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Physico-chemical Changes Of Minimally Processed Pomegranate Arils cv. Bhagwa as Effected by Packaging Materials

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ABSTRACT

Minimally processed pomegranate arils cv. Bhagwa were packed in 80, 150 guage of Polypropylene bags (PP) and 100, 150 guage of Low Density Polyethylene bags (LDPE) stored at 5°C. Arils packed with Low Density Polyethylene bags with 150 guage recorded significantly lower PLW than unpacked arils. Stastically lowest spoilage, correspondingly increased the shelf life upto 12 days and superior for appearance and overall acceptability of arils packed in 80 guage of PP bags. Significantly the highest Hunter color Lab values (L, a* & b*), TSS, brix-acid ratio, sugars, ascorbic acid in arils packed with PP bags with 80 guage. Arils packed in 80 guage of PP bags were superior for organoleptic attributes.*

Key words: *Arils, Packaging, Shelf life, Hunter color Lab values (L*, a* & b*) Quality.*

INTRODUCTION

Packaging materials are an effective method for prolonging shelf life of xide concentrations in the package due to interaction of respiration and film permeability[23]. The use of polymeric film packaging in order to develop a horticultural produce as respiration is depressed by decreasing oxygen and increasing the carbon diomicro controlled atmosphere reduces the respiratory activity and maintains unfavorable conditions for the action of many contaminating microorganisms[18].

Currently, there is a greater interest in pomegranate arils due to its high antioxidant activity and potential health benefits[12]. Citric acid is the predominant organic acid and glucose and fructose are the main sugars in pomegranate arils. The common anthocyanin in pomegranate arils is delphinidin-3,5-diglucoside[15]**.** Juice content amounts to 45-61% of the whole fruit, 76-85% expressed in relation to the weight of the arils. The juice contains 16-17% dry matter.

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Pomegranate consumption is limited due to difficulty in peeling to obtain the arils. Presenting pomegranate arils in 'ready-to-eat' form would be a convenient and desirable alternative to encourage the consumption of fresh arils and may also help to the demand for increase pomegranate cultivation. In pigmented products, an additional problem is the discolouration caused by oxidation of phenolic pigments and other phenolic compounds catalyzed by phenolases or peroxidases[2,10]. Since the colour of pomegranate aril is the most important quality attribute for consumers, its stability must be preserved.

Minimally processed pomegranate arils have less post-harvest life and arils are packed in packaging materials like polypropylene and low density polyethylene are helps to prevent microbial development[24]. Lack of appropriate information regarding packaging material of the arils for quality exports led to the development of appropriate technologies to orient for export of arils from the state of Telangana. However, little work on packaging of pomegranate arils has been done so far. Therefore a study has been undertaken to find out the effect of packaging material on shelf life and quality of minimally processed pomegranate aril cv. Bhagwa.

MATERIALS AND METHODS

The present experiment was carried out at college of Horticulture in collaboration with Post Harvest Technology Research Station, Dr. Y.S.R.HU, Rajendranagar, Hyderabad. The experiment was conducted by packaging the minimally processed pomegranate arils were packed in 80, 150 guage of Polypropylene bags (PP) and 100, 150 guage of Low Density Polyethylene bags (LDPE) having treatments with the experimental design was complete randomized block design with factorial concept and replicated quaterly.

After peeling, arils were divided into uniform groups (120 g) and at 23°C to remove residual water before analysis. The following parameters were analysed.

Physiological loss in weight of the arils was recorded on every 3 days and subtracted from the initial weight. The mean loss of weight in grams in relation to initial weight was calculated and expressed as percentage. The number of fruit arils spoiled in each replication were counted and expressed in percentage. The spoilage was determined based shrivelling and fungal infection and subsequent rotting of the arils. The shelf life of arils was determined by recording the number of days the arils remained in good condition in storage. The stage wherein more than 5 per cent of the stored arils became unfit for consumption was considered as end of shelf life in that particular treatment and expressed as mean number of days. The colour of the arils in each replication were instrumentally determined by using a colorometric spectrophotometer (Model: colorflex, Hunter lab, West Virginia, USA) and expressed in Hunter scale (L*, a* and b*).

