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Association Analysis for Biochemical and Physiological Characters in Strawberry (*Fragaria ananassa* Duch.) Coated with Silver Nitrate and Silver Nanoparticles

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ABSTRACT: The challenges of post-harvest losses in fruit includes inadequate infrastructure and storage facilities, leading to spoilage and reduced shelf life, impacting both farmer's livelihoods and food security. The aim of the study is to extend the shelf life of strawberry using silver nanoparticles (Ag-NPs). The experiment was carried out using four treatments (T_1-1000 ppm silver nitrate for 5 minutes, T_2-2000 ppm silver nitrate for 5 minutes, T_3- 30 ppm silver nanoparticles for 5 minutes, T_4-60 ppm silver nanoparticles for 5 minutes) with three replications. Traits used for analysis are Total Soluble Solids, Total Sugars, Reducing sugars, Non -reducing sugars, Titratable acidity, Vitamin C, Physical hydrogen, Fruit weight, Fruit firmness and physiological loss in weight. The readings were recorded on 3rd, 6th and 9th day of storage after treatment. Correlation analysis was conducted between the biochemical and physiological parameters. The experimental results found that high significant and positive correlation was observed between Vitamin 'C' and Physiological Loss Weight (0.406*). Fruit firmness showed positive and high significant association with total soluble sugars (0.382*), total sugars (0.501) and reducing sugars (0.390*). Interestingly, fruit weight had a significant correlation with reducing sugars (0.422*) and firmness (0.648**).**

Keywords: Biochemical, Physiological parameters, Silver nanoparticles, Silver nitrate, Strawberry, Vitamin C.

INTRODUCTION

The strawberry (*Fragaria ananassa* Duch), is a member of the Rosaceae family and grown all around the world. Fruits that are ingested fresh have a high vitamin C concentration and fantastic health advantages. Anthocyanin present in berries reduce the risk of heart attack. Antioxidants present in fruits like kaempferol, quercetin, and anthocyanin that prevent blood clots linked to form stroke (Satish *et al*., 2019). In berries, there is high demand for maintaining quality at its original level over a longer period. Due to excess texture softening, moisture loss, and physiological disorders, the strawberry has reduced shelf life of around 1–2 days at room temperature (Muley *et al*., 2022). A key factor in strawberry storage deterioration is pathogen attack. *Botrytis cinerea*, which produces the grey mould fungi, is one of the most commercially significant diseases of strawberries (Petrasch *et al*., 2019). Therefore, this study is carried out to increase the shelf life of strawberry using silver nanoparticles (Ag-NPs). The silver nanoparticles were biologically synthesized using G*ymnema sylvestre* leaf extract which acts as reducing and capping agent during the synthesis of AgNPs. The green synthesized silver nanoparticles were coated on strawberries at different concentrations and the correlation coefficient analysis was examined among the different biochemical and physiological characters.

MATERIALS AND METHODS

An investigation on "Shelf-life extension of strawberry (*Fragaria ananassa* Duch.) using Silver nanoparticles" was conducted at Division of Horticulture, School of Agricultural Sciences, Karunya Institute of Technology and Sciences, Karunya Nagar, Coimbatore during the year of 2022-2023. Strawberry fruits were purchased from local market in Coimbatore and they were subjected to different concentrations of silver nitrate (Ag NO_3) (T_1-1000 ppm for 5 minutes, T_2-2000 ppm for 5 minutes) and silver nanoparticles Ag-NPs (T_3- 30 ppm for 5 minutes, T_4-60 ppm for 5 minutes) and stored till the end of storage life under ambient condition. Traits used for analysis are Total Soluble Solids (TSS), Total Sugars (TS), Reducing sugars (RS), Non-reducing sugars (NRS), Titratable acidity (TA), Vitamin C, pH, Fruit weight (FW), Fruit firmness and Physiological loss in weight (PLW). The data was recorded on 3rd, 6th and 9th day of storage after the treatment. Correlation

estimation analysis was conducted between the biochemical and physiological parameters.

Statistical analysis. The data obtained from all the experiments were analyzed for correlation statistically using OPSTAT.

Table 1: Correlation with different physiological and biochemical parameter on day 3.

