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EFFECT OF ANTIOXIDANTS, PACKAGING MATERIAL AND STORAGE TEMPERATURE ON MICROBIAL CHARACTERS POMEGRANTE ARIL

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ABSTRACT

Lifestyles of modern consumers, along with their desire for fresh, convenient, and natural products that claim health benefits, have led to the current increase in the production and consumption of fresh-cut horticultural produce. However, the hard peel of pomegranates makes it difficult to release arils, thus limits its consumption as fresh fruit. Minimally processed (MP) pomegranate arils result in quality deterioration due to water loss, softening, increased respiration, aril browning, and microbial contamination that limits the shelf life of arils. The present investigations were carried out to study the effect of antioxidants, packaging material and storage temperature on microbial characters pomegranate aril. There were three factors, in factor I, antioxidants (ascorbic acid, citric acid and honey), in factor II packing material (polyethylene film and punnet) and in factor III storage temperature (0°C and 5°C) replicated twice in a factorial completely randomized block design. Observations were recorded at weekly intervals.Among the antioxidant treatments, citric acid five per cent recorded the lowest microbial parameters like total viable count, yeast, mould, coliform. Same trend was noticed in packaging material (punnets) and storage temperature (0°C). On overall interaction of all the treatments, combination of citric acid, punnets and 0°C ($A_3 + P_2 + S_1$) recorded the best in microbiological parameters, and extend the shelf life (30 days) of pomegranate arils.

Keywords: Pomegranate aril, antioxidants, packaging material, storage temperature and microbial parameters

INTRODUCTION

Pomegranate *(Punica granatum* L.*)* is an important favourite fruit of tropical, sub-tropical and arid regions. It belongs to the family Punicaceae and is believed to originate from the Middle East (Iran and adjoining countries) and spread to most tropical and sub-tropical countries of the world. It is one of the favourite dollar earning table fruits in the world, for its refreshing juice with nutritional and medicinal properties. The edible portion is the bright-red pulp (aril) surrounding the individual seed. The edible portion (aril) of fruit is about 55-60 per cent of the total fruit weight and consists of about 75-85 per cent juice and 15-25 per cent seeds (Al-Maiman and Ahmad, 2002). The fruit aril is consumed fresh or it can be processed into juice, syrup, jam or wine. In the last few years, there had also an increasing interest in the search for new pomegranate derived food products. Extracting arils is a time consuming process and therefore minimally processed pomegranate arils are sold as a convenience product (Gil *et al*., 1996).

The whole fruit can be stored for 3 to 4 months at temperatures below 10°C (Ghafir *et al*., 2010), but when peeled, the arils will only last a week or up to two weeks under modified atmosphere packaging (MAP) conditions at temperatures of 5°C and below (Lopez-Rubira *et al*., 2005). The shelf life of pomegranate arils stored at 0-2°C with 95 per cent RH is between 12 and 14 days. However, no common consensus has been reached regarding the recommended storage temperature of pomegranate arils yet. Packaging is especially important in pomegranate arils to preserve the quality of the fruit by reducing shrivelling, dehydration and weight loss (Nicola *et al.,* 2009). Although many studies have been reported on pomegranates across the world, there is a dearth of information regarding the effect of storage temperatures on the nutritional properties of pomegranate arils. This is particularly important since several researchers have shown that fruit quality of pomegranates differ significantly among growing regions (Schwartz *et al.,* 2009). Hence, the present investigation is designed to study the effect antioxidants, packaging material and storage temperature on microbial characters pomegranate aril.

MATERIALS AND METHODS

Experiments on "the effect antioxidants, packaging material and storage temperature on microbial characters pomegranate (cv. Bhagwa) aril" was carried out at farmer's field, Pattiveeranpatti, Periyakulam, Food Park, Jain Valley, Jain Irrigation Systems Limited. Three factors were replicated twice in a completely randomized factorial block design in factor I, antioxidants (ascorbic

acid, citric acid and honey), factor II packaging material (polyethylene film and punnet) and factor III storage temperature (0 ° C and 5 ° C). Observations at weekly intervals were reported.

