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RESEARCH ARTICLE

Correlation among quality parameters of parthenocarpic cucumber genotypes during storage

Vishal Tripathi, Vijay K. Singh, Amrita Kumari, Ajay Bhardwaj*, Paramveer Singh, Randhir Kumar

Deptt. of Hort. (Vegetable and Floriculture), Bihar Agricultural University, Sabour-813210, Bhagalpur (Bihar) India

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ABSTRACT

An experiment was conducted on 37 parthenocarpic cucumber genotypes at Bihar Agricultural University, Sabour in 2019 which was laid out in completely randomized design with four replications and Pearson's correlation matrix was analysed for physiological loss in weight (PLW), firmness, titratable acidity (TA), total soluble solids (TSS), chlorophyll and carotenoid content on 0, 4 and 7 days of storage at 24 ± 2 ºC and 60-80 % relative humidity (ambient condition). The study revealed that quality parameters TA and TSS showed a small correlation while, PLW exhibited moderate correlation in inverse direction with fruit firmness. Moreover, a positive correlation was also exhibited between TSS and PLW in cucumber during storage under ambient conditions.

Keywords: Correlation, parthenocarpy, ambient conditions, PLW, TSS, firmness

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INTRODUCTION

Fruits and vegetables are renowned to provide the essential nutrients such as vitamins, minerals and dietary fibre for world population. They also play an important role in reducing the prevalence of chronic diseases caused by an unhealthy diet. The parthenocarpic alias European cucumber is highly valued crop cultivated especially in off-season under protected conditions. It is characterised for their dark green colour, crispness, burpless quality and taste. The crop has a number of health benefits, including antioxidant, anti-inflammatory, and anti-cancerous properties due to high content of antioxidant nutrients (Mukherjee et al., 2013). Cucumbers are classified as "non-climacteric" fruits, and harvested at an immature stage for fresh consumption. The quality and quantity loss of cucumber occur at every stage in postharvest operation from harvesting to consumption. Being perishable in nature, the quality of this fruit is reduced dramatically after harvesting due to shrivelling, water loss, and colour changes if not properly stored.

* *For correspondence*: A. Bhardwaj (Email: bhardwaj.ajay.phd@gmail.com)

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Depending upon cultivars, the fruit should be firm or crispy, with dark green in colour and free from wrinkled ends (Gross et al., 2014). The main selection criteria for cucumbers are their green peel and desirable size. They also suffer mechanical injuries during transportation, which result in short shelf life and unmarketable quality. In market, the shelf life of cucumber is maximally up to 2-3 days. Being a chilling sensitive vegetable, they are not preferable to store at temperature below 7-10 ^{0}C (Raghav and Saini, 2018). The marketability of this perishable fruit is irrevocably linked to the availability of appropriate technology that mitigates losses during storage. Karl Pearson is the first to propose and investigate the correlation coefficients in 1896 (Hauke and Kossowski, 2011). Correlation coefficient analysis is an important measure to determine the mutual relationship between different traits and thus help in identification of traits on which inferences can be drawn. Here the case is for shelf life and hence the idea was to go for correlation analysis by which we can make some inference for prolonging the shelf life of cucumber fruits. Therefore, this study had been carried out to analyse correlation between various quality traits of cucumber during storage at ambient conditions.

MATERIALS AND METHODS

The experiment was carried out on 37 genotypes of parthenocarpic cucumber including 8 inbreds, 28 hybrids and 1 standard check (RS-03602833) in the laboratory of Department of Food Science and Postharvest Technology (FSPHT). The fruits of uniform size were taken from the field trial already progressing at polyhouse complex, Department of Horticulture (Vegetable and Floriculture), BAU, Sabour, Bhagalpur. The sorted fresh fruits were stored in the laboratory at ambient conditions temperature of 24 ± 2 ºC and relative humidity between 60-80% for analysis and other observations. The analysis of fruit quality was successfully done by assessing physiological loss in weight (PLW) percent, firmness, Titratable acidity, total soluble solids, chlorophyll and carotenoid content at 0, 4 and 7 days of storage.

