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Nidhi Dalal
CCS Haryana Agricultural University, Hisar, Haryana, India

Saleem Siddiqui
CCS Haryana Agricultural University, Hisar, Haryana, India

Neeraj
CCS Haryana Agricultural University, Hisar, Haryana, India

Corresponding Author:
Neeraj
CCS Haryana Agricultural University, Hisar, Haryana, India

Evaluation of effects of chemical treatments on sensory attributes of sunflower microgreens with storage

Nidhi Dalal, Saleem Siddiqui and Neeraj

Abstract
The microgreens under various treatments, *viz.* ethanol vapour, citric acid spray, ascorbic acid spray, citric acid+ethanol spray and citric acid+ascorbic acid spray and distilled water as control, and packaging were evaluated organoleptically during storage for color and appearance, taste, aroma, texture and overall acceptability characteristics. The microgreens exhibited acceptable scores for all the sensorial attributes by 12th day of storage in all the treatments. The aroma score was the most adversely affected attribute in all the treatments during storage. Citric acid spray treatment was the superior among all other treatments with respect to all sensory attributes followed by ascorbic acid spray treatment and ethanol vapour treatment. The preservation of organoleptic characteristics in sunflower microgreens could be attributed to creation of modified atmosphere due to packaging of microgreens in polystyrene trays.

Keywords: Genetic combining ability, Specific combining ability, Okra, Variance, Growth, Yield and Quality

1. Introduction
Microgreens are young and tender cotyledonary leafy greens that are found in a pleasing palette of colors, textures and flavors. They have three basic parts: a central stem and cotyledon leaf with total length of 1" to 2 ½". They can be grown in urban setups and don't require extensive input for growth and can even be grown at home. Their average growth time is 7-10 days and crops that germinate easily are good candidates for microgreens (Aggarwal & Aggarwal, 2013) [1]. Microgreens, in general, contain higher concentrations of bioactive compounds than their mature counterparts. In general, they contain five times greater amount of vitamin C, vitamin K, vitamin E, beta-carotene and carotenoids than mature vegetables (Xiao at al., 2005; Kou *et al*., 2013) [13]. They are thus referred to as "functional foods", which are food products that possess particular health promoting or disease preventing properties that are additional to their normal nutrient values.
Sunflower microgreens are made of 24% to 30% protein with 8 essential amino acids. The microgreens are a richer source of vitamins than the dry seeds due to action of enzymes that takes place while germinating. Lysine and tryptophan content and concentration of free amino acids increase greatly in sunflower microgreens during germination (Balasaraswathi & Sadasivam, 1997) [2]. Sunflower microgreens are high in fibre, protein, total phenols (caffeic and protocatechuic acids), total antioxidant activity, essential fatty acids and vitamins A, B complex, C, D and E (Pajak *et al*., 2014) [10]. They also contain calcium, phosphorous, iron, iodine, potassium, magnesium and the trace elements zinc, manganese, copper and chromium (Tony F., 2014) [12].
In addition to nutritional values, sensory attributes play an important role in determining the acceptance of produce among the consumers. The overall acceptability of the fresh produce depends on its color and appearance, texture, aroma and flavor (Barrett *et al*., 2010) [3]. Among all these quality attributes, color and appearance are the most important ones and are the first to be observed by the consumer and are important for first time purchase. Organoleptic properties on the other hand are important for repeated purchases (Francis *et al*., 2012; Barrett *et al*., 2010) [5, 3]. Consumer these days are aware of health benefits of various food and this makes a difference in their food preference. Nutritional quality and sensory attributes both play an important role in consumer acceptance.
Sunflower microgreens have a short shelf life of 1-2 days and nutritional quality goes down due (Yahia 2010) [15]. Applications of various GRAS (generally regarded as safe) chemicals like ethanol vapours, various antioxidants like citric and ascorbic acids and their combinations have been reported to extend the shelf life of minimally processed fruits and vegetables (Goyal

et al., 2014; Siddiqui *et al*., 2015;) [6, 11]. MAP (modified atmosphere packaging has been shown to extend the shelf life of fresh produce as it lowers respiration, delay ripening, prevent off-odour and flavour build-up, retard discoloration and hinder the growth of spoilage microorganisms (Zhang *et al*., 2015) [17].

While ample research data is available for sensory properties of fresh cut fruits and vegetables, limited studies have been published about sensory properties of microgreens. This work is attempt to throw some light on sensory attributes of sunflower microgreens with storage time and how organoleptic qualities might differ with chemical treatments.

