Effect on shelf-life and quality of passion fruit with polyethylene packaging under specific temperature

Akath Singh*, Yadav DS, Patel RK, Mousumi Bhuyan

Division of Horticulture, ICAR Research Complex for NEH Region, Umiam-793 103, India
*Email:akath2005@yahoo.co.in

Full ripe fruits of purple passion fruit were packed in perforated and non-perforated high density polyethylene (HDPE 0.03 mm, 0.05 mm, 0.08 mm) and low density polypropylene (LDPP 0.025 mm) and stored at ambient (26.5°C, 65.7% RH) and 5°C. Fruits packed in perforated HDPE of 0.03 mm thickness showed a shelf-life of 28 days at 5°C as against 4 days for control. Quality and nutritional value of fruit were better preserved, but there was slight reduction in flavour and colour of juice. The quality parameters, total soluble solids, titratable acidity, sugars and ascorbic acid contents were at par with initial value even after 28 days of storage.

Keywords: Passion fruit, Polyethylene, Shelf-life, Fruit quality

Passion fruit (*Passiflora edulis* Sims) belongs to the family Passifloraceae, of which 'Purple' and 'Yellow' types are common. Purple fruits (*P. edulis* Sims) are grown in Meghalaya. The fruits are a good source of vitamin C and they find a ready market as fresh fruit and also when processed into juices. Fruits of passion fruit are very much prone to shriveling and drying because fruits are wet and having high moisture when picked.

To avoid shriveling and increase the shelf-life, proper packaging and storage condition should be of paramount importance. Adequate and proper packaging protects the fruit from physical (firmness), physiological (weight) and pathological (decay) deterioration (Zagory and Kader 1988). Out of various packaging materials, use of plastic film is very common for packaging of fruits.

Apart from appropriate selection of plastic film, thickness of plastic film is also of vital importance in creating modified microenvironment around the packed produce (Miller et al 1997). The present investigation was carried out to identify the suitable plastic film with appropriate thickness for passion fruit packaging to extend the shelf-life under specific temperature.

Materials and methods

The studies were conducted during the year 2004-05. Uniform and well ripe purple passion fruits were harvested and packed in perforated (6 perforation, 3 mm in diameter) and non-perforated polyethylene bags (15 x 30 cm) of different thickness viz., high density polyethylene (HDPE 0.03 mm, 0.05 mm, 0.08 mm) and low density polypropylene (LDPP 0.025 mm) and stored at ambient (26.5°C, 65.7 % RH) and at 5°C. Mouth of polyethylene bags was sealed to create microenvironment. Fruits in control were kept in open floor. Twenty fruits per treatment were used for recording observations. Observations were recorded at 10 days interval up to 30 days. The cumulative physiological loss in weight (PLW) of the fruit was determined with formula given by Srivastava and Tandon (1968), on the basis of initial weight of the fruit and how much loss in the weight occurred and were expressed in per cent.

The fruit from different samples were weighed and cut, and then juice was extracted from the pulp by squeezing and straining through muslin cloth, all under aseptic condition. The juice per cent was calculated on fresh weight basis. The juice obtained was weighed and then measured with measuring cylinder and the density of the juice was determined from the weight divided by volume of the juice and is expressed in g/cc. The total soluble solids (TSS) content was determined with Erma hand refractometer (0-32°Brix). The tritratable acidity, the sugar and ascorbic acid contents were determined as per AOAC (1980).

The data were subjected to statistical analysis as per the method of Gomez and Gomez (1984). Least significant difference at 5% level was used for finding the significant differences if any, among the treatment means.

Results and discussion

The PLW of fruits increased with increasing period of storage in all treatments (Fig 1). Plastic packaging and storage temperature were effective to check