Total soluble solids was determined by using ERMA hand refractrometer and expressed as °Brix[22]. The brix–acid ratio was arrived at by dividing the total soluble solids with titratable acidity. Sugars were determined by the method of Lane and Eyon[3]. Ascorbic acid was estimated by the method presented by Ranganna (1986). Sensory evaluation was done by panel of 15 personnel of both the genders at College of Horticulture and Post Harvest Technology Research Station for standard organoleptic attributes using the 5 point hedonic scale[1]. Score card contains various aril quality attributes *viz.,* color, appearance and overall acceptability.

The data obtained was subjected to statistical analysis as per the procedure outlined by Panse and Sukhatme[19].

RESULTS AND DISCUSSION

Physiological loss in weight

Physiological loss in weight (PLW) (Table 1) indicates the total moisture lost during storage and ripening, which results in desiccation and a shrivelled appearance of the arils. Mean comparison on day 3 and 6, significantly lowest PLW was recorded in arils packed in 150 guage of LDPE bags (0.42) and whereas,

highest PLW noted in unpacked (5.81) arils. Similarly, minimum PLW recorded in P_4 (2.26) and highest in P_1 (3.51) of 9th and 12th day of storage. The using of different packaging material reduced the weight loss to a great extent in all treatments as compared to control. Unpacked arils had maximum weight loss compare to low density poyethylene packed arils, which might be due to effective increase in the rate of respiration and transpiration[9]. LDPE film showed to be inadequate to package minimally processed aril because of its low permeability to oxygen and carbon dioxide[8].

Spoilage: The storage life and spoilage (Table 1) of arils are directly related to the rate of respiration. Lowest spoilage was recorded in arils packed in P_1 (2.16) and whereas as highest in non-packed arils (5.18) during the mean of 3rd and 6th day of storage. The spoilage gradually increased with increase in storage period. Maximum in P_4 (5.34) and for the packaging material used, the loss in spoilage of arils was minimum with 80 guage (4.66) at the mean of 9th and 12th day of storage because of the minimum spoilage in packed fruits may be due to limited exposure of fruits to micro flora and atmospheric oxygen and also due to the accumulation of CO_2 within the polybags and its preserve effect[11].

Shelf life: Pomegranate arils are highly perishable and have a short shelf life (Table 1). Arils packed in P_1 recorded the highest shelf life of 12 days whereas, unpacked arils in P_5 recorded a minimum of 4.33 days only. The shelf life increased due to packaging which was attributed to reduction in gaseous exchange and increase in CO_2 concentration inside the package, and consequently further bringing down the rate of respiration[13,7&14] were also reported similar results while studying storage of sapota. The shelf life of pomegranate arils was 4 days without packing material under cold temperature. Control arils had minimum shelf life compared to polythene packed arils. This might be due to effective increase in the rate of respiration and transpiration[9].

Hunter L*, a* and b* value (Table 2 & 3) of arils gradually decreased with each successive storage period. The hunter color (L*, a* and b*) values of aril gradually decreased with each successive storage period and significantly maximum value was recorded in P_1 (21.77, 17.24 and 5.35) and whereas lowest was recorded in non-packed arils (20.91, 16.90 and 5.19) at their mean of 3rd and 6th day storage at 5°C. Significantly maximum value was recorded in P_1 (21.10, 16.81 and 5.17) of 9th and 12th day storage at 5°C. Color of the pomegranate fruit aril was found to be red which may be due to Anthocyanins pigments. The values of L*, a* and b* decreased as storage period increased because anthocyanins content was decreased[4].

Total soluble solids: The TSS (Table 3) of aril was gradually decreased with each successive storage period and significantly maximum value was recorded in P_1 (15.84) and whereas lowest in without packing (15.56) during their mean of 3rd and 6th day storage at 5°C and significantly maximum value was recorded in P_1 (15.60) and minimum value was recorded in P_4 (15.45) at their mean of 9th and 12th day storage at 5°C. In the experiments decrease in TSS at advanced stage is owing to the increased rate of respiration in later stage of storage[16] and lower temperature reduces the activity of degradative enzymes responsible for buildup of TSS, whereas lower respiration at lower temperature results in highest retention of TSS at cool chamber and cold storage[5,21&25.]