To determine the physiological loss in weight, fruits were weighed on each day during storage till the end of storage period of seven days. The results were expressed as the percentage loss of initial weight.

$$\text{PLW (\%)} = \frac{\text{Initial weight} - \text{final weight}}{\text{initial weight}} \times 100$$

Firmness of fruits were measured using an FTC's TMS-Pilot Texture analyzer machine. A cylindrical probe with diameter of 5 mm were used to puncture at distal, middle and blossom end of selected fruit to a depth of 5 mm and the mean value was calculated and reading on the machine was noted. For determination of total soluble solids content, fruits were randomly chosen from each replication and treatment was determined using digital refractometer (Atago, Tokyo, Japan) at room temperature and their average was worked out. Titratable acidity (TA) was measured using the method described by Ranganna, S. (1977). Five grams (5 g) sample of each cucumber fruit was taken and homogenized with 50 ml of distilled water using a kitchen blender. The mixture was filtered using a filter paper and 10 ml of the filtrate was pipetted and titrated to the end-point of phenolphthalein against 0.1 N NaOH. Results were expressed in percentage (grams of citric acid equivalent per100 g of cucumber).

$$\text{TA (\%)} = \frac{\text{Titre value x Normality of alkali x Vol. made up x Eq. wt. of acid}}{\text{Vol. of aliquot x wt. of sample x 1000}} \times 100$$

Chlorophyll and carotenoid content (mg/100 g fresh weight)- Chlorophyll and carotenoid were extracted by taking one gram of cucumber skin and cut into pieces. Addition of 9 ml of 80% acetone solution into the test tube containing fine pieces of peel and the samples were kept for 48 hours under dark conditions. The absorbance of the supernatant at 663.2 nm, 646.8 nm and 452.5

nm was determined using spectrophotometer against a blank reagent. The chlorophyll content was calculated using the following equation (Lichtenthaler and Buschmann 2001) and expressed in mg/100g peel weight:

Chl a (mg/g of FW) = (12.25 x A663.2-2.79 x A646.8) x V/1000 x m

Chl b (mg/g of FW) = (21.50 x A646.8-5.10 x A663.2) x V/1000 x m

Car (mg/g of FW) = {4.75 x A452.5-0.226 x (chl a + chl b)}x V/1000 x m

V= Combined extract volume (ml)

m = Sample dry weight (g)

Statistical analysis

The experiment was laid out in completely randomized design with four replications and Pearson's correlation was analysed using statistical package SAS 9.4 (The SAS system, Version 9.4, SAS Institute, Cary, NC).

RESULT AND DISCUSSION

The correlation matrix indicating relationship between various quality parameters cucumber fruits for 0, 4 and 7 days of storage is depicted in Table 1, 2 and 3 respectively. In fresh cucumber fruits, firmness exhibited a strong and negative correlation at *P<0.01* significant with chlorophyll a, b and total chlorophyll content in peel. Similar trends were also exhibited on 4th and 7th days of storage. During storage, a small and positive correlation was seen between TSS and firmness of fruits up to 4th days of storage, while a small and negative correlation was recorded between TSS and firmness on day 7. A small and negative correlation were also seen between TA and firmness of fruit during storage up to day 4, while at the end of storage, TA showed small and positive correlation with firmness. Concurrent to our findings, Sortino et al. (2017) also reported positive correlation between firmness and TA in peach; Gill et al. (2017) in pear fruits.

