

Results and Discussion

Effect on physiological loss in weight (PLW) and dry matter content:

Physiological loss in weight (PLW) increased linearly with an increase in storage period up to 28 days. This increase was however, slower in fruits coated with different plant extracts in comparison to control fruit (T_{13}) which recorded the highest mean PLW (4.68%). Coating the fruits with 50 per cent starlight wax (T_{12}) resulted in lowest PLW (3.91%) however, multiple least squares means comparisons revealed non-significant differences in PLW of fruits coated with 15 % AV, 10 and 20 % SWE and 30 % GE. Weight loss of fruits is attributed to transpiration, respiration and evaporation in fruits which continued even after harvest. Different coating formulations play an important role in preventing such losses by creating a modification in the internal atmosphere of the fruits as the coating adhere to pores on skin of fruits by forming a layer which interferes WVTR and the exchange of gasses from fruit surface.

The dry matter content of exhibited a gradual and linear increase during storage up to 28 days (Fig. 1). Different coatings effectively restricted the increase in dry matter content by reducing the moisture losses and dry matter content of control fruits after 28 days of refrigeration was highest (7.96%). Coating the fruits with 10 % SWE reduced dry matter content to minimum and comparative mean analysis also revealed non significant differences in mean values among some treatments including SWE (20 and 30 %) and GE (20 and 30 %). Continuous process of respiration and transpiration might be the possible reason for increase in dry matter content of the fruits during storage. Different coatings generally assists in restricting weight losses which might be the possible explanation for slow and gradual increase in dry matter content of such fruits (Tadesse, 2000). Our finding are also supported by results of Yeganah *et al.* (2013) in grapes.

Effect on total soluble solids (TSS), reducing and total sugar content

There was a gradual decrease in TSS content of the fruits as the storage period advanced (Fig 1). The maximum mean TSS (6.90°B) was recorded in fruits coated with 50 % starlight wax while, fruits coated with 25 % starlight wax were equally effective. The control fruits on the other hand recorded minimum mean TSS content (6.19°B). The TSS content increased rapidly during ripening while the coatings delayed peak of TSS in treated fruits, which indicated that different coatings could inhibit the senescence and starlight wax coating was most effective in this regard. Further, the stored metabolites are generally utilized during post harvest period due to respiration while, the decreased rate of respiration might have reduced the rate of utilization of these metabolites and hence their higher retention in the treated fruit samples (Behra *et al.*, 2004). Total and reducing sugars content followed a close linearity with the TSS content with an initial increase up to peak value and then a decline irrespective of the treatments and storage conditions (Fig. 1). This trend was more steep in control fruits which exhibited lowest mean reducing and total sugars content while, maximum mean reducing and total sugar contents were recorded in fruits coated with 50 and 25 % starlight wax emulsion with 15 % *Aloe vera* and 30 per cent mint leaf extract being equally effective. The initial increase in sugars

of the fruits coated with different plant extracts might be due to loss of water from the fruits and conversion of complex polysaccharides and pectic substances into sugars (mono & disaccharides). While, a decline thereafter during later phase of storage can be attributed to metabolic breakdown and senescence of fruit as a result of moisture and firmness losses. Similar observations have been recorded earlier by Ochoa-Reyes *et al.* (2013) and Bhardwaj and Sen (2003).

