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# Impact of post-harvest chemical dipping and wax coating on taste and aroma of the apple fruits infected with sooty blotch and fly speck disease complex

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**Abstract**
Sooty blotch and flyspeck are the two economically important diseases of apple that downgrade the fruits to an unmarketable extent, even just prior to harvest. Calcium hypochlorite (5%), calcium chloride (4%), sodium hypochlorite (3%) along with borax (1%), sodium hypochlorite (3%) with sodium bicarbonate (1%) and controls with and without treatment with water were evaluated as postharvest dips followed by rubbing and coating or non-coating. Wax Shool (1:1) and disinfectant Virosil-Agro (2.5%) were used as test coating materials. Calcium hypochlorite and calcium chloride treated fruits achieved maximum taste scores of 3.07 and 2.87 per cent compared to 1.95 and 1.80 scores awarded to water dip and no dip treatments, respectively. Coatings also increased the taste score from 2.25 recorded in uncoated fruits to 2.47 in Virosil-Agro and upto a maximum of 2.89 in Wax-Shool coated treatment. With regard to aroma, calcium hypochlorite treatment was awarded maximum aroma score of 3.04 compared to 2.54 to 2.77 values scored for rest of the test chemicals. Furthermore maximum aroma score of 2.72 was awarded to Wax-Shool and 2.49 Virosil-Agro treated fruits compared to a value of 2.14 for uncoated fruits.

**Keywords:** apple, aroma, chemical dips, fly speck sooty blotch, taste, wax coating

## Introduction
Sooty blotch and flyspeck are the two economically important diseases of pome fruits that have recently assumed the status of major diseases (Ivanovic *et al.* 2010) [7]. Both the diseases often co-exist in the same orchard and on the same fruit (Williamson and Sutton, 2000) [9]. The casual pathogens of both the diseases grow on the epicuticular wax layer of apple fruit and barely penetrate the epidermal layer (Hendrix 1991) [6], yet infected fruits are downgraded resulting in an unacceptable marketable appearance. An attempt was made to evaluate the impact of post-harvest chemical dipping and wax coating on taste and aroma of apple fruits infected with sooty blotch and fly speck disease complex.

## Materials and Methods
CvRed Delicious apples showing typical symptom of sooty blotch and flyspeck disease complex were harvested from orchards of Srinagar district. Unbruised and uncoated rotten fruits of uniform size and colour were selected. The average extent of sooty blotch and flyspeck was recorded before chemical dipping. Five chemical viz calcium hypochlorite (5%), calcium chloride (4%), sodium hypochlorite (3%) along with borax (1%), sodium hypochlorite (3%) with sodium bicarbonate (1%) and controls with and without treatment with water were evaluated as postharvest dips followed by rubbing and coating or non-coating. Wax Shool (1:1) and disininfectant Virosil-Agro (2.5%) were used as test coating materials. The fruits were first dipped in respective chemical treatment for a period of 10 minutes. The uniform dipping was ensured by turning the fruits continuously while dipping in the respective spray suspension solution of test chemical. Then the fruits were gently rubbed with muslin cloth for 30 sec (Batzer *et al.* 2002) [3]. After rinsing with tap water, the fruits of each treatment including both the checks were divided into three sub treatments such that each sub treatment comprised of 54 fruits. Each sub treatment was replicated thrice in factorial completely randomized design. Then the fruits of each treatment were given coating either with Wax-Shool or Virosil Agro or no coating. After dipping in coating material for 10 min, treated fruits were surface dried in air at room temperature. Thereafter, all the replicate fruits were weighed and stored in cardboard boxes at ambient room temp (5-20C) for 30 days.
The sensory evaluation of treated apples after 30 days of storage period was scored on a

four-point scale (Habibunnisa *et al*. 1988) [5] by a panel of five judges from SKUAST-K. Fruit samples from each treatment replication were polled and cut into slices for evaluation. The apple pieces for sensory evaluation were presented to judges in coded form and they were requested to note their sensory response on the basis of taste and aroma, on the following four-point scale. 4= Excellent, 3= Good, 2= Fair, 1= Poor

**Results and Discussion**

Perusal of data (Table 1) revealed that calcium hypochlorite and calcium chloride treated fruits achieved maximum taste scores of 3.07 and 2.87 per cent compared to 1.95 and 1.80 scores awarded to water dip and no dip treatments, respectively. Fruits treated with sodium hypochlorite alone or in combination with borax or sodium bicarbonate scored 2.55 to 2.76 points. Furthermore, coatings increased the taste score from 2.25 recorded in uncoated fruits to 2.47 in Virosil-Agro and upto a maximum of 2.89 in Wax-Shool coated treatment. The present findings are in agreement with that of Habibunnisa *et al*. (1988) [5] thereby confirming the reports that wax coating materials maintains the skin colourationand taste of apples during storage at ambient temperature and relative humidity. However, the interaction of dips and coatings proved to be non-significant. The present findings further indicated that dry rubbing (no dip) and wet rubbing (water dip) could at least increase the scores up to 1.80 and 1.95 per cent, respectively but did not seem enough compared to that noticed in chemical dip treatments.

