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EFFECT OF LOW DENSITY POLYETHYLENE (LDPE) PACKAGING AND CHEMICALS ON AMBIENT STORAGE OF KINNOW

S.K. Jawandha, P.S. Tiwan and J.S. Randhawa

Department of Horticulture, Punjab Agricultural University, Ludhiana–14004 (Punjab), India

ABSTACT: Study was planned and freshly harvested kinnow fruits were washed and treated with Sodium carbonate (2 & 3 %), Boric acid (2 & 3%) and packed in low density polyethylene (LDPE) bags with perforation and without perforation before packaging in CFB boxes. Fruits were analysed for various physico-chemical characteristics after 15, 30,45 and 60 days of storage. Results revealed that minimum rotting and maximum palatability rating and acidity were registered in Boric acid @ 3 % + LDPE packaging with perforation during the entire storage period. TSS was found maximum in control fruits, whereas minimum physiological loss in weight was recorded in Boric acid @ 3 % +LDPE packaging without perforation. It can be concluded that the storage rots can be reduced by treating the kinnow fruits with Boric acid @ 3 % +LDPE packaging with perforation and fruit health can be maintained up to 45 days at ambient conditions without much deterioration in quality.

Keywords : *Kinnow, storage, boric acid, sodium carbonate, packaging.*

Citrus is one of the most important sub-tropical fruits in the world. Kinnow mandarin a hybrid of King and Willow leaf occupies the prime position amongst the citrus fruits grown in India. It is precocious, prolific bearer and has excellent fruit quality with high juice content. The optimum period of Kinnow maturity is from mid January to mid February. There is often a glut like situation in the market at its peak harvest time. This results in low returns to the growers. There is a need to enhance the shelf-life of Kinnow fruit for its extended marketing during April and May. Earlier, attempts have been made to keep the surplus fruit in cold storage for use during summer months. Most of the cold storages operate at near zero temperature, the kinnow fruit may get pathological rotting during storage. The incidence of microbial fruit rots of fungal and bacterial origin is a common problem in storage, which markedly deteriorate the keeping quality of fruits. The species of *Penicillium, Alternaria, Aspergillus, Botrydi-ploidia* and *Geotrichum* etc. are particularly responsible for causing heavy losses (Kaur, 10). The main factor governing storage life of citrus fruits are weight loss and decay. Individual seal packaging could significantly reduce weight loss and shrivelling, but the potential decay problem of sealed fruits need to be solved through perforation/ chemicals. This paper reports the results of packaging and chemicals on storage rots and quality of Kinnow mandarin at ambient storage.

MATERIALS AND METHODS

The kinnow fruits harvested in January were constituted the study material. The studies were confined to ambient storage. Freshly harvested kinnow fruits were disinfected by washing in chlorinated water (100 ppm) and dried in air. After drying, following pre-storage treatments were given.

T_1= Sodium carbonate (2%) + LDPE packaging with 5 pin holes

T_2 = Sodium carbonate (3%) + LDPE packaging with 5 pin holes

T_3 = Boric acid 2% + LDPE packaging with 5 pin holes

T_4 = Boric acid 3% + LDPE packaging with 5 pin holes

T_5= Sodium carbonate (2%) + LDPE packaging

T_6=Sodium carbonate (3%) + LDPE packaging

T_7=Boric acid 2% + LDPE packaging

T_8=Boric acid 3% + LDPE packaging

T_9=LDPE packaging with 5 pin holes

T_{10}=LDPE packaging without holes

T_{11}=Control (unpacked, untreated)

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Fruits were dipped for five minutes in the treatment solutions, then air dried under shade and individually seal-packed in perforated and unperforated LDPE bags. The bags were sealed with an electric sealer and filled in corrugated fibre board (CFB) boxes and stored in well ventilated room at ambient temperature and relative humidity. For various physico-chemical characters the fruits were analysed after 30, 45 and 60 days at ambient storage. The physiological loss in weight was recorded by noticing the intial weight and final weight in each replication at each storage interval. The cumulative loss in weight was calculated on fresh fruit bases. Spoilage percentage of fruits was also calculated by counting the rotten fruits and total fruits in each treatment replication on each storage interval. The fruits were evaluated by a five member panel on a score card (maximum 10 points) based on physical appearance, taste and flavour. The fruits were rated excellent (8-10), very good (7 -8), good (6-7), fair (5-6) and poor (below 5). The total soluble solids were determined with the help of hand refrectometer. One or two drops of juice were placed on the refrectometer plate and the per cent TSS on the scale were recorded. The reading was calibrated against a standard temperature of 20°C (AOAC, 1).Whereas, acidity was determined by titrating 2 ml of juice against 0.1 N NaOH using phenolphthalein as the indicator. The data obtained were subjected to statistical analysis by following CRD method.