2. Materials and Methods

For growing sunflower microgreens, Sunflower seeds of variety "64-A-57 Pioneer" were procured from Department of Oilseeds Technology, CCS HAU, Hisar. The chemicals used in this investigation were analytical grade reagents from standard suppliers of the university.

2.1 Growing conditions, treatments and storage

The seeds of sunflower were soaked in water for 24 h and then distributed evenly over the wet surface of vermiculite filled in plastic trays. The trays were kept in shade house for germination and production of microgreens. The temperature in the shade house was 25 ± 5° C. The crop was kept moist until harvest and no fertilizer was applied. Microgreens were harvested after 7 days of growth, washed with tap water and subjected to the following treatments at room temperature:

Table 1: The Concentration and Duration

Treatment	Concentration and duration (min)
Ethanol vapour treatment (EV)	100% for 3.5 minutes
Citric acid spray treatment (CA)	0.5% w/v (100 ml/kg)
Ascorbic acid spray treatment (AA)	0.5% w/v (100 ml/kg)
Citric acid + Ethanol treatment (CA+E)	0.5% w/v + 40% v/v resp. (100 ml/kg)
Citric acid + Ascorbic acid spray treatment (CA+AA)	0.25% w/v each (100 ml/kg)

The duration and concentration of vapour and spray treatment was calculated and decided after pre-trails. Sunflower microgreens were treated to varying concentrations of sprays and varying time periods of vapours and the ones with the best sensory results was chosen for final testing.

EV treatment was given in a vapour chamber. The vapour chamber was saturated with the chemicals vapour and microgreens were subjected to ethanol vapours for given time duration. For spray treatments of CA, AA, CA+E and CA+AA, solutions of required strength were prepared. The solutions were sprayed on microgreens and the excess of solution was drained out and the microgreens were allowed to dry in air. Water was taken as control.

The microgreens from each treatment were packed either in 0.05% perforated LDPE bags and polystyrene trays wrapped with cling films with 6 pin hole size perforations in it. Filter paper soaked with water was placed at the bottom of the bag to maintain high humidity. Packs were stored for 16 days at low temperature (10±1 °C) maintained in B.O.D. (Biological oxygen demand) incubator having three replicates. Sampling was done at every 4th day.

2.2 Sensory analysis of sunflower microgreens

Sunflower microgreens at each sampling stage were subjected to sensory evaluation for color, texture, taste, aroma and overall acceptability attributes by 10 semi trained panellists using 9-point Hedonic scale. The overall rating was obtained by averaging the score given by the panellists.

2.3 Statistical analysis

The data obtained in the present investigation were subjected to analysis of variance (ANOVA) techniques and analysed according to three factorial completely randomized design (CRD). The critical difference (CD) value at 5 per cent level was used for making comparison among different treatments during storage period.

3. Results and discussion

3.1 Color and appearance

The data on color and appearance scores of sunflower microgreens under various treatments and packaging during storage is presented in Table 2 (See also Figure 1). There was progressive decrease in color and appearance scores of microgreens during storage. The average color and appearance score at 0-day was 8.50, which decreased to 6.67 by 16th of storage. The microgreens were of acceptable color and appearance even by 16th day of storage in all the treatments. There was no significant effect of various treatments on color and appearance scores. The interactions between various treatments and storage were found to be significant. The decrease in color and appearance of sunflower microgreens could be due to degradation of pigments like chlorophyll and carotenoids with time (Hodges *et al*., 2010; Xiao *et al*., 2014) [14].

Table 2: Effect of treatments and storage on taste of microgreens

	Treatments						
Storage period (days)	**Control**	**EV**	**CA**	**AA**	**CA+E**	**CA+AA**	**Mean**
0	8.00	8.00	8.00	7.67	7.67	7.67	7.83
4	7.33	7.33	7.33	7.67	7.67	7.33	7.44
8	6.67	5.33	6.33	5.67	5.67	5.67	5.89
12	6.67	5.33	5.67	5.67	6.00	6.00	5.89
16	6.00	5.00	6.00	6.00	6.00	5.33	5.72
CD at 5%	Treatment: 0.345		Storage: 0.315		Treatment × storage: NS		

3.2 Taste

The data on taste scores of sunflower microgreens under various treatments and packaging during storage is presented in Table 3. There was progressive decrease in taste scores of microgreens during storage. The average taste score at 0-day was 7.83, which decreased to 5.72 by 16th day of storage. The microgreens were still of acceptable taste even by 16th day of storage in all the treatments. The taste scores with respect to control were slightly but significantly reduced by various treatments. Maximum reduction in taste scores were observed by EV treatment and it was followed by CA+AA treatment. The interactions between various treatments and storage were found to be non-significant.