Treatment details

Factor 1	A_1 – Chlorinated water (150 ppm)
	A_2 – Chlorinated water (150 ppm) + ascorbic acid (5 per cent)
	A_3 – Chlorinated water (150 ppm) + citric acid (5 per cent)
	A_4 – Chlorinated water (150 ppm) + honey 10 per cent
	A_5 – Chlorinated water (150 ppm) + honey 20 per cent
Factor II	P_1 – Polyethylene film
	P_2 – Punnets packaging
Factor III	S_1 – Refrigerated storage at 0°C
	S_2 – Refrigerated storage at 5 °C

Microbial activity

Microbial population like total viable count, yeast, mould and Coliform were observed using serial plate technique and expressed in CFU/g.

Shelf life

Observations were recorded at weekly interval and shelf life was calculated based on the physical, chemical, sensory and microbial parameters and expressed in days.

Statistical Analysis

The statistical analysis of data was done by adopting the standard procedures of Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Microbiological analysis showed total viable count, yeast, mould, coliform and bacteria are also responsible for off-flavour development in pomegranate arils during cold storage (Juven *et al.,* 1984). Extending the shelf life of arils has recently enjoyed global scientific interest (Lopez-Rubira *et al*., 2005; Tedford *et al*., 2005).

The results of the present study revealed that antioxidant solution, packing material and storage temperature had its own impact on microbial population like total viable count, yeast, mould and coliform of minimally processed arils. In present investigation, among the antioxidant treatments citric acid at five per cent recorded the lowest microbial content during the storage period.

Packaging material and storage temperature had significant effects on microbial growth. This may be due to probable moisture loss, dehydration and weight loss. On analyzing the overall performance, treatment (citric acid + punnets + 0 °C) registered the lowest microbial population. This may be due to the combined effect of antioxidants, packaging material and storage temperature which in turn registered the increased acidity in respective treatments.

Data on shelf life of arils revealed that, among the different treatments and their interactions revealed that, the treatment $A_3P_2S_1$ (citric acid five per cent + punnets + 0 °C) recorded the highest shelf life up to 30 days with physical, chemical and microbial quality. This might due to the combined effect of antioxidants, packaging material and storage temperature. The results were in agreement

Table.1. Effect of antioxidants, packaging material and storage temperature on Yeast (cfu/g) (30th day)

Treatment	P_1	P_2	S_1	S_2	P_1S_1	P_1S_2	P_2S_1	P_2S_2	Mean
A_1	6250.00	5250.00	5500.00	6000.00	6000.00	6500.00	5000.00	5500.00	**5750.00**
A_2	600.00	100.00	150.00	550.00	1000.00	200.00	100.00	100.00	**350.00**
A_3	10.00	5.00	5.00	10.00	10.00	10.00	0.00	10.00	**7.50**
A_4	4350.00	2850.00	3400.00	3800.00	3100.00	4200.00	450.00	2600.00	**3093.75**
A_5	3450.00	2600.00	3100.00	2950.00	3300.00	3600.00	2600.00	2600.00	**3025.00**
Mean	**2932.00**	**2161.00**	**2431.00**	**2662.00**	**2682.00**	**2902.00**	**1630.00**	**2162.00**	
IQF	**0.00**								

	SEd	**CD (0.05)**		
A	95.110	198.410		
P	60.150	125.480	**A**	Additives
S	60.150	NS	**P**	Packaging material
AP	134.510	280.600	**S**	Storage temperature
AS	134.510	280.600	**IQF**	Individually Quick Freezing
PS	85.700	NS	**NS**	Non-significant
APS	190.230	384.79		

Table.2. Effect of antioxidants, packaging material and storage temperature on Mould (cfu/g)(30th day)