RESULTS AND DISCUSSION

Mean minimum rotting was noticed in boric acid 3.0 %+LDPE packaging with 5 pin holes (Table 1). It might be due to disinfectant, bactericide and cell wall strengthening action of boric acid. The spoilage in seal packed fruits without perforation was more as compared to sealed fruits with perforation. It may be due to accumulation of more humidity in the vicinity of fruits which may aggravates spoilage due to microbial attack. Data also showed that as the storage period increased , the spoilage increased .It might be due to the weakening of the defense system against fungal attack .Similar observations on spoilage over longer period of storage have been reported by Iidis and Travert (8).

Highest palatability rating was recorded in boric acid 3.0 %+LDPE packaging with 5 pin holes during the entire storage period (Table 2). Fruits were in acceptable quality up to 45 day of storage. The palatability rating decreased with increase in storage period. Individually LDPE sealed fruits without perforation developed off-flavor and low palatability rating. It might be due to anaerobic respiration in LDPE sealed fruits without perforation which leads to off flavor.

Mean minimum physiological loss in weight (PLW) was recorded in sodium carbonate 3.0 %+LDPE packaging (Table 3). Reduction in PLW in sealed fruits was due to retardation in evaporation and respiration processes. The chemical application coupled with LDPE sealing was effective in reducing weight loss. It might due to blocking of stomatal apertures and lenticels, thereby reducing the rate of respiration and transpiration. A similar reduction in the physiological loss in weight (PLW) of individually seal packed grape fruit, Shamouti oranges and lemons with HDPE film was probably because of saturated humidity and no air circulation inside the seal package (Ben-Yehousha *et al.*, 2, 3 and 4).

An increase in TSS was recorded with advancement of storage period irrespective of the treatments (Table 4).The increase in total soluble solids with prolongation of storage period may probably be due to increased hydrolysis of polysaccharides and concentration of juice due to dehydration. At the end of storage maximum TSS was recorded in control fruits. It may be due to maximum water loss in these fruits. Similar results were reported by Dhatt *et al.* (5) on kinnow.

At the end of storage maximum acidity was recorded in boric acid 3.0 %+LDPE packaging with 5 pin holes and minimum was recorded in control fruits (Table 5). The decrease in acidity with the storage period might be due to utilization of organic

Table 1: Effect of chemicals and packaging on rotting of Kinnow mandarin during ambient storage.

Treatments	Rotting (%)				
	After 15 Days	After 30 Days	After 45 Days	After 60 Days	Mean
Sodium carbonate(2%) +LDPE with holes	-	5.03	10.00	18.00	8.26
Sodium carbonate(3%) +LDPE with holes	-	7.33	10.00	14.00	7.83
Boric acid (2%)LDPE with holes	1.67	7.53	11.67	15.50	9.09
Boric acid (3%)+LDPE with holes	-	-	5.50	10.5	4.00
Sodium carbonate 2%)+LDPE	20	13.33	18.33	25.00	19.17
Sodium carbonate (3%) +LDPE	5.00	8.33	12.00	18.63	10.99
Boric acid (2%) +LDPE	5.0	12.53	15.00	21.67	13.55
Boric acid (3%) +LDPE	6.67	11.67	13.00	17.25	10.45
LDPE with holes	3.33	8.33	13.00	20.33	11.25
LDPE without holes	1.67	13.33	20.67	32.35	17.01
Control (unpacked untreated)	5.50	15.00	22.46	30.26	18.31
Mean	4.90	9.76	14.51	18.82	12.00

CD (P=0.05): Dates:2.32, Treatments: 2.53, Dates x Treatments: NS

Table 2: Effect of chemicals and packaging on palatability rating of Kinnow mandarin during ambient storage.

Treatments	Palatability rating				
	After 15 Days	After 30 Days	After 45 Days	After 60 Days	Mean
Sodium carbonate(2%)+LDPE with holes	8.7	8.0	7.17	3.5	6.84
Sodium carbonate(3%) +LDPE with holes	8.83	8.0	7.33	4.2	7.09
Boric acid (2%)LDPE with holes	7.67	7.50	7.07	3.5	6.43
Boric acid (3%)+LDPE with holes	8.86	8.5	7.67	4.9	7.48
Sodium carbonate(2%)+LDPE	8.17	7.17	6.83	3.10	6.31
Sodium carbonate(3%) +LDPE	8.0	7.67	7.0	3.17	6.46
Boric acid (2%) +LDPE	7.33	7.17	6.50	3.50	6.12
Boric acid (3%)+LDPE	7.67	7.33	6.67	3.80	6.36
LDPE with holes	8.83	8.17	7.33	3.67	7.00
LDPE without holes	8.00	7.66	7.17	3.85	6.67
Control (unpacked ,untreated)	7.5	5.5	4.5	2.5	5.00
Mean	8.14	7.51	6.84	3.61	

CD (P=0.05) :- Dates:0.85, Treatments: 0.76, Dates x Treatments:1.80

Table 3: Effect of chemicals and packaging on PLW of Kinnow mandarin during ambient storage.