Table 3: Effect of treatments and storage on color and appearance of microgreens

	Treatments						
Storage period (days)	**Control**	**EV**	**CA**	**AA**	**CA+E**	**CA+AA**	**Mean**
0	8.33	8.33	8.33	8.67	8.67	8.67	8.50
4	8.33	8.00	7.67	7.67	7.33	8.00	7.83
8	8.00	8.00	7.67	7.67	7.67	7.67	7.78
12	7.67	7.67	7.33	7.00	6.33	7.00	7.17
16	7.00	7.00	7.33	7.00	6.00	5.67	6.67
CD at 5%	Treatment: 0.345		Storage: 0.315		Treatment × storage: 0.772		

3.3 Texture

The data on texture scores of sunflower microgreens under various treatments and packaging during storage is presented in Table 4. There was progressive decrease in texture scores of microgreens during storage. The average texture score at 0-day was 8.67, which decreased to 7.11 by 16th day of storage. The microgreens were still of acceptable texture even by 16th day of storage in all the treatments. The texture scores with respect to control were slightly but significantly reduced by various treatments. Maximum reduction in texture scores were observed by CA+E and CA+AA treatment. The interactions between various treatments and storage were found to be significant.

Plant materials contain a significant amount of water and other liquid-soluble materials surrounded by a semi-permeable membrane and cell wall. The texture of fruits and vegetables is derived from their turgor pressure, and the composition of individual plant cell walls and the middle lamella (Barrett *et al*., 2010) [3]. The decrease in texture score can be attributed to loss of moisture in fresh produce with time and degradation of polysaccharide components with storage period (Yanuriati *et al*., 1999) [16].

Table 4: Effect of treatments and storage on texture of microgreens

	Treatments						
Storage period (days)	**Control**	**EV**	**CA**	**AA**	**CA+E**	**CA+AA**	**Mean**
0	8.67	8.67	8.67	8.67	8.67	8.67	8.67
4	8.67	7.67	7.67	7.33	8.00	7.67	7.83
8	7.33	8.00	7.33	7.33	7.33	8.00	7.56
12	8.00	7.33	7.33	7.33	7.00	6.00	7.17
16	7.33	7.33	7.33	6.67	7.00	7.00	7.11
CD at 5%	Treatment: 0.362		Storage: 0.330		Treatment × storage: 0.810		

3.4 Aroma

The data on aroma scores of sunflower microgreens under various treatments and packaging during storage is presented in Table 5. There was progressive decrease in aroma scores of microgreens during storage. The average aroma score at 0-day was 8.11, which decreased to unacceptable score of 5.61 by 16th day of storage. The aroma scores with respect to control were slightly but significantly reduced by various treatments. Maximum reduction in aroma scores was observed by CA+AA treatment followed by CA+E treatment. The interactions between various treatments and storage were found to be significant.

Chandra *et al*. (2012) reported higher off-odour and lower sensory quality of microgreens treated with chlorine, citric acid + ascorbic acid, citric acid + ethanol and water washed samples. Medina *et al*. (2015) [9] reported production of off-odour in baby spinach leaves stored under variable relative humidities. The production of off-odour and decrease in overall acceptability was similar for all storages irrespective of relative humidity of package.

Table 5: Effect of treatments and storage on aroma of microgreens

	Treatments						
Storage period (days)	**Control**	**EV**	**CA**	**AA**	**CA+E**	**CA+AA**	**Mean**
0	8.00	8.33	8.00	8.00	8.00	8.33	8.11
4	8.00	7.00	7.33	7.00	7.00	7.00	7.22
8	7.00	7.00	6.00	6.00	6.00	6.00	6.33
12	6.00	6.33	5.67	6.00	6.00	6.33	6.06
16	6.00	6.00	6.33	5.67	5.00	4.67	5.61
CD at 5%	Treatment: 0.232		Storage: 0.211		Treatment × storage: 0.518		

Table 6: Effect of treatments and storage on overall acceptability of microgreens

	Treatments						
Storage period (days)	**Control**	**EV**	**CA**	**AA**	**CA+E**	**CA+AA**	**Mean**
0	8.25	8.33	8.17	8.33	8.25	8.33	8.28
4	8.17	7.50	7.50	7.17	7.42	7.58	7.56
8	7.50	7.58	6.92	6.58	6.83	7.00	7.07
12	6.83	6.75	6.50	6.75	6.17	6.25	6.54
16	6.50	6.50	6.75	6.33	6.00	5.58	6.28
CD at 5%	Treatment: 0.261		Storage: 0.238		Treatment × storage: 0.583		