Treatment	P_1	P_2	S_1	S_2	P_1S_1	P_1S_2	P_2S_1	P_2S_2	Mean
A_1	7950.00	4250.00	5100.00	7100.00	5700.00	10200.00	4500.00	4000.00	**6100.00**
A_2	950.00	1050.00	850.00	1150.00	1100.00	800.00	600.00	1500.00	**1000.00**
A_3	1250.00	340.00	550.00	1040.00	1800.00	700.00	280.00	400.00	**795.00**
A_4	5550.00	3500.00	5000.00	4050.00	5500.00	5600.00	4500.00	2500.00	**4525.00**
A_5	4050.00	2685.00	2500.00	4235.00	3500.00	4600.00	1500.00	3870.00	**3367.50**
Mean	**3950.00**	**2365.00**	**2800.00**	**3515.00**	**3520.00**	**4380.00**	**2276.00**	**2454.00**	
IQF	**0.00**								

	SEd	CD (0.05)		
A	113.120	235.980		
P	71.540	149.240	**A**	Additives
S	71.540	149.240	**P**	Packaging material
AP	159.980	333.730	**S**	Storage temperature
AS	159.980	333.730	**IQF**	Individually Quick Freezing
PS	101.180	211.070	**NS**	Non-significant
APS	226.250	471.960		

Table.3. Effect of antioxidants, packaging material and storage temperature on coliform (cfu/g) (30th day)

Treatment	P_1	P_2	S_1	S_2	P_1S_1	P_1S_2	P_2S_1	P_2S_2	Mean
A_1	1200.00	950.00	850.00	1300.00	900.00	1600.00	800.00	1000.00	**1075.00**
A_2	60.00	30.00	35.00	55.00	0.00	50.00	70.00	60.00	**45.00**
A_3	65.00	15.00	30.00	50.00	60.00	70.00	0.00	30.00	**40.00**
A_4	325.00	200.00	225.00	300.00	300.00	500.00	150.00	100.00	**262.50**
A_5	150.00	365.00	340.00	175.00	530.00	150.00	150.00	200.00	**257.50**
Mean	**360.00**	**312.00**	**296.00**	**376.00**	**358.00**	**474.00**	**234.00**	**278.00**	
IQF	**0.00**								

	SEd	CD (0.05)		
A	15.190	31.680		
P	9.600	20.040	**A**	Additives
S	9.600	20.040	**P**	Packaging material
AP	21.480	44.810	**S**	Storage temperature
AS	21.480	44.820	**IQF**	Individually Quick Freezing
PS	13.580	28.340	**NS**	Non-significant
APS	30.380	63.370		

Table.4. Effect of antioxidants, packaging material and storage temperature on shelf life of arils

Treatment	P_1	P_2	S_1	S_2	P_1S_1	P_1S_2	P_2S_1	P_2S_2	Mean
A_1	14.20	15.50	15.50	14.50	14.40	14.00	16.00	15.00	**14.85**
A_2	25.00	26.75	26.50	25.25	25.00	25.00	28.00	25.50	**25.87**
A_3	26.00	28.75	28.00	26.75	26.00	26.00	30.00	27.50	**27.37**
A_4	20.50	24.00	22.50	22.00	21.00	20.00	24.00	24.00	**22.25**
A_5	24.50	25.00	24.50	25.00	24.00	25.50	24.00	25.00	**24.75**
Mean	**22.04**	**24.00**	**23.34**	**22.70**	**22.08**	**22.00**	**24.60**	**23.40**	
IQF	**More than 30 days**								

	SEd	CD (0.05)		
A	0.770	1.610		
P	0.490	1.020	**A**	Additives
S	0.490	NS	**P**	Packaging material
AP	1.090	NS	**S**	Storage temperature
AS	1.090	NS	**IQF**	Individually Quick Freezing
PS	0.690	NS	**NS**	Non-significant
APS	0.990	1.450		

with Sepulveda *et al.,* (2001) in different cultivars of pomegranate arils.

CONCLUSION

Among the different post harvest treatments, application of antioxidants citric acid with 5 per cent registered the lowest microbial population. The packing of pomegranate arils with punnets reduced the microbial parameters like total viable count, yeast, mould and coliform in comparison with other treatments. Same trend was noticed in storage of arils at 0°C. Therefore it is noticed that, treating the arils with five per cent citric acid, packed with punnets and stored at 0 °C recorded the lowest microbial population with extended shelf life up to 30 days.

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