

*Research Article*

## **Effect of low density polyethylene packaging and chemicals on ambient storage of kinnow**

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### **Abstract**

Kinnow, a variety of mandarin, is the major citrus fruit grown in Punjab and its ripening period coincides with the winter months and there is a lower demand for fresh fruit during this period. Kinnow is perishable in nature and cannot be stored for long periods at ambient conditions. Keeping this in view, a study was planned and freshly harvested kinnow fruit 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 packing in CFB boxes. Fruit were analyzed for various physicochemical 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 to be maximum in control fruit, whereas minimum physiological loss in weight was recorded in Boric acid @3 % + LDPE packaging without perforation. It can be concluded that the storage deterioration can be reduced by treating the kinnow fruit 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:** citrus, LDPE, post harvest, boric acid, sodium carbonate, India.

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### **Introduction**

Citrus is one of the most important sub-tropical fruits in the world. Kinnow mandarin, a hybrid of King and Willow leaf occupies a prime position amongst the citrus fruit grown in India. It is a precocious, prolific bearer and has excellent fruit quality with high juice content. The optimum period for 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 [1]. As most of the cold storages operate at near zero temperature, the kinnow fruit may get pathological rotting during storage. The incidence of microbial fruit rot of fungal and bacterial origin is a common problem in storage,

which markedly deteriorates the keeping quality of the fruit. The species of *Penicillium*, *Alternaria*, *Aspergillus*, *Botrydiploidia* and *Geotrichum* etc. are particularly responsible for causing heavy losses [2]. The main factors governing storage life of citrus fruit are weight loss and decay. Individual sealed packaging could significantly reduce weight loss and shrivelling, but the potential decay problem of sealed fruit needs to be resolved through perforation/chemicals. This paper reports on the results of packaging trials and chemicals on storage rot and quality of kinnow mandarin at ambient storage.

## Materials and Methods

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

T <sub>1</sub>	=	Sodium carbonate (2%) + LDPE packaging with 5 pin holes
T <sub>2</sub>	=	Sodium carbonate (3%) + LDPE packaging with 5 pin holes
T <sub>3</sub>	=	Boric acid 2% + LDPE packaging with 5 pin holes
T <sub>4</sub>	=	Boric acid 3% + LDPE packaging with 5 pin holes
T <sub>5</sub>	=	Sodium carbonate (2%) + LDPE packaging
T <sub>6</sub>	=	Sodium carbonate (3%) + LDPE packaging
T <sub>7</sub>	=	Boric acid (2%) + LDPE packaging
T <sub>8</sub>	=	Boric acid (3%) + LDPE packaging
T <sub>9</sub>	=	LDPE packaging with 5 pin holes
T <sub>10</sub>	=	LDPE packaging without holes
T <sub>11</sub>	=	Control (unpacked, untreated)

Fruit 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 placed in corrugated fibre board (CFB) boxes and stored in a well ventilated room at ambient temperature and relative humidity. For various physico-chemical characteristics, the fruit were analysed after 30, 45 and 60 days at ambient storage. The physiological loss in weight was recorded by noting the initial weight and final weight in each replication at each storage interval. The cumulative loss in weight was calculated on fresh fruit basis. Spoilage percentage of fruit was also calculated by counting the rotten fruit and total fruit in each treatment replication at each storage interval. The fruit were evaluated by a five member panel using a scorecard (maximum 10 points) based on physical appearance, taste and flavour. The fruit 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 a hand refractometer. One or two drops of juice were placed on the refractometer plate and the percentage TSS on the scale recorded. The reading was calibrated against a standard temperature of 20<sup>0</sup>C [3]. 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 fruit without perforation was greater when compared to sealed fruit with perforation. This may be due to accumulation of more humidity in the

vicinity of fruit which may aggravate spoilage due to microbial attack. Data also showed that as the storage period increased, the spoilage increased. This could be due to the weakening of the defence system against fungal attack. Similar observations on spoilage over a longer period of storage have been reported by Iidis and Travert [4].

**Table 1. Effect of chemicals and packaging on rot in 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 (5%)

Dates: 2.32

Treatments: 2.53

Dates x Treatments: NS

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

Mean minimum physiological loss in weight (PLW) was recorded in sodium carbonate 3.0%+LDPE packaging (Table 3). Reduction in PLW in sealed fruit was due to retardation in evaporation and respiration processes. The chemical application, coupled with LDPE sealing, was effective in reducing weight loss. This could be caused by 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 due to saturated humidity and no air circulation inside the sealed package [5, 6, 7].

**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 (5%)

Dates: 0.85

Treatments: 0.76

Dates x Treatments: 1.80

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 fruit. It may be due to maximum water loss in these fruit. Similar results were reported by Salunkhe *et al* [8] on peach and apricot and Singhrot *et al* [9] and Dhatt *et al* [10] 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 fruit (Table 5). The decrease in acidity with the storage period might be due to utilization of organic acids in the respiration process. A gradual decrease in acidity has also been reported by Josan *et al* [11], Huelin [12] and El-Aswah *et al* [13].

**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 (5%), Dates: 0.32, Treatments: 0.53, Dates x Treatments: 1.20

**Table 4. Effect of chemicals and packaging on Total Soluble Solids (%) 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 (5%), 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: 0.30, Treatments: 0.50, Dates x Treatments: NS

## Conclusion

It may be concluded from this study that Kinnow fruit can be safely stored for up to 45 days at ambient temperature with little deterioration in quality after treating with boric acid 3.0 %+LDPE packaging with 5 pin holes.

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