Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(4): 1983-1985
Received: 03-05-2017
Accepted: 04-06-2017

Response of polyethylene packaging on postharvest physiology of tomato

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Abstract
Present investigation entitled "Response of Polyethylene Packaging on Postharvest Physiology and Quality of Tomato" was carried out in the Department of Horticulture, Rajasthan College of Agriculture, Udaipur. Experiment was conducted during 22th Feb.–13th March, 2017. The fully matured but unripe fruit at colour turning stage were harvested and packed in low density polyethylene bag (20, 40, 60, 80 µ thicknesses) and newspaper (control). Experiment consists of 4 treatment were evaluated under factorial completely randomized design with three replications. The stored fruit examined at 5 days interval up to 20 days for physiological, biochemical, color, quality and sensory changes. The result exhibited the significant effect of polyethylene packaging on all physiological, of tomato fruit during storage. Among the Polyethylene Packaging, treatment P_4 (60 µ LDPE) proved best with minimum PLW (2.05%), ripening index (9.24%) and maximum respiration rate (8.01 ml CO_2 kg-1 h^{-1}), ethylene evaluation rate (7.85 µl C_2H_4 Kg^{-1} h^{-1}), firmness (42.65 N) was observed in treatment P_4 (60 µ LDPE) on 20th day.

Keywords: polyethylene packaging, Quality of Tomato, biochemical

Introduction
Tomato (*Lycopersicon esculentum* L.; Solanaceae) is one of the most popular vegetables in the world. In India, area covered under tomato is 8.79 Lakh ha with the production of 21.2 MT. Major tomato producing states are Andhra Pradesh, Karnataka, Madhya Pradesh, Odisha, West Bengal, Gujarat and Bihar. In Rajasthan, tomato is grown over 15,510 ha with a production of 7,3570 MT and productivity of 4,757 kg ha^{-1} (Anonymous, 2014) [4].
Packaging of fruits is one of the most commonly used postharvest practice that puts them into unitized volumes which are easy to handle while also protecting them from hazards of transportation and storage (Burdon 2001) [5]. Packaging was used primarily to prevent food contamination with unwanted objects. However, consumer demand for desirable food quality has led to a surge in packaging innovation. For instance, Cha and Chinnan (2004) [6] noted the increasing use of plastic films in food packaging, which combines the biophysical properties of plastic films with biopolymer coatings to maintain the nutritional and sensory quality of the product. Using plastic as packaging material also offers marketing advantage. Unlike metal and aluminium packaging materials, harnessing the transparency of film packaging for product visibility is now widely practiced, enabling consumers to assess the visual quality of the product prior to purchase. However, the variable permeability of plastics to light, gases and vapours is a major drawback.

Materials and Methods
The fruits were harvested at colour turning stage (initial pink colour development stage) by hand from Horticulture farm, RCA, Udaipur and brought to the fruit and vegetable processing unit within an hour. The fruit were packed and sealed by electric sealing machine in 20, 40, 60, and 80 µ thicknesses low density plastic bags and fruit wrapped in newspaper served as control. Approximately of 250 g fruits used per treatment. The gas permeability was measured using OTR (OTR model OPT-500, PBI Dansensor, Denmark).

Table 1: Details of the treatments used

S.No.	Packaging material	Notation
1	Control (without packaging)	P_1
2	Low Density Polyethylene Bag (LDPE) (20µ thickness)	P_2
3	Low Density Polyethylene Bag (LDPE) (40µ thickness)	P_3
4	Low Density Polyethylene Bag (LDPE) (60µ thickness)	P_4
5	Low Density Polyethylene Bag (LDPE) (80µ thickness)	P_5

Table 2: Method and Observations recorded for physiological Characteristics

S. No.	Observation	Unit of measurement	Method
1	PLW	Percent	By measuring initial and final weight
2	Firmness	Firmness	Texture Analyzer
3	Respiration rate	ml Co2 kg 1 h^{-1}	Head Space Gas Analyzer
4	Ethylene production	µl C_2H_4 kg $^{-1}$ h^{-1}	Ethylene Analyzer
5	Ripening index	Per cent	Va´squez-Caicedo *et al*. (2005)

