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Effect of Plastic Films on Shelf-life of Okra (*Abelmoschus esculentus* L.)

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ABSTRACT

Okra fruits were prepacked in polyethylene 200 gauge (P_1), polyethylene 150 gauge (P_2) and polypropylene 100 gauge (PP) with 0% (V_0), 1% (V_1) and 2% (V_2) perforation or ventilation and then shelf-life was studied in ambient condition (25.4°C to 33.3°C temperature and relative humidity of 78 to 80%). It was found that P_1 (polyethylene, 200 gauge) was superior over P_2 (polyethylene, 150 gauge) and PP (Polypropylene, 100 gauge) for the different post harvest characters i.e. physiological loss in weight (PLW), shrinkage, blackening and sensory quality during storage at ambient condition. Non-perforated packages (V_0) in general maintained the quality for longer period and increased shelf-life compared to perforated packages (V_1 and V_2). The effect of P_1V_0 treatment (Polyethylene 200 gauge × 0% perforation) was best because of low PLW, shrinkage, blackening and maintained better sensory score upto 12 days of storage. This was followed by P_2V_0 (Polyethylene 150 gauge × 0% perforation) and PPV_0 (Polypropylene 100 gauge × 0% perforation) treatment.

Key words : Okra, Perforation, Polyethylene, Polypropylene, Shelf-life.

. India is the highest producer of okra in the world with an annual production of 3.3 million tonnes (Anon, 2004). Inspite of high production, in a tropical country like India, it is difficult to maintain the quality and storability of vegetables. Poor pre-packaging and poor handling methods and marketing system causes a high post harvest loss of commodity. Although okra crop is very much popular in India, the shelf life of this vegetable is limited to only few days due to high moisture loss, shrinkage, toughening, blackening and spoilage. Packaging increases the shelf life by creating a modified atmosphere with an increase in the concentration of CO_2 in the package. So, the present investigation was undertaken with the objective to exten the post harvest shelf-life of okra and reduce post harvest losses by using convenient and affordable consumer size packages and also to find out the physiological changes of okra under different prepackage condition.

MATERIAL AND METHODS

Freshly harvested, tender green okra pods, free from blemishes, adhering sand or soil or foreign matters were used for the experiment. The pods were washed, dried and subjected to packaging in different polythene bags/packages i.e. Polyethylene 200 gauge (P_1) (20.6 X 24.9 cm^2), polyethylene 150 gauge (P_2) (25 X 17 cm^2) and polypropylene 100 gauge (PP) (22.5 X 20.5 cm^2) with different percentage of perforation (vent) i.e. 0% perforations or without perforation (V_0), 1% perforation (V_1) and 2% perforation (V_2). Area of one perforation was 0.125 cm^2 and number of fruits per packet was 8. The different treatment combinations are 0% perforation and polyethylene 200 gauge (P_1V_0), 1% perforation and polyethylene 200 gauge (P_1V_1), 2% perforation and polyethylene 200 gauge (P_1V_2), 0% perforation and polyethylene 150 gauge (P_2V_0), 1% perforation and polyethylene 150 gauge (P_2V_1), 2% perforation and polyethylene 150 gauge (P_2V_2), 0% perforation and polypropylene 100 gauge (PPV_0), 1% perforation and polypropylene 100 gauge (PPV_1) and 2% perforation and polypropylene 100 gauge (PPV_2). The fruits in different polythene packages were stored in cool, dry place on racks at room temperature in the laboratory of the department of Post Harvest Technology of Horticultural crops during April-June 2006. The maximum and minimum temperature during storage period varied from 30.6°C to 33.3°C and 22°C to 25.4°C respectively and relative humidity from 78% to 80%. Observations were recorded on physiological loss in weight (PLW), blackening and sensory quality. For determining the PLW, fruits were numbered and packed in different polyethylene packages. The packed fruits were weighed on the day of observation and PLW was expressed as percentage of the original weight of fruits. Blackening was estimated visually and sensory quality was evaluated on the basis of general appearance and acceptability depending upon the condition of the pods in 1-5 scale (Kalra *et al*., 1988). The experiment was laid out in 2 factor factorial completely randomized design.

RESULTS AND DISCUSSION

Physiological loss in weight (PLW%)

Table 1 showed that PLW of polyethylene packages and perforation treatment were significant (5%) at different days interval during storage. On the 2nd day of storage PLW was least 2.13% in P_1 (Polyethylene 200 gauge) followed by 3.20% in P_2 (polyethylene 150 gauge) and highest in 4.58% PP (polypropylene) 100 gauge). PLW of P_1, P_2 and PP increases gradually throughout the storage period upto 12th day. However, PLW of P_1 remained significantly lower than P_2 and PP.

On the 2nd day PLW was least 0.52% with V_0 (0% perforation) and it was followed by 3.18% in V_1 (1% perforation) and 6.21% in V_2 (2% perforation). On the 12th day PLW of V_0 was low (3.02%) compared to V_1 (24.38%) and V_2 (41.84%). In general, PLW increased with increase in perforation percentage.