Variables	TSS	TS	RS	NRS	TA	pH	Firmness	FW	PLW
TSS	1.000								
TS	0.366	1.000							
RS	0.442*	0.900**	1.000						
NRS	-0.322	-0.188	-0.597**	1.000					
TA	0.236	0.232	0.368	-0.402*	1.000				
pH	-0.282	-0.140	-0.101	-0.031	0.240	1.000			
Firmness	0.593**	0.363	0.437*	-0.316	0.121	-0.184	1.000		
FW	0.070	-0.111	-0.154	0.142	0.184	0.277	-0.113	1.000	
PLW	-0.048	-0.250	-0.266	0.139	-0.264	-0.002	0.233	-0.622**	1.000
Vitamin C	-0.110	-0.168	-0.143	0.014	-0.175	0.027	-0.446*	0.244	-0.417*

** Significance at 0.01, *significance at 0.05. TSS – Total soluble solids, TS - Total Sugars, RS – Reducing Sugars, NRS – Non-Reducing Sugars, TA – Titrable Acidity, PH – Potential Hydrogen, Fruit firmness, FW – Fruit weight, PLW – Physiological Loss of Weight

Table 2: Correlation with different physiological and biochemical parameter on day 6.

Variables	TSS	TS	RS	NRS	TA	pH	Firmness	FW	PLW
TSS	1.000								
TS	0.262	1.000							
RS	0.403*	0.831**	1.000						
NRS	-0.289	0.155	-0.421*	1.000					
TA	0.303	0.291	0.237	0.055	1.000				
pH	-0.004	-0.070	-0.184	0.211	0.257	1.000			
Firmness	0.491**	0.248	0.216	0.021	0.430*	0.202	1.000		
FW	0.417*	0.242	0.317	-0.169	0.559**	0.295	0.242	1.000	
PLW	0.217	0.064	-0.050	0.193	0.134	-0.015	0.063	-0.028	1.000
Vitamin C	-0.143	-0.059	0.061	-0.206	-0.202	-0.175	-0.403*	-0.177	-0.004

** Significance at 0.01, *significance at 0.05. TSS – Total soluble solids, TS - Total Sugars, RS – Reducing Sugars, NRS – Non-Reducing Sugars, TA – Titrable Acidity, PH – Potential Hydrogen, Fruit firmness, FW – Fruit weight, PLW – Physiological Loss of Weight

Table 3: Correlation with different physiological and biochemical parameter on day 9.

Variables	TSS	TS	RS	NRS	TA	pH	Firmness	FW	PLW
TSS	1.000								
TS	0.289	1.000							
RS	0.332	**0.800****	1.000						
NRS	-0.083	0.274	-0.358	1.000					
TA	0.262	0.269	0.437*	-0.283	1.000				
pH	-0.250	-0.076	-0.300	0.362	0.046	1.000			
Firmness	**0.382***	**0.501****	**0.390***	0.155	0.311	-0.030	1.000		
FW	0.282	0.287	**0.422***	-0.229	**0.504****	**-0.411***	**0.648****	1.000	
PLW	0.102	0.118	0.030	0.136	0.030	0.180	-0.220	-0.373	1.000
Vitamin C	-0.170	-0.025	-0.062	0.060	-0.229	0.136	-0.302	-0.162	**0.406***

** Significance at 0.01, *significance at 0.05. TSS – Total soluble solids, TS - Total Sugars, RS – Reducing Sugars, NRS – Non-Reducing Sugars, TA – Titrable Acidity, PH – Potential Hydrogen, Fruit firmness, FW – Fruit weight, PLW – Physiological Loss of Weight

RESULTS AND DISCUSSION

A. Correlation coefficient analysis for different characters on Day 3

Correlation coefficient was analyzed among different characters at different levels of significance. The analysis of correlation coefficient showed that Vitamin C had a negative and high significant association with firmness (-0.446*) and physiological loss in weight (-0.417*). While, there was no positive significant association was observed in Vitamin C with other characters in the study.

Beside this, Reducing sugars had high significance and positive association with total sugars (0.900**) and TSS (0.442*). Significant negative association was observed in Non-reducing sugars with reducing sugars (-0597**). Titratable acidity negatively correlated with non-reducing sugars (-0.402*). Firmness was positively correlated with total soluble solids (0.593**) and reducing sugars (0.437*). Physiological loss in weight (PLW) had high negative correlation with fruit weight (-0.622**).

B. Correlation coefficient analysis for different characters on Day 6

Vitamin C was negatively correlated with firmness (-0.403*). Reducing sugars had positively correlated with Total sugars (0.831**) and TSS (0.403*). Non-reducing sugars was negatively correlated with reducing sugars (-0.421*). Positive correlation was found between firmness with TSS (0.491**) and titratable acidity (0.430*). Fruit weight was positively correlated with titratable acidity (0.559**) and TSS (0.417*).

C. Correlation coefficient analysis for different characters on Day 9

Vitamin C was positively correlated with physiological loss in weight (0.406*). Reducing sugars was positively correlated with Total sugars (0.800**). Titratable acidity was found to be positively correlated with reducing sugars (0.437*). Firmness was positively correlated with total sugars (0.501**) reducing sugars (0.390*) and TSS (0.382*). Positive correlation was found between fruit weight with and firmness (0.648**), titratable acidity (0.504**), reducing sugars (0.422*) and fruit weight was found to be negatively correlated with pH (-0.411*).