3.5 Overall acceptability

The data on overall acceptability scores of sunflower microgreens under various treatments and packaging during storage is presented in Table 6. There was progressive decrease in overall acceptability scores of microgreens during storage. The average overall acceptability score at 0-day was 8.28, which decreased to 6.288 by 16th of storage. The overall acceptability scores with respect to control were slightly but significantly reduced by various treatments. Maximum reduction in overall acceptability scores were observed by CA+AA treatment and it was followed by CA+E treatment. The interactions between various treatments and storage were found to be significant.

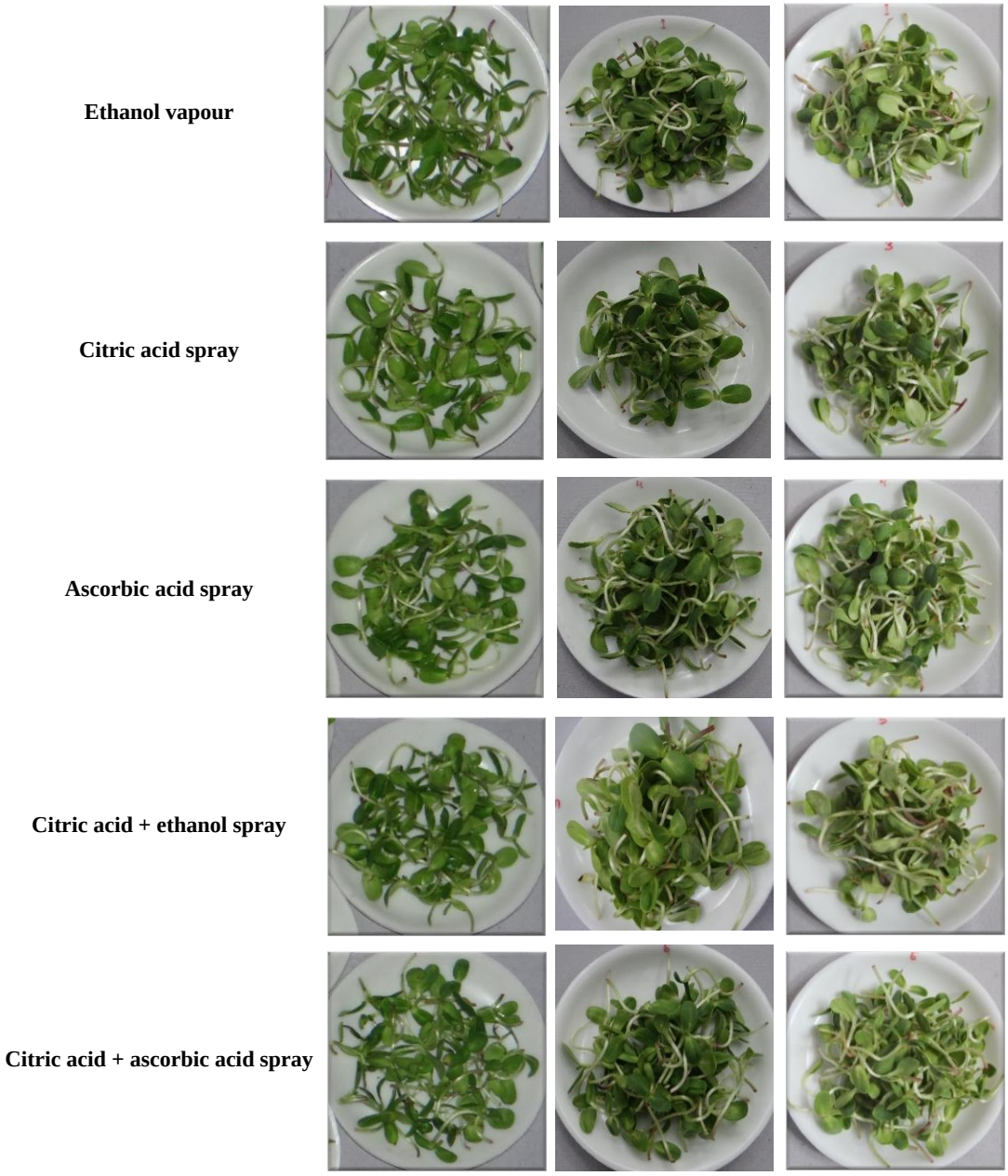

Fig 1: Colour and appearance of sunflower microgreens on zero, 12th and 16th day of storage.