The interaction effect between polyethylene packages and perforation percentage on PLW was significant (5%) at different days of storage (Table 2). On the 2nd day, PLW of P_1V_0 (polyethylene 200 gauge ´ 0% perforation) was the lowest 0.47% followed by 0.56% P_2V_0 (polyethylene 150 gauge ´ 0% perforation) and 0.59% PPV_0 (polypropylene 100 gauge ´ 0% perforation). Although PLW of P_1V_0 was lower than P_2V_0 and PPV_o but there is no significant difference between P_2V_0 and PPV_0. The PLW of P_1V_0 remained very low throughout the storage period upto 12th day. The PLW of P_1V_0 increased from 0.47% to 2.13% on the 12th day. Similarly, PLW of P_2V_0 increased from 0.56% to 3.09% from 2nd day upto 12th day and PLW of PPV_0 from 0.59% to 3.85%. It was observed that irrespective of the different polyethylene packages the PLW increased with increase in the perforation percentage (0% to 2%).

Blackening

The blackening percentage of okra pods as influenced by different polyethylene packages and perforation percentage were significant (5%) at different days interval during storage (Table 3). The blackening (%) of okra pods stored in different polyethylene packages increases gradually during storage. On the 12th day, blackening (%) was least 2.51% in P_1 and highest in PP 3.36%.

The effect of perforation on blackening was significantly low in V_0 (0% perforation) as compared to V_1 (1% perforation) and V_2 (2% perforation) on different days of storage (Table 3). On the 12th day blackening (%) was significantly lower in V_0 (2.01%) than in V_1 (3.14%) and V_2 (3.56%) respectively. In general blackening (%) gradually increased with an increase in storage period and perforation percentage.

Table 4 represents the interaction effect between polythene packages and perforation on blackening (%) of okra. Blackening (%) was least 0.11% in P_1V_0 (polyethylene 200 gauge ´ 0% perforation) and 0.32% in P_2V_0 (Polyethylene 150 gauge ´ 0% perforation) and 0.50% in PPV_0 (polypropylene 100 gauge ´ 0% perforation). On the 12th day, blackening was minimum 1.54% in P_1V_0 and maximum in PPV_2 (4.00%). Throughout the storage period, It has been observed that blackening (%) increased with the increase in perforation percentage irrespective of the different polyethylene packages used.

Sensory evaluation

Sensory evaluation was evaluated on the basis of general appearance and acceptability on the condition of okra pods (Table 5). On the 2nd day of storage, sensory score was high (1) in P_1V_0, P_2V_o and PPV_0 whereas it was (2) in other treatments i.e. P_1V_1, P_1V_2, P_2V_1, P_2V_2, PPV_1 and PPV_2. It was observed that the sensory score of P_1V_0 even in the 4th day was (1) whereas the other treatments was (2). The score went down as the storage days increased. On the 12th day, the treatments P_1V_0, P_2V_0 and PPV_0 still recorded fairly good sensory score (3).

The results indicated that P_1 (polyethylene, 200 gauge) was superior over P_2 (polyethylene, 150 gauge) and PP (polypropylene, 100 gauge) for the different post harvest characters i.e., PLW, shrinkage, blackening and sensory quality during storage at ambient condition. Non-perforated packages (V_0) in general maintained the quality for longer period compared to perforated packages (V_1 and V_2). The effect of P_1V_0 treatment (polyethylene 200 gauge ´ 0% perforation) was best because of lowest PLW, shrinkage, blackening and good sensory score up to 12 days of storage followed by P_2V_0 and PPV_0 treatment. The non-perforated polyethylene packages has also been reported to be effective in reducing PLW and blackening and

Table 1. Effect of polythene packages and perforation on PLW (%) of okra fruits during storage under ambient condition

Treatment	Storage period (days)					
	2	4	6	8	10	12
P_1	2.13	4.81	7.52	10.58	13.02	15.59
P_2	3.20	6.83	10.77	15.08	19.18	22.88
PP	4.58	10.18	15.47	20.97	22.91	30.76
V_0	0.52	1.05	1.62	2.13	2.57	3.02
V_1	3.18	7.31	11.38	16.16	20.44	24.38
V_2	6.21	13.46	20.77	28.34	32.11	41.84
SEm (±)	0.225	0.526	0.845	0.847	1.995	1.163
CD (5%)	0.669	1.564	2.513	2.517	5.929	3.456

P_1 (polyethylene 200 gauge), P_2 (polyethylene 150 gauge), pp (polypropylene 100 gauge), V_0 (0% perforation), V_1 (1% perforation), V_2 (2% peroration).