Treatments	PLW (%)				
	After 15 Days	After 30 Days	After 45 Days	After 60 Days	Mean
Sodium carbonate(2%) +LDPE with holes	2.41	4.81	6.05	7.03	5.08
Sodium carbonate(3%) +LDPE with holes	1.70	3.55	5.20	6.89	4.34
Boric acid (2%)LDPE with holes	2.49	4.52	6.33	7.00	5.09
Boric acid (3%)+LDPE with holes	1.77	3.58	5.52	6.80	4.42
Sodium carbonate(2%)+LDPE	1.91	3.41	4.96	6.72	4.25
Sodium carbonate(3%) +LDPE	1.70	3.13	4.54	6.5	3.97
s Boric acid (2%) +LDPE	2.03	3.78	4.72	6.70	4.31
Boric acid (3%)+LDPE	1.72	3.40	4.66	6.66	4.11
LDPE with holes	2.24	3.98	5.78	7.00	4.75
LDPE without holes	1.59	3.42	4.87	6.70	4.15
Control (unpacked ,untreated)	10.5	21.40	32.42	43.63	26.99
Mean	2.73	5.36	7.73	10.15	

CD (P=0.05) :- Dates: 0.32, Treatments: 0.53, Dates x Treatments: 1.20

Table 4: Effect of chemicals and packaging on TSS (%) of Kinnow mandarin during ambient storage.

Treatments	TSS(%)				
	After 15 Days	After 30 Days	After 45 Days	After 60 Days	Mean
Sodium carbonate(2%) +LDPE with holes	11.3	11.5	11.8	12.1	11.7
Sodium carbonate(3%) +LDPE with holes	11.0	11.3	11.5	12.1	11.5
Boric acid (2%)LDPE with holes	11.7	11.9	12.4	12.6	12.2
Boric acid (3%)+LDPE with holes	10.6	11.1	11.7	12.9	11.6
Sodium carbonate(2%)+LDPE	10.8	11.7	12.0	12.0	11.6
Sodium carbonate(3%) +LDPE	10.6	11.0	11.6	11.8	11.3
Boric acid (2%) +LDPE	11.2	11.2	11.6	12.0	11.5
Boric acid (3%)+LDPE	10.5	10.7	11.1	12.0	11.1
LDPE with holes	11.3	11.8	12.3	12.8	12.1
LDPE without holes	11.0	11.7	12.0	12.7	11.9
Control (unpacked ,untreated)	12.0	12.5	13.9	14.3	13.2
Mean	11.1	11.5	12.0	12.5	

CD (P=0.05) :- Dates:0.35, Treatments:0.59, Dates x Treatments: NS

Table 5: Effect of chemicals and packaging on total acidity (%) of Kinnow mandarin during ambient storage.

Treatments	Acidity(%)				
	After 15 Days	After 30 Days	After 45 Days	After 60 Days	Mean
Sodium carbonate(2%) +LDPE with holes	0.64	0.49	0.42	0.34	0.49
Sodium carbonate(3%) +LDPE with holes	0.64	0.52	0.47	0.34	0.49
Boric acid (2%)LDPE with holes	0.68	0.51	0.42	0.34	0.59
Boric acid (3%)+LDPE with holes	0.83	0.70	0.44	0.40	0.48
Sodium carbonate(2%)+LDPE	0.64	0.55	0.40	0.32	0.58
Sodium carbonate(3%) +LDPE	0.70	0.67	0.55	0.40	0.55
Boric acid (2%) +LDPE	0.70	0.67	0.45	0.38	0.63
Boric acid (3%)+LDPE	0.83	0.77	0.52	0.38	0.50
LDPE with holes	0.64	0.60	0.38	0.36	0.55
LDPE without holes	0.77	0.70	0.40	0.34	0.39
Control (unpacked ,untreated)	0.64	0.40	0.30	0.21	
Mean	0.71	0.61	0.43	0.35	

CD (5%):- Dates:0.03, Treatments:0.05, Dates x Treatments: NS

acids in respiration process. A gradual decrease in acidity has also been reported by El-Aswah *et al.* (6), Huelin (7) and Josan *et al.* (9),

CONCLUSION

It may be concluded from the study that Kinnow fruits can safely be stored up to 45 days at ambient storage without much deterioration in quality after treating with boric acid 3.0 %+LDPE packaging with 5 pin holes.

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