Effect on ascorbic acid, titratable acidity (TA) and total phenols

The significant differences were observed for mean values of ascorbic acid content among various coatings though there was a gradual decline in ascorbic acid content with advancement in storage (Table 1). This decline was minimum in the fruits coated with 50 per cent starlight wax emulsion and such fruits recorded maximum mean ascorbic acid content of 110.44 mg/100g. Mean separation also revealed non significant differences in ascorbic acid content of the fruits coated with 25% starlight and 15 % *Aloe vera* extracts. The loss in ascorbic acid during storage might be due to its degradation during metabolic processes or through enzymatic oxidation of L-ascorbic acid to dehydro ascorbic acid by oxidizing enzymes like ascorbic acid oxidase, peroxidase, catalase and polyphenol oxidase (Mapson, 1970), as well as utilization by developing microorganisms (Tandon and Tandon, 1974; Taneja *et al.* 1983). The variation in ascorbic acid retention in different treatments might be due to different level of oxidation as affected by the altered permeability of the fruit skin by application of various coating formulations. The results are in good agreement with the findings of Plaza *et al.* (2006), Deepa *et al.* (2007) and Ghasemnazhad *et al.* (2011) in bell peppers.

The titratable acidity decreased gradually with advancement in storage periods under all treatments (Table 2), however fruits treated with 50% starlight wax emulsion and 15 per cent *Aloe vera* gel extract exhibited the lowest decrease in TA & consequently retained highest mean titratable acidity 0.34 % and 0.33 %. Titratable acidity is directly related to the concentration of organic acids present in the fruit, which are important in maintaining quality. The balance between TSS & acid content i.e. TSS: acid ratio defines the flavour of fresh fruits and such changes ultimately alter the overall acceptability of the fruits. Similar findings have been reported earlier by Sharma and Thakur (2017) in pear fruits coated with starlight fruit conserve wax emulsion.

Maturity is the most important factor that determines the content of phenols in fruits and vegetables. Usually once the commodities are removed from the growth source total phenols starts to decline gradually. The fruits coated with treated with 50 % starlight wax emulsion and 15 % *Aloe vera* gel retained highest mean phenolic contents of 51.91 and 51.41 mg/100 g respectively, while significant differences were recorded in mean values of total phenol content of the fruits coated with different extracts with time. The continuous decline in phenolic content of the fruits might be due to oxidation of polyphenols by polyphenol oxidase and

peroxidases (Yamaguchi *et al.*, 2003 and Mapson, 1970) or peroxidase or due to polymerization of simple polyphenols. While, the capsaicinoids starts to accumulate in fruits which are usually paralleled by the disappearance of the phenols. The results of the present investigation are in a good agreement with those reported in sweet cherry by Asghari *et al.* 2013, chestnuts by Pen and Jiang, 2003 and apples by Chauhan *et al.* 2011.

Effect on capsaicin content and respiration rate

The capsaicin content was highest in the freshly harvested fruits and continued to decline with the advancement in storage (Table 2). The mean separation shows that there was a non significant difference in capsaicin content of the fruits treated with 50 and 25% starlight wax and 15 per cent *Aloe vera* leaf extract which recorded 0.72, 0.69 and 0.69% capsaicin content respectively after 28 days of refrigeration. Capsaicin is the most abundant pungent principle in chillies, synthesized by condensation of vanillylamine with a short chain branched fatty acid. After the harvest as the ripening begins, the capsaicin concentration has been reported to decrease and can be expected to decrease with further ripening and senescence. Conversely, coating treatments delay ripening and senescence and helps in retention of higher capsaicin content. The reduced amount of capsaicin in mainly expected to be due to the formation of secondary compounds rather than their disappearance. The results of the present investigation are in good agreement with those reported by Estrada *et al.* (2002), Bernal *et al.* (1993), Reyes-Escogido *et al.* (2011), Srinivas *et al.* (2009) Margarita and Yahia (1998), Sharma and Thakur (2017) and Topuz and Ozdemir (2004) who have reported that capsaicinoid content of paprika was significantly decreased with advancement in storage.

It is clear from the data shown in tables 2 that a gradual decline in respiration rate of bell pepper fruits was observed under all treatments during the storage for 28 days. Comparative mean analysis of the respiration rate revealed that the respiration rate of fruits treated with 10, 20 and 50 % was non significant with respective mean respiration rates of 18.21, 18.23 and 18.26 ml CO₂/kg/hr. Whereas, the uncoated control fruits exhibited the highest respiration rate of 19.54 ml CO₂/kg/hr after 28 days of storage. Coatings usually restrict permeation of gases through the skin of the fruits & generally increase the internal CO₂ and decrease the internal O₂ levels of fruits which reduce their subsequent respiration. In mango fruit, the decline in respiration rate, fruit weight, and titratable acidity were all effectively inhibited by chitosan coating (Jitareerat *et al.* 2007).