The results with regard to aroma indicated that calcium hypochlorite treatment was awarded maximum aroma score of 3.04 compared to 2.45 to 2.77 values scored for rest of the test chemicals, with least score for sodium hypochlorite plus sodium bicarbonate treatment. Furthermore, panelists also awarded maximum aroma score of 2.72 to Wax-Shool coated fruits and 2.49 Virosil-Agro treatments compared to a value of 2.14 for uncoated fruits. The combined effect of chemical dipping and coating was observed statistically non-significant but wax coating on fruits dipped in calcium hypochlorite was appreciated by panelists and scored a value of 3.04 compared to 1.81 value averaged for uncoated fruits that did not receive any chemical or water dip (undipped). Thus the study revealed that the chemical dipping and/or coating retained the aroma of fruits to some extent compared to no dip or water dip or no coating upto 30 days of storage under ambient conditions. Otherwise, apple fruits have been reported to soften during storage due to breakdown of pectic substances. (Gupta *et al*. 1987). The increase in aroma could be attributed to increase in calcium content and partially to wax coating and such results have been partially observed by Ajaz (2003). Similar results have also been reported in grapes to increase the shelf life by coating of aloe vera (Ali Javid *et al*. 2016) [2]

**Table 1:** Effect of various chemicals and wax coatings as post-harvest dips on taste score of "Red Delicious" apples infected with sooty blotch and fly speck disease complex.

| Treatment | Conc. (%) | Taste score *(pt) Coatings Wo ** | WwWv | | Overall Mean*** |
|---|---|---|---|---|---|
| Sodium hypochlorite | 3.0 | 2.49(1.58) | 2.93(1.71) | 2.60(1.61) | 2.67(1.63) |
| Calcium hypochlorite | 5.0 | 2.72(1.65) | 3.38(1.84) | 3.12(1.77) | 3.07(1.75) |
| Sodium hypochlorite + Borax | 3.0 + 1.0 | 2.41(1.55) | 3.13(1.77) | 2.72(1.58) | 2.76(1.66) |
| Sodium hypochlorite + Sodium bicarbonate | 3.0 + 1.0 | 2.37(1.53) | 2.82(1.68) | 2.46(1.56) | 2.55(1.59) |
| Calcium chloride | 4.0 | 2.65(1.62) | 3.11(1.76) | 2.85(1.69) | 2.87(1.69) |
| Water | _ | 1.60(1.26) | 2.45(1.53) | 1.80(1.35) | 1.95(1.38) |
| Check (no dip) | _ | 1.50(1.21) | 2.40(1.52) | 1.75(1.32) | 1.80(1.35) |
| Mean | _ | 2.25(1.50) | 2.89(1.69) | 2.47(1.57) | CD $_{(p= 0.05)}$ |
| Treatment | (0.12) | | | | |
| Coating | (0.07) | | | | |
| Treatment x Coating | NS | | | | |

* Based on 4 point scale, 4 excellent; 3 Good; 2 Fair; 1 poor

** Wo, Ww and Wv denote no Wax, Wax-Shool and Virosil-Agro coating.

*** Figures within parenthesis are square root transformed value

**Table 2:** Effect of various chemicals and wax coatings as post-harvest dips on aroma score of "Red Delicious" apples infected with sooty blotch and flyspeck disease complex.

| Treatment | Conc.% | Aroma score* (pt) Coatings | | | Mean |
|---|---|---|---|---|---|
| Sodium hypochlorite | 3.0 | 2.19 (1.47) *** | 2.88(1.70) | 2.54(1.59) | 2.54(1.59) |
| Calcium hypochlorite | 5.0 | 2.72(1.65) | 3.31(1.82) | 3.09(1.75) | 3.04(1.74) |
| Sodium hypochlorite + Borax | 3.0+1.0 | 2.52(1.59) | 2.66(1.64) | 2.58(1.61) | 2.59(1.61) |
| Sodium hypochlorite + Sodium bicarbonate | 3.0+1.0 | 2.01(1.41) | 2.72(1.65) | 2.61(1.62) | 2.45(1.56) |
| Calcium chloride | 4.0 | 2.43(1.60) | 3.14(1.77) | 2.74(1.68) | 2.77(1.65) |
| Water | _ | 1.57(1.25) | 2.17(1.47) | 2.00(1.41) | 1.91(1.37) |
| Check (no dip) | _ | 1.53(1.23) | 2.13(1.46) | 1.77(1.32) | 1.81(1.34) |
| Treatment | (0.14) | | | | |
| Coating | (0.09) | | | | |
| Treatment x Coating | NS | | | | |

* Based on 4 point scale, 4 excellent; 3 Good; 2 Fair; 1poor

** Wo, Ww and Wv denote no Wax, Wax-Shool and Virosil-Agro coating.

*** Figures within parenthesis are square root transformed values

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