Brix-acid ratio: It is evident from data that the brix-acid ratio (Table 4) of aril significantly increased with each successive packaging material. Significantly maximum brix-acid ratio of 56.50 (P_5) was recorded and minimum of 49.36 (P_1) the mean of 3rd and 6th day storage at 5°C and significantly the storage of aril the brix-acid ratio was increased with corresponding packaging material noticed that minimum value in 54.73 (P_1) and maximum values in 65.67 (P_4) the mean of 9th and 12th day storage. The brix-acid ratio increased significantly in all treatments

mainly due to a decrease in titrable acidity during storage[4,12].

Sugars: Maximum sugars (Table 4) (total sugars) content was recorded in P_1 (8.33) and minimum in un packed arils (8.12) at the mean of 3rd and 6th day of storage at 5°C and significantly the storage of aril the sugars was decreased with corresponding packaging material observed that highest value in P_1 (7.99) lowest values in P_4 (7.82) the mean of 9th and 12th day storage because of in control low sugars were recorded due to exposure of fruit to atmosphere and concomitant increase in respiration. This could be due to slow ripening process in modified atmospheric packaging which leads to slow build-up of the sugars. There was a gradual increase in total sugars and reducing sugars which reached its maximum at ripe stage and there after decreased gradually[6].

Ascorbic acid: Maximum ascorbic acid (Table 5) content was recorded in 8.38 (P_1) and minimum (8.12) in un packed arils at the mean of 3rd and 6th day storage at 5°C and significantly the storage of aril the ascorbic acid was decreased with corresponding packaging material observed that highest value in 7.47 (P_1) and lowest values in 7.12 (P_4) the mean of 9th and 12th day storage due to the reduction in ascorbic acid content might be due to the activity of oxidative enzymes during storage. However, the decrease in ascorbic content was observed in the present study, in most of the packages, may be due to the oxidative reduction of vitamin C in presence of molecular oxygen by ascorbic acid oxidase enzyme[20].

Organoleptic evaluation: Arils packed in P_1 recorded highest organoleptic evaluation (Table 5) (3.86) and non-packed P_5 (3.03) arils recorded minimum. The score for organoleptic evaluation decreased with decrease in storage period. This might be due to the breakdown of ascorbic acid during storage of products[14] and the arils stored without packing material showed lower organoleptic evaluation, which might be the respiratory rate is markedly reduced at low temperature. Similar results were obtained[24] in pomegranate.

Table 1: Effect of packaging material on physiological loss in weight (%), spoilage (%) and shelf life (days) of pomegranate arils cv. Bhagwa.

Treatments	Storage period (days)												Shelf life (days)
	Physiological loss in weight (%)						Spoilage (%)						
	3	6	Mean	9	12	Mean	3	6	Mean	9	12	Mean	
PP 80 gauge	0.19	2.03	1.11^{b}	3.32	3.69	3.51^{c}	1.36	2.95	2.16^{a}	4.31	5.00	4.66^{a}	12.00^{a}
PP 150 gauge	0.17	1.61	0.90^{ab}	2.90	3.27	3.09^{bc}	1.66	3.25	2.46^{ab}	4.61	5.30	4.96^{b}	10.69^{b}
LDPE 100 gauge	0.08	1.20	0.64^{ab}	2.49	2.86	2.68^{ab}	1.81	3.41	2.61^{abc}	4.77	5.46	5.12^{c}	10.00^{b}
LDPE 150 gauge	0.05	0.78	0.42^{a}	2.07	2.44	2.26^{a}	2.04	3.63	2.84^{bc}	4.99	5.68	5.34^{d}	9.04^{c}
NO Packing	5.65	5.97	5.81^{c}	-	-		3.51	6.85	5.18^{d}	-	-		4.33^{d}
Mean	1.23^{a}	2.32^{b}		2.70^{a}	3.07^{b}		2.08^{a}	4.02^{b}		4.67^{a}	5.36^{b}		
	S.Em±		CD at 5%	S.Em±		CD at 5%	S.Em±		CD at 5%	S.Em±		CD at 5%	CD at 5%
Days (D)	0.22		0.65	0.14		0.43	0.23		0.66	0.03		0.10	
Treatments(T)	0.14		0.41	0.10		0.30	0.14		0.43	0.02		0.07	0.82
D x T	0.31		NS	0.20		NS	0.32		NS	0.05		NS	

Figures with same alphabets did not differ significantly; NS–Not significant. (-) indicates spoilage of aril on particular day.