The present investigations suggests that among different plant extracts and waxing materials starlight wax coating @ 50 and 25% along with 15% *Aloe vera* proved to be most effective treatment in maintaining fruit quality and minimizing deterioration during 28 days storage at 10±2 °C. These treatments effectively reducing capsicum metabolism by delaying respiration rate and senescence as evident from retention of higher firmness, TSS, sugars, phenols and acidity leading to a net increase in storability of capsicum fruits.

Table 1. Effect of different coating treatments and refrigerated storage conditions (10 ± 2 °C temp. and 90-95 % RH) on physiological loss in weight (%), PLW), titratable acidity (% of and ascorbic acid (%)) of capsicum.

Treatment	PLW (%)					Titratable acidity (%)					Ascorbic acid (mg/100g)				
	7	14	21	28	Mean	7	14	21	28	Mean	7	14	21	28	Mean
MILE (10 %)	3.81±0.08 ^b	4.19±0.09 ^b	4.37±0.10 ^b	4.78±0.08 ^b	4.29±0.05 ^b	0.29±0.01 ^c	0.25±0.01 ^d	0.21±0.01 ^d	0.18±0.01 ^c	0.24±0.01 ^c	113.08±0.67 ^c	105.83±1.06 ^c	96.50±0.74 ^f	90.57±0.89 ^f	101.50±0.87 ^g
MILE (20 %)	3.78±0.04 ^b	4.11±0.06 ^b	4.30±0.04 ^{bc}	4.72±0.04 ^{bc}	4.23±0.01 ^c	0.31±0.03 ^c	0.27±0.01 ^c	0.23±0.01 ^{bc}	0.21±0.01 ^b	0.26±0.01 ^b	113.43±0.26 ^c	106.12±0.87 ^d	98.82±0.45 ^e	93.92±0.91 ^e	103.07±0.44 ^f
MILE (30 %)	3.62±0.09 ^d	3.94±0.12 ^{abcd}	4.24±0.07 ^c	4.64±0.05 ^{cd}	4.11±0.03 ^d	0.35±0.02 ^{ab}	0.30±0.03 ^b	0.25±0.02 ^a	0.23±0.01 ^b	0.28±0.03 ^b	114.83±0.01 ^b	108.44±0.56 ^e	103.12±0.67 ^e	96.18±0.72 ^e	105.64±0.56 ^{de}
GE (10 %)	3.74±0.06 ^{bc}	4.10±0.10 ^{bc}	4.33±0.09 ^{bc}	4.77±0.07 ^b	4.24±0.06 ^b	0.26±0.01 ^b	0.22±0.01 ^{cd}	0.21±0.02 ^d	0.18±0.02 ^c	0.22±0.02 ^{cd}	113.42±0.01 ^c	106.23±0.76 ^d	97.84±0.32 ^e	92.87±0.57 ^e	102.59±0.45 ^f
GE (20 %)	3.69±0.04 ^c	4.02±0.08 ^c	4.26±0.09 ^c	4.67±0.08 ^{cd}	4.16±0.06 ^d	0.29±0.01 ^{bc}	0.25±0.02 ^d	0.24±0.01 ^c	0.23±0.02 ^b	0.25±0.01 ^b	113.73±1.10 ^c	108.52±0.86 ^e	100.07±1.12 ^d	95.23±0.84 ^{de}	104.39±0.88 ^{cd}
GE (30 %)	3.55±0.06 ^{de}	3.93±0.06 ^d	4.17±0.05 ^c	4.60±0.11 ^{cd}	4.06±0.01 ^c	0.34±0.02 ^b	0.27±0.01 ^c	0.25±0.01 ^a	0.25±0.01 ^a	0.28±0.01 ^b	115.98±0.01 ^{ab}	109.84±1.02 ^b	104.34±1.05 ^c	97.52±0.89 ^e	106.92±0.78 ^c