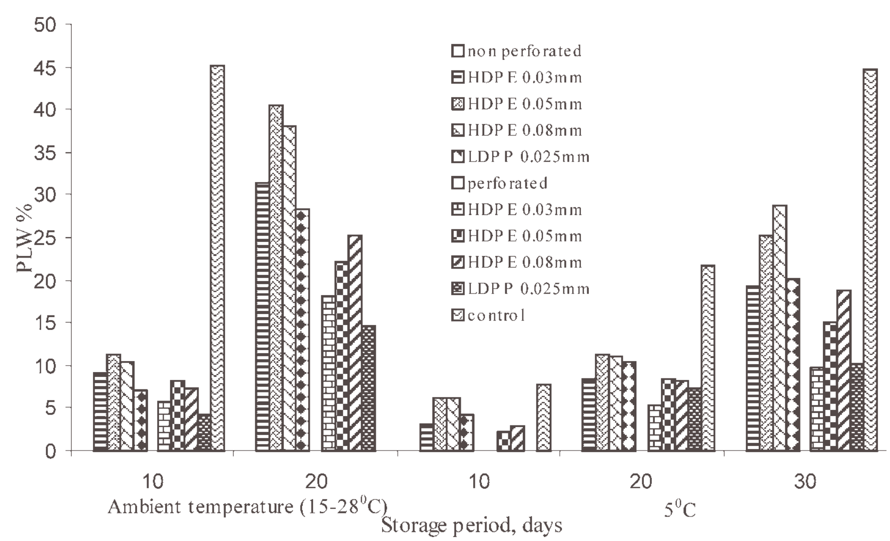

Fig. 1. Physiological weight loss (PLW) of passion fruit during storage

the PLW. Fruits packed in different polyethylene, stored at 5^{0}C temperature reduced the weight loss to a great extent in all the treatments as compared to those stored at ambient temperature. Packaging material and its thickness also has significant effect on reduction of weight loss. The minimum PLW (1.6-6.01%) was observed in fruits stored at 5^{0}C, packed in perforated HDPE (0.03 mm) bags and this was at par with perforated LDPP (0.025 mm) bags (1.7-6.5%). The maximum weight loss (32.5%) was recorded in control after 30 days of storage. At ambient temperature, perforated LDPP (0.025 mm) was most effective in minimizing the weight loss (2.8%-6.8%) up to 20 days. Minimum weight loss at low temperature might be due to the retardation of the process of transpiration and respiration. Storing fruits in plastic film or bag with micro perforation at lower temperature creates modified atmospheric conditions (Mattheis and Fellman 2000), which retard the rate of respiration, transpiration, ethylene evolution (Moleyar and Narasimham 1994) and subsequently resulting in better quality retention during storage (Joon Neeraj and Bhatia 2003)

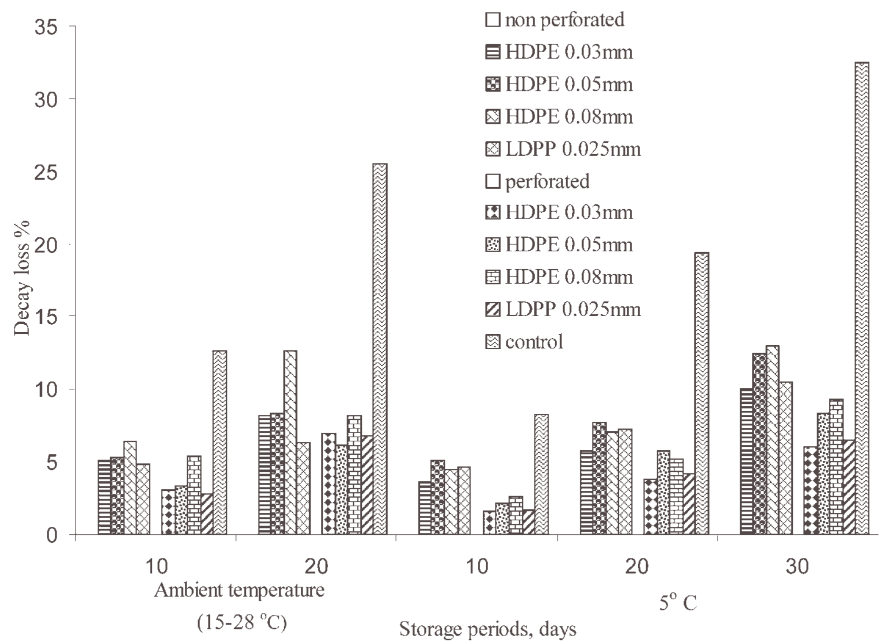

Fig. 2. Decay loss in passion fruit during storage

Decay loss increased with the increase in period of storage in all packaging treatments (Fig. 2). Decaying of fruits started from 4th day in control at ambient temperature and on 10th day it reached 45.2%. The decay loss was significantly lower at low temperature (5^{0}C) as compared to ambient temperature in all the packaging materials including control. After 10 days, there was no decay in the fruits packed in perforated HDPE (0.03