Table 2. Interaction effect between polythene packages and perforation on PLW (%) of okra fruits during storage under ambient condition

Treatment	Storage period (days)					
	2	4	6	8	10	12
P_1V_0	0.47	0.79	1.01	1.36	1.63	2.13
P_1V_1	2.04	5.32	8.16	12.27	14.68	17.81
P_1V_2	3.87	8.32	13.39	18.09	22.76	26.83
P_2V_0	0.56	1.03	1.70	2.22	2.69	3.09
P_2V_1	2.85	6.50	10.48	14.66	19.40	22.50
P_2V_2	6.21	12.96	20.14	28.36	35.09	43.06
PPV_0	0.59	1.34	2.14	2.80	3.40	3.85
PPV_1	4.64	10.10	15.50	21.55	27.24	32.83
PPV_2	8.57	19.09	28.77	38.57	48.09	55.62
SEm (±)	0.390	0.911	1.465	1.467	2.450	2.014
CD (5%)	1.160	2.270	4.353	4.360	4.502	5.986

P_1 (polyethylene 200 gauge), P_2 (polyethylene 150 gauge), pp (polypropylene 100 gauge), V_0 (0% perforation), V_1 (1% perforation), V_2 (2% peroration).

Table 3. Effect of polythene packages and perforation on blackening (%) of okra fruits during storage under ambient condition

Treatment	Storage period (days)					
	2	4	6	8	10	12
P_1	0.61	0.99	1.31	1.57	2.01	2.51
P_2	0.72	1.25	1.45	2.01	2.55	2.84
PP	1.16	1.77	2.0	2.29	2.87	3.36
V_0	0.31	0.72	0.91	1.35	1.82	2.01
V_1	0.73	1.24	1.63	1.92	2.58	3.14
V_2	1.46	2.06	2.26	2.60	3.03	3.56
SEm (±)	0.007	0.009	0.009	0.016	0.016	0.007
CD (5%)	0.014	0.019	0.020	0.034	0.033	0.014

P_1 (polyethylene 200 gauge), P_2 (polyethylene 150 gauge), pp (polypropylene 100 gauge), V_0 (0% perforation), V_1 (1% perforation), V_2 (2% peroration).

Table 4. Interaction effect between polythene packages and perforation on blackening (%) of okra fruits during storage under ambient condition

Treatment	Storage period (days)					
	2	4	6	8	10	12
P_1V_0	0.11	0.40	0.70	1.00	1.36	1.54
P_1V_1	0.50	0.90	1.26	1.62	2.10	2.82
P_1V_2	1.24	1.69	1.98	2.10	2.58	3.18
P_2V_0	0.32	0.78	0.82	1.42	1.99	2.00
P_2V_1	0.70	1.00	1.53	1.99	2.69	3.02
P_2V_2	1.15	1.99	2.00	2.62	2.99	3.51
PPV_0	0.50	1.00	1.21	1.64	2.11	2.51
PPV_1	1.00	1.83	2.11	2.15	2.97	3.58
PPV_2	2.00	2.50	2.82	3.10	3.53	4.00
SEm (±)	0.012	0.016	0.016	0.028	0.028	0.012
CD (5%)	0.025	0.033	0.035	0.058	0.058	0.25

P_1 (polyethylene 200 gauge), P_2 (polyethylene 150 gauge), pp (polypropylene 100 gauge), V_0 (0% perforation), V_1 (1% perforation), V_2 (2% peroration).

Table 5. Effect of polythene packages and perforation on sensory evaluation of okra fruits during storage under ambient condition

Treatment	Storage period (days)					
	2	4	6	8	10	12
P_1V_0	1	1	2	2	3	3
P_1V_1	2	2	2	3	3	4
P_1V_2	2	2	2	3	3	4
P_2V_0	1	2	2	3	3	3
P_2V_1	2	2	2	3	3	4
P_2V_2	2	2	2	3	3	4
PPV_0	1	2	2	3	3	3
PPV_1	2	2	2	3	3	4
PPV_2	2	2	3	3	4	5

1 = Excellent, 2 = Good, 3 = Fairly good, 4 = Acceptable, 5 = Unacceptable.

P_1 (polyethylene 200 gauge), P_2 (polyethylene 150 gauge), pp (polypropylene 100 gauge),
V_0 (0% perforation), V_1 (1% perforation), V_2 (2% peroration).

increase acceptability for longer period by Siambhi and Randhawa (1983) and Kalra *et al*. (1988) which is also in conformity with the present findings. The okra fruits maintained an acceptable appearance at ambient condition in 400 gauge polyethylene bags for 8-10 days either with or without perforation (Anandaswamy *et al*., 1963; Singh *et al*., 1980; Ghai, 2002). Further polyethylene package of okra created a modified atmosphere and reduced the decay, softening and loss of solids and increase shelf-life (Sandha, 2002).

Thus it can be concluded that prepackaging of okra in 200 gauge polyethylene without perforation (P_1V_0) was most effective in retaining the market quality and increasing shelf-life up to 12 days in ambient condition.

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