AVG (5 %)	3.61±0.04 ^d	3.90±0.04 ^d	4.12±0.03 ^{de}	4.72±0.06 ^b	4.09±0.10 ^{cd}	0.32±0.01 ^{bc}	0.29±0.02 ^{bc}	0.25±0.01 ^c	0.21±0.01 ^b	0.27±0.01 ^b	111.29±0.01 ^c	108.21±0.45 ^d	100.97±0.81 ^d	96.97±0.67 ^e	104.36±1.23 ^{cd}
AVG (10 %)	3.53±0.05 ^{de}	3.82±0.12 ^c	4.04±0.11 ^c	4.59±0.08 ^d	4.00±0.05 ^c	0.34±0.01 ^b	0.32±0.01 ^b	0.27±0.01 ^b	0.25±0.02 ^c	0.30±0.01 ^b	112.62±0.81 ^c	108.53±0.67 ^c	104.31±0.45 ^c	99.32±0.77 ^b	106.20±0.78 ^c
AVG (15 %)	3.46±0.06 ^e	3.77±0.12 ^c	3.98±0.07 ^e	4.47±0.09 ^d	3.92±0.05 ^e	0.37±0.02 ^{ab}	0.34±0.01 ^{ab}	0.27±0.01 ^a	0.27±0.01 ^a	0.33±0.01 ^a	114.92±0.58 ^b	110.84±1.04 ^b	106.57±0.69 ^b	103.64±0.71 ^a	108.99±0.68 ^{ba}
SW (10 %)	3.57±0.05 ^d	3.94±0.08 ^d	4.15±0.09 ^{de}	4.63±0.03 ^d	4.07±0.08 ^e	0.32±0.02 ^{bc}	0.24±0.02 ^d	0.22±0.01 ^c	0.19±0.02 ^c	0.24±0.01 ^{bc}	113.12±0.01 ^c	109.92±0.98 ^b	104.64±0.32 ^c	96.69±0.46 ^e	106.09±0.78 ^c
SW (25 %)	3.50±0.03 ^e	3.86±0.07 ^c	4.07±0.06 ^e	4.50±0.05 ^{de}	3.98±0.03 ^f	0.30±0.02 ^c	0.30±0.01 ^b	0.26±0.01 ^b	0.22±0.02 ^b	0.27±0.01 ^{bc}	115.42±0.96 ^b	110.24±1.21 ^b	106.92±1.20 ^b	103.98±1.02 ^a	109.14±0.93 ^a
SW (50 %)	3.43±0.07 ^e	3.77±0.12 ^c	4.00±0.04 ^e	4.44±0.07 ^d	3.91±0.08 ^{de}	0.39±0.03 ^b	0.36±0.03 ^b	0.33±0.02 ^a	0.30±0.03 ^a	0.34±0.02 ^a	116.74±1.01 ^a	112.56±1.12 ^a	108.20±0.77 ^{ab}	104.27±0.96 ^d	110.44±1.12 ^a
Control	4.03±0.12 ^a	4.45±0.09 ^a	4.92±0.12 ^a	5.32±0.14 ^a	4.68±0.03 ^a	0.25±0.01 ^d	0.24±0.01 ^d	0.19±0.03 ^c	0.17±0.01 ^c	0.21±0.01 ^c	112.20±0.01 ^d	104.95±0.78 ^e	95.73±0.86 ^f	87.82±0.67 ^g	100.18±1.09 ^g

MILE: Mint Leaf Extract, GE: Garlic Extracts, AVG: *Aloe vera* gel, SW: Startlight Wax

Data presented in Table is the average pooled data of two consecutive years (2015-16 and 2016-17, respectively). Measurements were made at harvest, after 7, 14, 21 and 28 days of storage under refrigerated conditions

Values are mean ± SD. The values followed by the same lowercase letter and parameter are not significantly different (Tukey's new multiple range test at P < 0.05)

Table 2. Effect of different coating treatments and refrigerated storage conditions (10 ± 2 °C temp. and 90-95 % RH) on capsaisin content (%), total phenols (mg/100g) and respiration rate (ml of CO2/kg/h) of capsicum.