Results and discussion

Effect of packaging material was observed significantly best on all physiological characters of tomato during storage and the minimum PLW (2.05%), ripening index (9.24%) and maximum respiration rate (8.01 ml CO_2 kg-1 h^{-1}), ethylene evaluation rate (7.85 µl C_2H_4 Kg^{-1} h^{-1}), firmness (42.65 N) was observed in treatment P_4 (60 µ LDPE) on 20th day.

The result showed that the use of storage packaging material contributed to the significant reduction of fruit weight loss, respiration rate, ethylene evaluation rate and ripening index during storage. Climacteric rise in the rates of respiration or ethylene production was observed in harvested tomato fruit during storage, which suggests that tomato is a climacteric fruit. Similar results on fruit weight loss have been obtained in several fruits, such as loquat (Amoros *et al*., 2008) [2], table grape (Martinez *et al*., 2003) [10], nectarines (Retamales *et al*., 2000) [12], peaches (Akbudak and Eris, 2004) [1], and cherries (Kappel *et al*., 2002) [7]. Among others reduction of respiration rate, a delay on climacteric respiration peak has been reported in tropical fruits (Yahia, 2006) [15]. Increase in ripening index might be due to decrease in acidity and sometimes also due to increase in TSS, similar finding also suggested by Majidi *et al*., (2011) [9] in tomato. PG activity in chitosan coated Jujube fruit reached a peak level 3.6-fold higher than initial activity level after 7 days storage at room temperature (Qiuping and Wenshui, 2007) [11] in Indian jujube. Ripening of the fruit increased the pectin methyl esterase (PME) activity and Fruit firmness decrease continuously during storage, with a higher rate of decline in Chinese bayberry stored at higher temperature (Yang *et al*., 2010) [16]. Ethylene evolution rate increased from green mature to fully ripe stage, then again declined in overripe fruit (Andrews, 1995 and Leliver *et al*., 1997 in tomato) [3] [8].

Table: 3: Effect of packaging material on PLW, firmness and respiration rate.

Treatment	PLW%				Firmness				Respiration rate			
	5day	10day	15day	20day	5day	10day	15day	20day	5day	10day	15day	20day
P_1	1.45	1.62	2.10	2.51	44.05	40.36	38.79	30.11	12.19	12.73	9.05	6.39
P_2	1.29	1.40	1.85	2.36	46.16	42.31	41.87	38.84	9.95	11.04	8.81	6.81
P_3	1.23	1.37	1.31	2.31	47.14	43.44	43.41	39.65	8.89	10.32	9.15	7.39
P_4	0.76	0.93	1.12	2.05	49.20	46.48	46.08	42.65	7.68	9.56	9.55	8.01
P_5	1.08	1.21	1.30	2.21	47.80	44.71	44.07	40.29	8.08	10.30	8.10	6.64
CD (P=0.05)	0.020	0.020	0.021	0.033	0.62	0.58	0.52	0.47	0.12	0.15	0.25	0.12

Table: 4. Effect of packaging material on Ethylene production and ripening index.

Treatment	Ethylene production				Ripening index			
	5day	10day	15day	20day	5day	10day	15day	20day
P_1	8.09	10.67	8.82	6.23	9.04	10.49	10.46	8.00
P_2	6.75	9.28	8.58	6.65	8.14	9.02	9.78	8.39
P_3	6.09	8.69	8.92	7.23	7.74	8.67	9.07	8.36
P_4	5.07	8.02	9.32	7.85	7.30	7.77	8.60	9.24
P_5	5.48	8.74	7.87	6.49	7.55	8.35	9.00	8.47
CD (P=0.05)	0.14	0.13	0.12	0.10	0.11	0.12	0.13	0.12

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