Table 1. Juice quantity, juice density, total soluble solids (TSS) and acidity in passion fruit packed and stored in different polyethylene at different temperatures

PF film	Juice, %					Juice density					TSS, °Brix					Acidity, %				
	AT		5^{0}C			AT		5^{0}C			AT		5^{0}C			AT		5^{0}C		
	10d	20d	10d	20d	30d	10d	20d	10d	20d	30d	10d	20d	10d	20d	30d	10d	20d	10d	20d	30d
Non perforated			32.8*					1.1*					14.2*					2.88*		
HDPE 0.03mm	30.2	26.0	30.7	25.9	21.0	1.06	1.00	1.03	1.00	0.96	12.2	10.6	13.1	13.1	11.9	1.79	1.94	2.82	3.13	2.67
HDPE 0.05mm	30.5	23.2	30.2	24.2	19.4	1.03	0.88	0.97	0.96	0.92	11.7	10.3	13.0	13.1	11.4	1.78	1.97	2.70	2.76	2.69
HDPE (0.08mm)	30.1	23.0	28.6	24.5	19.2	1.01	0.90	0.97	0.95	0.90	12.9	10.1	12.5	12.8	10.7	1.82	2.04	2.72	2.74	2.35
LDPP (0.025mm)	29.1	25.4	30.8	26.2	21.0	1.01	0.91	1.02	0.97	0.94	12.2	10.8	13.1	13.6	11.8	1.89	1.91	2.80	2.83	2.64
Perforated																				
HDPE (0.03mm)	30.9	27.2	32.8	27.6	25.8	1.10	1.02	1.05	1.00	1.00	12.3	11.1	14.1	14.9	12.4	1.98	2.04	3.00	3.23	2.78
HDPE (0.05mm)	30.3	25.2	31.5	26.4	21.0	1.05	0.90	1.03	1.00	0.98	12.1	10.9	14.0	13.7	11.4	1.94	2.07	2.90	2.92	2.69
HDPE (0.08mm)	30.3	24.9	30.1	26.0	21.0	1.03	0.97	1.05	0.98	0.96	12.6	10.8	14.0	13.1	11.3	1.70	2.07	2.76	2.84	2.55
LDPP (0.025mm)	30.3	28.4	31.2	28.9	24.4	1.06	0.97	1.06	1.01	0.98	13.2	11.3	14.1	14.5	12.8	1.89	2.04	2.90	2.93	2.74
Control	25.8	-	27.3	-	-	0.90	-	0.92	-	-	10.9	-	11.3	-	-	1.40	-	1.97	-	-
SEm ±	1.1	1.2	1.1	1.2	1.1	0.01	0.01	0.02	0.01	0.012	0.53	0.49	0.23	0.29	0.34	.013	.010	0.11	.014	0.11
CD (0.05)	2.3	2.4	2.3	2.4	2.4	0.05	0.04	0.05	NS	NS	1.58	1.04	0.69	0.88	1.02	.04	.032	.036	.041	0.36

* Initial values, AT : Ambient temp (15-28°C), d : days, (n = 3)

mm) and LDPP (0.025 mm) at low temperature. The minimum decay loss of 0.00-9.66%, followed by 0.00-10.11% upto 30 days of storage was recorded in fruits packed in perforated HDPE (0.03 mm) and LDPP (0.025 mm) at low temperature, respectively. The reduced decay loss may be attributed to limited permeability of gases (CO_2 and O_2) and water vapour which can interplay with physiological processes of fruit. The results are in accordance with reports of Ben-Yehoshua et al (1999). Higher decay loss at higher temperature may be due to rapid drop of respiration rate at higher temperature, due to destruction and death of the tissue (Adsule and Tandon 1983).

