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Short communication

Response of GA_3, $Ca(NO_3)_2$, bavistin and neem extract on the storage life of Nagpur mandarin (*Citrus reticulata* Blanco)

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The mandarin (*Citrus reticulata* Blanco) cultivar-Nagpur belongs to family rutaceae and is one of the important fruits of citrus group. Nagpur mandarin are of importance because of their pleasant flavors and refreshing taste. It is a sub acidic fruit, used for preparing commercial pectin, refreshing drinks and making cosmetics. However, the fruits are perishable in nature. During harvesting season, there is a gult in the market compelling the farmers to sell their produce at throw away prices. The fluctuation in market price can be controlled by selling the fruits in phases and this can be achieved by storing the fruits with the treatment of different chemicals to prolong the shelf life of mandarin fruits. The main objectives of different types of chemicals is to control the rate of respiration, transpiration, ripening and also other undesirable bio-chemical changes and disease infections (Naik, 1985).

It is, however, advisable that the suitability of these methods under a particular condition should be tested before putting them in to commercial use. The establishment of a suitable treatment would help in market regulation, fetch higher prices and may be equally useful for consumers. Keeping these facts in view, the present investigation on Nagpur mandarin fruits were under taken.

The investigation was carried out at Navsari Agricultural University, Navsari (Gujarat) in completely randomized design with three replication and nine treatments during the year 2004. Fully ripe greenish yellow healthy fruits were procured from the *Phal Ane Saak Bhaji Mandi*, Dudhia Talao, Navsari. They were brought to the laboratory and sorted. Thus, fruits of uniform shape, size and ripeness were treated with different concentrations of gibberellic acid, calcium nitrate, bavistin and neem extract after initial physico-chemical analysis. The treatments were T_1 Control, T_2 Gibberellic acid 150 ppm, T_3 Gibberellic acid 250 ppm, T_4 Calcium nitrate 0.5 percent T_5 calcium nitrate-1.0 per cent, T_6 Bavistin- 500 ppm, T_7 Bavistin 750 ppm, T_8 Neem extract 1.5 per cent, T_9 Neem extract 2.0 per cent

Each treatment comprised of 3 kg fruits, five fruits were kept for physical observation and remaining for chemical analysis. Each treatment was termed as one unit. For fungicidal dip treatment fruits were washed in tap water, air dried and then after all fruits were dipped in the solution of fungicide. Bavistin (Carbendazim) 500 and 750 ppm for five minutes. The fruits were air dried and packed in polythene bags. For Gibberellic acid and calcium nitrate treatment, fruits were dipped in different concentrations of GA_3 and $Ca(NO_3)_2$ for five minutes, air dried and packed in polythene bags. For neem extract treatments, neem extract was prepared from the fresh neem leaves by boiling and then desired concentration of extract was prepared by increasing the volume by the addition of distilled water. Fruits were dipped in different concentrations of Neem extract for five minutes, air dried and packed in polythene bags. Fruits used as control were washed in the same way as the treated ones and dipped in distilled water for the same period and packed in poly bags. The bags of 45 x 30 cm^2 of 200 gauge thickness having 2 per cent area under perforations were used for the study.

Physical characteristics

The effect of different concentrations of GA_3, $Ca(NO_3)_2$, Bavistin and Neem extract on physiological characteristics are presented in Table-1. The physiological loss in weight was affected significantly by all treatments at 28 days of storage except control. The loss in weight was higher in control and minimum loss in weight was recorded in GA_3 150 ppm at 28th day of storage.

Similar results have also been reported in grapefruit and orange (Roy, 1985; and 1989) and mango (Naik, 1985

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The values of various parameters at 0 hrs of treatment are depicted in table below.

SNo	Observation	Values (%)
1	Physiological loss in weight	0.00
2	Rotting percentage	0.00
3	Juice content	49.00
4	Total soluble solids	8.50
5	Active acidity (pH)	3.40
6	Total sugars	7.69
7	Reducing sugar	2.45

and Singh 1987). The reduction in weight loss was possibly due to loss in moisture through transpiration and utilization of some of the reserve food materials in the process of respiration.