4. Conclusion

Sunflower microgreens present an excellent opportunity as edible fresh produce that can be consumed as such. Organic acids and washing with distilled water with MAP was sufficient enough to increase their shelf-life for 12 days. Other treatments like calcium spray, plant hormones, etc. can be explored to further maintain the texture and aroma of sunflower microgreens.

5. References

1. Aggarwal P, Aggarwal P. Microgreens in the Food World. Indian Food Industry. 2013; 32(41):18-24.
2. Balasaraswathi R, Sadasivam S. Changes in oil, sugars and nitrogenous components during germination of sunflower seeds, *Helianthus annuus*. Plant Foods for Human Nutrition. 1997; 51:71-77.
3. Barrett DM, Beaulieu JC, Shewfelt R. Color, flavor, texture, and nutritional quality of fresh-cut fruits and vegetables: desirable levels, instrumental and sensory measurement, and the effects of processing. Critical reviews in food science and nutrition. 2010; 50(5):369-389.
4. Chandra D, Kim JG, Kim YP. Changes in microbial population and quality of microgreens treated with different sanitizers and packaging films. Horticulture, Environment and Biotechnology. 2014; 53(1):32-40.
5. Francis GA, Gallone A, Nychas GJ, Sofos JN, Colelli G, Amodio ML *et al*. Factors affecting quality and safety of fresh-cut produce. Critical reviews in food science and nutrition. 2012; 52(7):595-610.
6. Goyal Siddiqui A, Upadhyay SN, Soni J. Effects of ultraviolet irradiation, pulsed electric field, hot water and ethanol vapours treatment on functional properties of mung bean sprouts. Journal of Food Science and Technology. 2014; 51(4):708-714.
7. Hodges DM, Forney CF, Wismer W. Processing line effects on storage attributes of fresh-cut spinach leaves. Hortscience. 2000; 35(7):1308-1311.
8. Kou L, Yang T, Xiao Z, Turner ER, Lester GE, Wang Q *et al*. Postharvest biology, quality and shelf life of

buckwheat microgreens. Food Science and Technology. 2013; 51(1):73-78.
9. Medina MS, Tudela JA, Marín A, Allende A, Gil MI. Short postharvest storage under low relative humidity improves quality and shelf life of minimally processed baby spinach (*Spinacia oleracea* L.). Postharvest Biology and Technology. 2015; 67:1-9.
10. Pajak P, Socha R, Gałkowska D, Roznowski J, Fortuna T. Phenolic profile and antioxidant activity in selected seeds and sprouts. Food Chemistry. 2014; 143:300-306.
11. Siddiqui MW, Rahman MS. Minimally processed foods: Technologies for safety, quality, and convenience. Springer Verlag International Publishing, Switzerland, 2015, 306.
12. Tony F. Sunflower microgreen nutrition information. Farmer Tony's mission greens, 2014. http://sproutingseedsoflove.com/nutrition/sunflowermicrogreensproutsnutritioninformation
13. Xiao Z, Lester GE, Park E, Saftner RA, Luo Y, Wang Q. Evaluation and correlation of sensory attributes and chemical compositions of emerging fresh produce: Microgreens. Postharvest Biology and Technology. 2015; 110:140-148.
14. Xiao Z, Luo Y, Lester GE, Kou L, Yang T, Wang Q. Postharvest quality and shelf life of radish microgreens as impacted by storage temperature, packaging film, and chlorine wash treatment. LWT-Food Science and Technology. 2014; 55(2):551-558.
15. Yahia EM. The contribution of fruits and vegetables consumption to human health. In: Fruit and Vegetable Phytochemicals: Chemistry, nutritional and stability, pp. 3-52. Gonzalez-Aguilar GA, Alvarez-Parrilla E, de la Rosa L, Eds., Wiley-Blackwell, Iowa, 2010.
16. Yanuriati A, Savage GP, Rowe RN. The effects of ethanol treatment on the metabolism, shelf life and quality of stored tomatoes at different maturities and temperatures. Journal of the Science of Food and Agriculture. 1999; 79(7):995-1002.
17. Zhang M, Meng X, Bhandari B, Fang Z, Chen H. Recent application of modified atmosphere packaging (MAP) in fresh and fresh-cut foods. Food Reviews Int. 2015; 31:172-193.