Juice content and juice density did not change significantly in all the treatments up to 10 days of storage (DOS) and afterwards showed a decreasing trend on 20 and 30 DOS under ambient and low temperature conditions (Table 1). The maximum juice content (32.8%) was recorded in non-perforated HDPE (0.03 mm) followed by LDPP (31.8%) at low temperature on 10^{th} day of storage. Even upto 30 DOS, there was not much deterioration in juice content in both the packaging materials (27.7%) at low temperature. Higher juice content in this treatment may be attributed to less water loss from fruits due to evaporation and transpiration, which was also reflected in decreased fruit loss in the same treatment. However, in contrast juice density was found higher (1.06 g/cc) at ambient temperature as compared to low temperature storage after 10 days, afterwards it decreased drastically at ambient temperature. After 30 DOS the maximum density was found in fruits packed in non perforated HDPE (0.03 mm) stored at 5^0C, which was significantly higher than any other treatments. TSS, acidity and total sugars increased during storage upto 20 days and there after a slight decline was noticed in case of low temperature storage, while in case of ambient temperature declining started even at 10^{th} day of storage. The maximum TSS (14.93^0Brix), acidity (3.23%) and total sugars (9.4%) were recorded in fruits packed in perforated HDPP (0.03 mm), followed by LDPP (0.025 mm) at low temperature on 20^{th} day of storage. However, at 30 DOS perforated LDPP (0.025 mm) showed maximum TSS (12.80^0Brix), whereas HDPE (0.03 mm) had maximum acidity (2.8%) and total sugars (8.3%), which were at par with initial value. This increase in TSS followed by slight decline might be due to conversion of reserved starch and other polysaccharides to soluble form of sugar during storage. Similarly, the pattern of conversion of total sugars may be due to metabolic transformation in soluble compounds and more conversion of organic acid into sugar. These findings are also in close conformity with the findings of Singh and Narayan (1999).

Ascorbic acid content of fruits decreased with increasing period of storage in all the treatments (Table 2). Fruits packed in polyethylene and stored at lower temperature maintained higher ascorbic acid content as compared to ambient temperature irrespective of treatments. Minimum ascorbic acid content was observed in control at ambient temperature whereas, maximum (24.7 mg/100 g pulp) was observed in fruits packed in perforated HDPE (0.03 mm) at lower temperature, which was at par with initial value (24.71 mg/100 g pulp). Perforated HDPE (0.03 mm) packing and storage at lower temperatures maintained higher ascorbic acid (20 mg/100 g pulp) content than any other treatments even after 30 DOS. Decrease in ascorbic acid might be due to enzymatic oxidation of L-ascorbic acid to dehydro ascorbic acid (Mapson (1970). Higher ascorbic acid at lower temperature packed in perforated HDPE (0.03 mm) up to 30 days could be attributed to low rate of physiological process accompanied by lower respiration rate and transpiration losses compared to other treatments (Miller and McDonald 1989).

It can be concluded that shelf-life of 'Purple' passion fruit can be extended upto 28 days with good colour, appearance and quality by storing at 5°C temperature followed by packing in perforated HDPE (0.03 mm) bags.

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Table 2. Reducing sugars, total sugars and ascorbic acid content in passion fruit packed and stored for 30 days in different polyethylene at different temperatures

PF film	Reducing sugar, %					Total sugars, %					Ascorbic acid, mg/100g pulp				
	AT		5^0C			AT		5^0C			AT		5^0C		
	10	20	10	20	30	10	20	10	20	30	10	20	10	20	30
Non-perforated films				3.4*				8.5*					24.7*		
HDPE (0.03mm)	3.2	3.1	3.3	3.3	3.6	8.2	7.9	8.1	8.4	8.1	21.6	18.2	22.4	21.8	18.1
HDPE (0.05mm)	3.3	2.8	3.2	3.4	3.5	7.7	7.3	8.1	8.3	8.1	21.5	18.0	21.3	19.9	18.3
HDPE (0.08mm)	3.2	2.5	3.3	3.4	3.5	7.3	7.1	8.0	8.4	8.1	20.1	17.2	21.0	19.1	16.8
LDPP (0.025mm)	3.2	3.2	3.4	3.4	3.5	8.1	7.4	8.2	8.4	8.2	23.6	20.0	21.6	21.2	19.1
Perforated films															
HDPE (0.03mm)	3.3	3.1	3.4	3.4	3.9	8.3	7.9	8.6	9.4	8.3	21.7	19.5	24.7	23.2	20.4
HDPE (0.05mm)	3.2	3.0	3.4	3.4	3.6	8.2	7.1	8.5	9.0	8.1	21.7	18.2	23.2	22.0	20.2
HDPE (0.08mm)	3.3	2.8	3.4	3.3	3.4	8.0	7.2	8.2	8.8	8.2	20.7	17.7	23.0	21.1	18.2
LDPP (0.025mm)	3.5	3.2	3.4	3.5	3.9	8.3	7.6	8.6	9.4	8.2	23.7	20.2	22.7	22.6	20.1
Control	3.1	-	3.3	-	-	7.9	-	8.1	-	-	19.20	-	19.60	-	-
SEm±	0.054	0.05	0.06	0.08	0.061	0.05	0.05	0.08	0.069	0.134	1.06	0.994	1.10	1.12	0.678
CD (0.05)(n = 3)	0.16	0.15	0.20	0.23	0.17	0.17	0.17	0.24	0.20	0.39	3.16	2.95	3.27	3.33	2.01