Treatment	Capsaicin content (%)					Storage interval in days					Respiration rate (ml of CO2/kg/h)				
	7	14	21	28	Mean	7	14	21	28	Mean	7	14	21	28	Mean
MILE (10 %)	0.70±0.02 ^d	0.66±0.03 ^c	0.59±0.04 ^d	0.51±0.01 ^d	0.62±0.02 ^d	51.32±0.12 ^c	48.52±0.23 ^c	45.64±0.37 ^f	42.72±0.18 ^b	47.35±0.31 ^g	19.87±0.12 ^b	19.37±0.05 ^b	18.57±0.05 ^{bc}	18.03±0.04 ^b	18.96±0.01 ^{bc}
MILE (20 %)	0.74±0.01 ^c	0.70±0.02 ^{bc}	0.63±0.01 ^{cd}	0.54±0.01 ^d	0.65±0.01 ^{cd}	52.46±0.54 ^d	49.68±0.31 ^d	46.76±0.75 ^e	43.78±0.31 ^f	48.17±0.42 ^e	19.85±0.09 ^b	19.31±0.06 ^c	18.51±0.07 ^c	17.99±0.05 ^b	18.90±0.09 ^c
MILE (30 %)	0.78±0.02 ^b	0.73±0.04 ^{bc}	0.68±0.03 ^{bc}	0.60±0.02 ^c	0.70±0.03 ^{ab}	54.66±0.31 ^b	50.79±0.57 ^c	47.86±0.23 ^d	45.10±0.34 ^{de}	49.60±0.34 ^{de}	19.82±0.11 ^b	19.24±0.03 ^b	18.46±0.02 ^c	17.97±0.01 ^{bc}	18.86±0.05 ^c
GE (10 %)	0.72±0.02 ^d	0.68±0.04 ^c	0.60±0.01 ^{cd}	0.54±0.03 ^d	0.64±0.04 ^{cd}	51.05±0.32 ^c	47.06±0.51 ^f	44.38±0.21 ^g	41.44±0.23 ^g	45.98±0.33 ^h	19.33±0.04 ^d	18.2±0.04 ^e	18.03±0.01 ^e	17.47±0.02 ^{ef}	18.41±0.07 ^f
GE (20 %)	0.76±0.03 ^b	0.74±0.01 ^{ab}	0.63±0.02 ^{cd}	0.57±0.03 ^d	0.67±0.01 ^c	52.92±0.21 ^d	48.92±0.34 ^e	45.99±0.33 ^f	43.56±0.21 ^f	47.75±0.19 ^f	19.30±0.05 ^d	18.74±0.07 ^f	17.95±0.02 ^f	17.43±0.08 ^f	18.38±0.06 ^f
GE (30 %)	0.80±0.02 ^a	0.77±0.03 ^{ab}	0.66±0.03 ^{bc}	0.60±0.01 ^b	0.71±0.03 ^{ab}	54.56±0.60 ^b	49.79±0.12 ^d	47.23±0.16 ^e	44.42±0.33 ^e	48.93±0.27 ^d	19.27±0.08 ^{cd}	18.70±0.08 ^f	17.87±0.02 ^g	17.41±0.05 ^g	18.35±0.02 ^f