Table 1: Correlation matrix of quality parameters in fresh (0 days) cucumber fruits

Traits	TSS (^{0} Brix)	Chlorophyll a (mg/100g)	Chlorophyll b (mg/100g)	Total Chlorophyll (mg/100g)	Total Carotenoid (mg/100g)	Firmness (N)
Titratable acidity (%)	-0.254	0.058	0.102	0.079	0.122	-0.150
TSS (^{0} Brix)		-0.045	-0.201	-0.103	0.117	0.266
Chlorophyll a (mg/100g)			0.907**	0.985**	0.260	-0.752**
Chlorophyll b (mg/100g)				0.964**	0.123	-0.727**
Total Chlorophyll (mg/100g)					0.216	-0.757**
Total Carotenoid (mg/100g)						-0.189

*** and** Significant at *P < 0.05* and *P < 0.01* respectively**

Table 2: Correlation matrix of quality parameters in cucumber fruits on 4th days of storage

Traits	Titratable acidity (%)	TSS (^{0} Brix)	Chlorophyll a (mg/100g)	Chlorophyll b (mg/100g)	Total Chlorophyll (mg/100g)	Total Carotenoid (mg/100g)	Firmness (N)
PLW (%)	0.162	0.161	0.288	0.168	0.247	0.206	-0.131
Titratable acidity (%)		-0.153	0.230	0.352*	0.286	0.256	-0.114
TSS (^{0} Brix)			-0.084	-0.079	-0.086	0.075	0.196
Chlorophyll a (mg/100g)				0.863**	0.980**	0.131	-0.744**
Chlorophyll b (mg/100g)					0.946**	0.100	-0.672**
Total Chlorophyll (mg/100g)						0.125	-0.742**
Total Carotenoid (mg/100g)							-0.205

*** and** Significant at *P < 0.05* and *P < 0.01* respectively**

Table 3: Correlation matrix of quality parameters in cucumber fruits on 7th days of storage

Traits	Titratable acidity (%)	TSS (^{0} Brix)	Chlorophyll a (mg/100g)	Chlorophyll b (mg/100g)	Total Chlorophyll (mg/100g)	Total Carotenoid (mg/100g)	Firmness (N)
PLW (%)	0.086	0.337*	0.272	0.152	0.229	0.287	-0.394*
Titratable acidity (%)		-0.065	0.083	0.420**	0.200	0.152	0.016
TSS (^{0} Brix)			0.269	0.174	0.273	0.278	-0.223
Chlorophyll a (mg/100g)				0.659**	0.958**	0.358*	-0.643**
Chlorophyll b (mg/100g)					0.838**	0.302	-0.581**
Total Chlorophyll (mg/100g)						0.367*	-0.651**
Total Carotenoid (mg/100g)							-0.305

*** and** Significant at *P < 0.05* and *P < 0.01* respectively**

PLW exhibited moderate and negative correlation with firmness of fruit, but it was found to be significant (*P<0.05*) on day 7 of storage. A small and positive correlation was observed between PLW and Titratable acidity on 4 and 7 days of storage, while TSS showed a small and positive correlation with PLW during first four days of storage, while on day 7, it was recorded positive and moderate correlation at *P<0.05* significant level with PLW. During storage, PLW manifested a small and positive correlation with chlorophyll and carotenoid content in peel. Gill et al. (2017) observed negative correlation between PLW and Firmness, while positive correlation between PLW and TSS in pear during storage at low temperature.

TA exhibited a small and negative correlation with TSS during storage. Similar to this, Sortino et al. (2017) and Gill et al. (2017) also reported negative correlation between TA and TSS for peach and pear, respectively.

TSS exhibited small and negative correlation with chlorophyll a, b and total chlorophyll content in peel on 0 and 4th day of estimation, but a positive and small correlation was seen on last day of storage. No significant correlation was exhibited between TSS and total carotenoid content during storage period.

Chlorophyll a showed a positive and strong correlation at *P<0.01* significant level with chlorophyll b and total chlorophyll content, while significant (*P<0.01*) and positive correlation was observed with carotenoid only for day 7. Similarly, Chlorophyll b showed strong and positive correlation with total chlorophyll content during period of investigation. A small and positive correlation was

observed between total chlorophyll and total carotenoid content, but the correlation was found to be significant (*P<0.05*) on last day of storage.

Thus, present study revealed that quality parameters namely TA and TSS showed a small correlation while, PLW exhibited moderate correlation in inverse direction with fruit firmness. Moreover, a positive correlation was also exhibited between TSS and PLW in cucumber during storage under ambient conditions.

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