Galoburda *et al.* (2010) reported that strawberry cultivars 'Polka', 'Honeoye' and 'Senga Sengana' had a close correlation with vitamin C and total sugars. High value for TSS, titrable acidity, reducing sugar, total sugar, fruit weight and vitamin C which was reported by Sah *et al*. (2010). Singh *et al*. (2018) studied that highest correlation was with fruit weight. Positive correlation was found in non-reducing sugar, average berry weight and total soluble solids (Singh *et al*., 2018). Kilic *et al*. (2012) concluded that fruit color parameters, soluble solid content (SSC), total acidity, fruit firmness, and vitamin C in fruits of three strawberry cultivars were significant inter correlation. Mishra *et al*. (2015) reported that Titratable acidity and reducing sugar revealed the highest positive significant relationships with reducing sugars and total sugars. According to correlation study done by Kirad *et al*. (2007), ascorbic acid and TSS have a favorable and significant correlation with overall weight loss. Total sugar and total ascorbic acid both had significant and positive correlations with total soluble solid. Ascorbic acid and total sugar were positively associated. Singh *et al*. (2018) reported that reducing sugar had significant positive correlation with total sugar.

CONCLUSIONS

In the present study strawberry fruits treated with silver nanoparticles showed positive correlation with Total sugars, Total soluble solids, Reducing sugars, Fruit firmness, Titratable acidity, Physiological Loss of Weight and vitamin 'C' on 9th day of storage. Therefore, it is concluded that coating with silver nanoparticle enhances the quality parameters with increase in shelf life of strawberry.

FUTURE SCOPE

Inferring based on the correlation analysis the traits Total sugars, Total soluble solids, Reducing sugars, fruit firmness, Titrable acidity and physiological loss of weight can be used for indirect selection of vitamin 'C' rich strawberry lines. Further, coating of fruits with silver nano particles can be attempted with different genotypes of strawberry for its wider applicability and feasibility.

REFERENCES

Galoburda, R., Boca, S., Skrupskis, I. and Seglina, D. (2014). Physical and chemical parameters of strawberry puree. In *9th Baltic Conference on Food Science and Technology "Food for Consumer Well-Being* (p. 172).

Kilic, N., Burgut, A., Gündesli, M. A., Nogay, G., Ercisli, S., Kafkas, N. E. and Szopa, A. (2021). The effect of organic, inorganic fertilizers and their combinations on fruit quality parameters in strawberry. *Horticulturae*, *7*(10), 354.

Kirad, K. S., Barche, S., Dash, A. and Sharma, R. K. (2007). Response of different packaging materials and chemicals on the shelf life of strawberry (*Fragaria ananassa* Duch.) and correlation between different traits. In *International Conference on Quality Management of Fresh Cut Produce 746* (pp. 89-96).

Mishra, P. K, Ram, R. B. and Kumar, N. (2015). Genetic variability, heritability and genetic advance in Strawberry (*Fragaria* × *ananassa* Duch.). *Turkish Journal of Agriculture and Forestry*., *39*, 451- 458.

Muley, A. B., Kedia, P., Pegu, K., Kausley, S. B. and Rai, B. (2022). Analyzing the physical and biochemical changes in strawberries during storage at different temperatures and the development of kinetic models. *Journal of Food Measurement and Characterization*, *16*, 222–247.

Petrasch, S., Knapp, S. J., Van Kan, J. A. and Blanco Ulate, B. (2019). Grey mould of strawberry, a devastating disease caused by the ubiquitous necrotrophic fungal pathogen *Botrytis cinerea*. *Molecular plant pathology*, *20*(6), 877-892.

Sah, S., Sharma, G. and Sharma, N. (2010). Heritability, genetic variability correlation and nonhierarchical Euclidean cluster analysis of different almond (*Prunus dulcis*) genotypes. *Indian Journal of Agricultural Sciences*, *80*, 576-883.

Satish Kuchi, V. and Sai Ratna Sharavani, Ch. (2019). Fruit Physiology and Postharvest Management of Strawberry. In *Strawberry - Pre- and Post-Harvest Management Techniques for Higher Fruit Quality*. Intech Open.

Singh, G., Kachwaya, D. S., Kumar, R., Vikas, G. and Singh, L. (2018). Genetic variability and association analysis in strawberry (*Fragaria* × *ananassa* Duch). *Electronic Journal of Plant Breeding*, *9*(1), 169-182.

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