AVG (5 %)	0.67±0.02 ^e	0.62±0.01 ^d	0.58±0.02 ^d	0.53±0.03 ^d	0.60±0.01 ^c	53.01±0.32 ^c	48.23±0.41 ^d	45.38±0.18 ^e	43.44±0.42 ^e	47.52±0.39 ^f	19.45±0.11 ^c	18.96±0.08 ^g	18.15±0.04 ^{de}	17.60±0.06 ^d	18.54±0.03 ^d
AVG (10 %)	0.70±0.04 ^d	0.64±0.02 ^c	0.62±0.02 ^{cd}	0.56±0.02 ^{cd}	0.63±0.02 ^d	54.20±0.44 ^b	50.36±0.22 ^c	47.47±0.32 ^d	45.54±0.63 ^c	49.39±0.35 ^c	19.43±0.06 ^c	18.90±0.03 ^g	18.08±0.08 ^e	17.57±0.05 ^d	18.52±0.04 ^d
AVG (15 %)	0.72±0.01 ^d	0.69±0.02 ^b	0.65±0.03 ^c	0.62±0.02 ^b	0.69±0.03 ^b	55.98±0.56 ^a	52.52±0.34 ^b	49.66±0.19 ^b	46.72±0.63 ^b	51.42±0.47 ^a	19.40±0.04 ^c	18.82±0.02 ^h	18.00±0.09 ^e	17.55±0.05 ^d	18.49±0.02 ^d
SW (10 %)	0.73±0.01 ^c	0.68±0.05 ^c	0.65±0.03 ^{bc}	0.57±0.01 ^{cd}	0.66±0.02 ^{bc}	53.32±0.37 ^c	49.52±0.23 ^c	46.67±0.12 ^c	44.74±0.45 ^c	48.56±0.52 ^c	19.18±0.07 ^f	18.66±0.07 ^f	17.88±0.02 ^g	17.33±0.01 ^{gh}	18.26±0.03 ^{gh}
SW (25 %)	0.76±0.02 ^b	0.74±0.03 ^a	0.67±0.04 ^{bc}	0.59±0.02 ^{cd}	0.69±0.03 ^b	54.90±0.45 ^b	51.70±0.51 ^c	48.78±0.26 ^c	45.65±0.43 ^c	50.67±0.34 ^b	19.15±0.03 ^f	18.56±0.01 ^h	17.77±0.03 ^h	17.30±0.05 ^h	18.23±0.06 ^{gh}
SW (50 %)	0.80±0.03 ^a	0.78±0.04 ^a	0.73±0.03 ^a	0.66±0.04 ^a	0.72±0.02 ^{ab}	56.22±0.52 ^a	53.36±0.42 ^a	50.49±0.23 ^a	47.58±0.23 ^a	51.91±0.53 ^a	19.12±0.02 ^f	18.48±0.02 ^h	17.60±0.01 ⁱ	17.27±0.04 ^h	18.21±0.08 ^h
Control	0.61±0.02 ^f	0.54±0.01 ^e	0.50±0.01 ^e	0.46±0.03 ^e	0.53±0.02 ^f	50.46±0.32 ^d	46.25±0.52 ^e	43.34±0.21 ^f	40.24±0.22 ^f	45.07±0.42 ^f	20.45±0.01 ^a	19.86±0.06 ^a	19.14±0.04 ^a	18.76±0.07 ^a	19.54±0.04 ^a