(PP – Polypropylene & LDPE – Low density polyethylene)

Table 2: Effect of packaging material on Hunter color L* and a* of pomegranate arils cv. Bhagwa

Treatments	Storage period (days)													
	Hunter color L*							Hunter color a*						
	0	3	6	Mean	9	12	Mean	0	3	6	Mean	9	12	Mean
PP 80 gauge	21.96	21.76	21.58	21.77^{a}	21.13	21.07	21.10^{a}	17.28	17.24	17.19	17.24^{a}	16.84	16.77	16.81^{a}
PP 150 gauge	21.96	21.68	21.50	21.71^{ab}	21.05	20.99	21.02^{a}	17.28	17.17	17.12	17.19^{ab}	16.77	16.70	16.73^{b}
LDPE 100 gauge	21.96	21.52	21.34	21.60^{abc}	20.89	20.83	20.86^{b}	17.28	17.09	17.04	17.14^{abc}	16.69	16.62	16.66^{c}
LDPE 150 gauge	21.96	21.43	21.25	21.55^{abc}	20.80	20.74	20.77^{c}	17.28	17.03	16.98	17.10^{abc}	16.63	16.56	16.60^{d}
NO Packing	21.96	20.94	19.84	20.91^{d}	-	-		17.28	16.87	16.54	16.90^{d}	-	-	
Mean	21.96^{a}	21.46^{b}	21.10^{b}		20.97^{a}	20.91^{a}		17.28^{a}	17.08^{b}	16.97^{c}		16.73^{a}	16.66^{b}	
	S.Em±		CD at 5%	S.Em±		CD at 5%		S.Em±		CD at 5%	S.Em±		CD at 5%	
Days (D)	0.20		0.58	0.02		0.08		0.06		0.16	0.02		0.05	
Treatments(T)	0.15		0.45	0.19		0.05		0.04		0.13	0.01		0.04	
D x T	0.34		NS	0.38		NS		0.10		NS	0.03		NS	

Figures with same alphabets did not differ significantly; NS–Not significant. (-) indicates spoilage of aril.

(PP – Polypropylene & LDPE – Low density polyethylene)

Table 3: Effect of packaging material on Hunter color b*and Total Soluble Solids (^{o}Brix) of pomegranate arils cv. Bhagwa

Treatments	Storage period (days)													
	Hunter color b*							Total Soluble Solids (^{o}Brix)						
	0	3	6	Mean	9	12	Mean	0	3	6	Mean	9	12	Mean
PP 80 gauge	5.42	5.39	5.25	5.35^{a}	5.19	5.14	5.17^{a}	15.93	15.84	15.75	15.84^{a}	15.63	15.56	15.60^{a}
PP 150 gauge	5.42	5.37	5.23	5.34^{ab}	5.17	5.12	5.15^{ab}	15.93	15.78	15.69	15.80^{ab}	15.57	15.50	15.53^{b}
LDPE 100 gauge	5.42	5.31	5.17	5.30^{abc}	5.11	5.06	5.09^{bc}	15.93	15.71	15.63	15.76^{abc}	15.51	15.44	15.48^{bc}
LDPE 150 gauge	5.42	5.28	5.14	5.28^{abc}	5.08	5.03	5.06^{c}	15.93	15.67	15.58	15.73^{abc}	15.46	15.39	15.45^{c}
NO Packing	5.42	5.15	5.01	5.19^{d}	-	-		15.93	15.48	15.28	15.56^{d}	-	-	
Mean	5.42^{a}	5.30^{b}	5.16^{c}		5.14^{a}	5.09^{b}		15.93^{a}	15.70^{b}	15.59^{b}		15.54^{a}	15.47^{d}	
	S.Em±		CD at 5%	S.Em±		CD at 5%		S.Em±		CD at 5%	S.Em±		CD at 5%	
Days (D)	0.03		0.08	0.02		0.06		0.06		0.16	0.02		0.06	
Treatments(T)	0.02		0.06	0.01		0.04		0.04		0.12	0.01		0.04	
D x T	0.05		NS	0.03		NS		0.10		NS	0.03		NS	

Figures with same alphabets did not differ significantly; NS–Not significant. (-) indicates spoilage of aril.