*Initial values ; AT : Ambient temp (15-28°C)

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Prof Dr HN Mishra

President, Association of Food Scientists & Technologists, India

Professor and Head, Post Harvest Technology Centre, IIT, Kharagpur, West Bengal.

Phone: Off: 91-3222-283130/282287/282288; Res: 283131

Fax: 91-3222-282288, 282244, 255303

E-mail: hnm@agfe.iitkgp.ernet.in; chairphtc@agfe.iitkgp.ernet.in

Dr H N Mishra, born in 1957, obtained his B Sc, M Sc (Food Technology) and Ph D degrees from the University of Gorakhpur (UP), GBPUA&T Pant Nagar (UT) and IIT Kharagpur (WB), respectively. He has over 25 years of professional experience in teaching and research. Before joining IIT Kharagpur in 1991, Dr Mishra served at G B Pant University of Agriculture & Technology, Pant Nagar. He is currently Head of the Post Harvest Technology Centre at Indian Institute of Technology, Kharagpur, India.

Recipient of Dr J S Pruthy award of AIFPA, New Delhi for new product / process development, Dr Mishra has more than 125 research papers and popular articles in refered journals of national and international repute and 2 Indian patents. He is on the board of referees of reputed journals and has guided more than 70 student research projects including 10 Ph D research projects and has handled sponsored research & industrial consultancy projects. Dr. Mishra has been instrumental for the establishment of an *Integrated Rural Food Processing & Training Centre* at IIT Kharagpur for providing on-line practical training to rural women, unemployed youths and entrepreneurs. He visited several countries including France, Switzerland, Taiwan and Thailand.

Life member of the Association of Food Scientists & Technologists (India), Dr. Mishra has served the Association as Secretary and Treasurer of the Kharagpur Chapter, Vice President (Chapters), and is currently its national President.

Dr. Baldev Raj

Hon.Secretary, Association of Food Scientists & Technologists, India

Scientist, Food Packaging Technology, CFTRI, Mysore-570020

Phone: Off: 91-0821-2514552; Res: 91-0821-2542341; Mobile: 9986394715

Email: baldev1564@yahoo.com

Dr Baldev Raj, born in 1953, obtained his M.Sc (Organic Chemistry) from Kanpur University and Ph D from Mysore University. He started his career in pharmaceutical company as an analytical chemist. He joined CFTRI in 1978 and continues till date in Food Packaging Technology. He has expertise in designing unit functional packages of required shelf life for food products and safety evaluation of plastics coming in food contact. He has also drafted a BIS specification (IS 9845-1998) on “Overall/global migration of plastic additives in food stimulating solvents”.

He has published more than 40 research papers in National & International Journals and presented more than 25 papers in National/International seminars/symposia. He also developed a simple methodology for detection/estimation of migrating colours from coloured plastics used in food packaging. He is involved in industrial consultancies on safe use of plastics in food packaging.

As a life member of Association of Food Scientists & Technologists India, Dr Baldev Raj served the Association in various capacities as Hon Treasurer, Vice President and currently serves as Honorary Secretary.

In the Year 2007, the Golden Jubilee year of AFST(I), Dr Baldev Raj plans to strengthen some of its activities through all the chapters and initiate new activities like awareness programme on food, health and nutrition for children and mothers, women empowerment by entrepreneurship. Bringing AFST (I) activities on-line, including journal publishing and member’s access to the web will be his priority. AFST (I) intends to provide a common platform to academia, food industries, regulatory authorities and students with an aim to promote food sector. Steps have been initiated in these directions. He would like to dedicate resources of AFST (I) in getting recognition and voice at Government level in policy making. Association should become one point solution database for matters relating to food processing.