The rotting of fruits was significantly affected by all the treatments except control. The bavistin 750 ppm showed minimum rotting percentage (33.46) at 28th day of storage and control showed maximum (78.41). Neem extract also minimized the per cent fruit rotting next to bavistin. The minimum rotting percentage recorded in fruits treated with bavistin and neem extract might be due to the chemical fungicides which check the fungal growth and Neem extract a bio-pesticide. Motine and Locke (1993), Bhoromick and Vardhan, 1981also reported similar findings. The treatment GA_3 250 ppm showed minimum loss in juice percentage (39.13) at 28th day of storage. While control showed the maximum decreasing trend of juice content (27.27) on the 28th day of storage as compared to all the treatments. Juice of mandarin fruits decreased slowly during advancement of storage period. Mandarin oranges when packed in polythene bags helped in minimizing the juice percentage reduction to some extent. (Singh and Rana, 1992). Similar results have been obtained by Dhillon *et al.* (1977) in kinnow mandarin.

Chemical characteristics

The effect of different concentrations of GA_3 $Ca(NO_3)_2$ Bavistin and Neem extract on chemical characteristics are given in Table 1. The rate of increase in TSS percentage was higher in control (11.44) as compared to other treatments. GA_3 (250 ppm) showed minimum TSS (9.61) on 28th day of storage. The total soluble solids content in mandarin fruits increased during storage, which was possibly due to hydrolysis of polysaccharides to monosaccharide and increased concentration of juice as a result of dehydration (Das and Dash, 1967). The findings reported by Singh, 1987 in mango and Singh *et al.* 1970 in guava comfirm to this prerequisite. In active acidity (pH) control registered highest increasing rate (3.67) of pH as compared to other treatments at the 28th day of storage. Overall minimum pH was observed (3.57) under treatment of GA_3 150 ppm. The active acidity, declined in the fruits with the advancement of storage period. This reduction was partly due to decline in acid content. Further, possibly of utilization of some of the acids in the process of respiration and conversion of some of them to sugar also could not be ruled out. These results are in conformity with the observations of Singh (1987) in mango, Hurding (1954) and Kumar *et al.*, 1987 in citrus fruits. Total sugar content increased continuously with the advancement of storage. The maximum total sugar content recorded in control (9.95)

Table 1: Effect of GA_3 $Ca(NO_3)_2$, Bavistin and Neem extract on physical and chemical characteristics at 28th day of storage.

Treatment	Physiological loss in weight (%)	Rotting per cent	Juice content (%)	T.S.S.) (%	Active acidity (pH)	Total sugar (%)	Reducing sugar content (%)
Control	36.96	78.41	27.27	11.44	3.67	3.95	9.95
GA_3 150 ppm	17.41	42.90	39.04	10.09	3.57	3.76	9.86
GA_3 250 ppm	17.91	41.96	39.13	9.61	3.60	3.66	9.76
$Ca(NO_3)_2$, 0.5%	23.35	64.92	33.60	10.57	3.61	3.80	9.76
$Ca(NO_3)_2$, 1.0%	23.29	61.84	34.60	10.28	3.62	3.93	9.80
Bavistin 500 ppm	23.27	35.20	32.99	11.05	3.66	3.92	9.93
Bavistin 750 ppm	19.11	33.46	39.02	10.76	3.59	3.95	9.45
Neem extract 1.5%	23.52	38.81	34.55	10.86	3.63	3.76	9.74
Neem extract 2.0%	23.43	37.10	34.16	10.57	3.61	3.83	9.80
SEm±	0.040	0.053	0.404	0.100	0.033	0.086	0.082
C.D. 5%	0.141	0.199	1.104	0.219	NS	0.157	0.147

on 28th day of storage. In case of reducing sugar per cent, all treatments showed increasing trend for reducing sugars except bavistin 750 ppm which showed decrease in reducing sugars as compared to all other treatments. The rise in sugars was possibly due to hydrolysis of polysaccharides to mono-saccaharides and increased concentration of juice as a result of loss of moisture by transpirations. These findings are comparable to some earlier reports in guava (Singh *et al.*, 1970) and in litchi (RayChoudhary *et al.*, 1992).

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