(PP – Polypropylene & LDPE – Low density polyethylene)

Table 4: Effect of packaging material on brix-acid ratio and total sugars (%) of pomegranate arils cv. Bhagwa

Treatments	Storage period (days)													
	Brix-Acid Ratio							Total sugars (%)						
	0	3	6	Mean	9	12	Mean	0	3	6	Mean	9	12	Mean
PP 80 gauge	47.78	49.50	50.81	49.36^{a}	53.90	55.57	54.73^{a}	8.42	8.36	8.21	8.33^{a}	8.06	7.91	7.99^{a}
PP 150 gauge	47.78	49.31	52.30	49.80^{ab}	55.61	57.41	56.51^{ab}	8.42	8.31	8.16	8.30^{ab}	8.01	7.86	7.94^{ab}
LDPE 100 gauge	47.78	50.68	55.82	51.43^{ab}	59.65	61.76	60.71^{c}	8.42	8.24	8.09	8.25^{abc}	7.94	7.79	7.87^{bc}
LDPE 150 gauge	47.78	52.23	62.32	54.11^{bc}	64.42	66.91	65.67^{d}	8.42	8.19	8.04	8.22a^{bcd}	7.89	7.74	7.82^{c}
NO Packing	47.78	55.29	66.44	56.50^{d}	-	-		8.42	8.11	7.83	8.12^{d}	-	-	
Mean	47.78^{a}	51.40^{b}	57.54^{c}		58.40^{a}	60.41^{b}		8.42^{a}	8.24^{b}	8.07^{c}		7.98^{a}	7.83^{b}	
	S.Em±		CD at 5%		S.Em±		CD at 5%	S.Em±		CD at 5%		S.Em±		CD at 5%
Days (D)	1.58		4.57		0.76		2.27	0.04		0.11		0.03		0.09
Treatments(T)	1.22		3.54		0.54		1.61	0.03		0.0		0.02		0.07
D x T	2.74		NS		1.07		NS	0.07		NS		0.04		NS

Figures with same alphabets did not differ significantly; NS–Not significant. (-) indicates spoilage of aril.

(PP – Polypropylene & LDPE – Low density polyethylene)

Table 5: Effect of packaging material on ascorbic acid (mg/100g) and organoleptic evaluation of pomegranate arils cv. Bhagwa

Treatments	Storage period (days)							
	Ascorbic acid (mg/100g)							Organoleptic evaluation
	0	3	6	Mean	9	12	Mean	0
PP 80 gauge	8.64	8.47	8.02	8.38^{a}	7.64	7.29	7.47^{a}	3.86^{a}
PP 150 gauge	8.64	8.36	7.91	8.30^{ab}	7.53	7.18	7.36^{ab}	3.83^{ab}
LDPE 100 gauge	8.64	8.23	7.78	8.22^{bc}	7.41	7.06	7.24^{bc}	3.72^{abc}
LDPE 150 gauge	8.64	8.13	7.68	8.15^{bcd}	7.29	6.94	7.12^{c}	3.68^{abc}
NO Packing	8.64	8.06	7.67	8.12^{cd}	-	-		3.03^{d}
Mean	8.64^{a}	8.25^{b}	7.81^{c}		7.47^{a}	7.12^{b}		
	S.Em±		CD at 5%		S.Em±		CD at 5%	CD at 5%
Days (D)	0.06		0.16		0.01		0.22	0.26
Treatments(T)	0.04		0.12		0.05		0.15	
D x T	0.10		NS		0.10		NS	

Figures with same alphabets did not differ significantly; NS–Not significant. (-) indicates spoilage of aril.

(PP – Polypropylene & LDPE – Low density polyethylene)

CONCLUSION

Arils packed in polypropylene with 80 guage recorded a shelf life of 12 days as well as superior in quality when stored at 5^{o}C.

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