MILE: Mint Leaf Extract, GE: Garlic Extracts, AVG: *Aloe vera* gel, SW: Startlight Wax.

Data presented in Table is the average pooled data of two consecutive years (2015-16 and 2016-17, respectively). Measurements were made at harvest, after 7, 14, 21 and 28 days of storage under refrigerated conditions

Values are mean ± SD. The values followed by the same lowercase letter and parameter are not significantly different (Tukey's new multiple range test at P < 0.05)

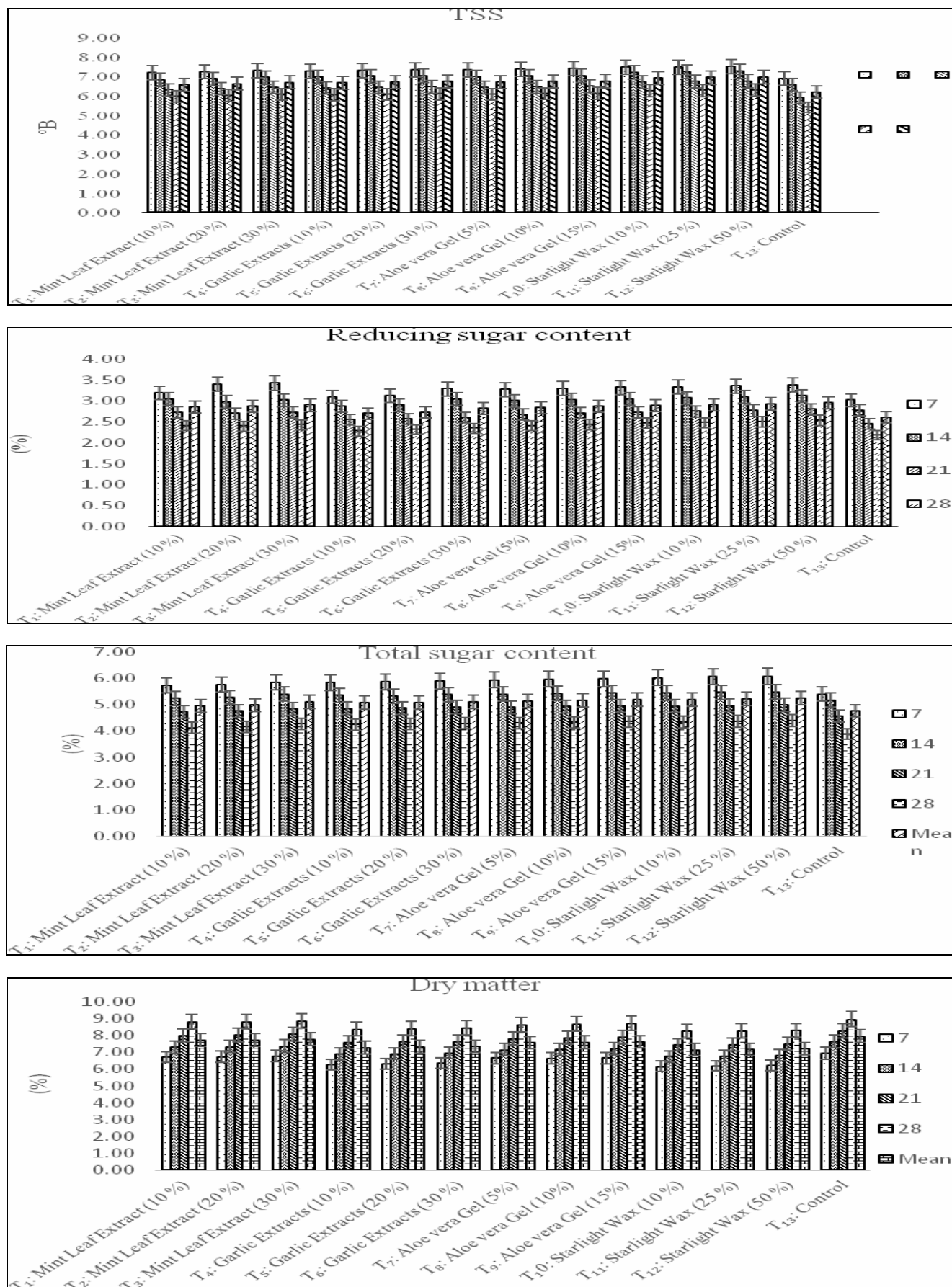


Fig. 1 : Changes in TSS, reducing sugar, total sugar and dry matter content of capsicum during storage under refrigerated conditions.

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