

THE IMPACT ON SHELF LIFE AND RIPE FRUIT QUALITY OF ALOBUA™ FC-12 FRUIT COATING ON LATE SEASON NEW ZEALAND 'HASS' AVOCADOS.

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ABSTRACT

Harvested avocado fruit have a short storage and shelf life that limits the length of time available for marketing and retailing the fruit. Treatments that reduce water loss and/or inhibit ethylene metabolism have been used to extend ripening time. However, avocado fruit that take a long time to ripen also have greater numbers of rots than avocados that ripen quickly. Alobua™ FC-12 is a fruit coating consisting of natural and plant based polymers that have been suggested as a useful treatment to extend the ripening time of avocados. The ripening time and fruit quality of late season 'Hass' avocado fruit dipped in half strength Alobua™ FC-12 were compared to untreated fruit, fruit dipped in water, prochloraz and a combination of prochloraz and quarter strength Alobua™ FC-12. The fruit dipped in varying concentrations of Alobua™ FC-12 had significantly longer ripening times than untreated, water dipped and prochloraz treated fruit. When ripe the fruit dipped in half strength Alobua™ FC-12 had more rots than the untreated control fruit which was correlated with the longer ripening time. Treatment with prochloraz reduced the number of ripe rots to level of the untreated control fruit. Dipping in Alobua™ FC-12 is very effective in delaying ripening of late season New Zealand 'Hass' avocados but the delay in

ripening results in high levels of rots in the fruit when ripe.

INTRODUCTION

Avocado fruit once detached from the tree have a limited storage and shelf life (Kays and Paull, 2004). Individual fruit can vary considerably in their ripening time depending on the storage environment, ripening temperature, humidity and maturity (Hopkirk *et al.*, 1994; Dixon *et al.*, 2003a; Dixon *et al.*, 2004a and Dixon *et al.*, 2004b). The greater the fruit maturity, as defined by dry matter content, the faster the fruit soften to eating softness. The ripening time for late season fruit (dry matter > 32%) can be as short as 2 to 3 days for fruit that has been stored for 4 weeks at 5°C and ripened at 20°C, 60% relative humidity (Dixon *et al.*, 2003a). Fruit with such a short ripening time present a challenge to retailers and marketers to sell the fruit before it is overripe.

To extend the ripening time of avocado fruit treatments that reduce water loss and/or inhibit ethylene metabolism have been used. These treatments have been storage and ripening in high humidity (Dixon *et al.*, 2003b; Dixon *et al.*, 2004b), modified atmosphere storage (Dixon *et al.*, 2003b), coating with waxes (Johnston and Banks, 1996) and exposure to 1-methylcyclopropene (1-MCP) applied individually or in combination (Jeong *et al.*, 2003). Coating with waxes and exposure to 1-MCP increased the ripening time by up to 60% while ripening in high humidity did not affect ripening time despite significantly lower rates of weight loss. Storage and ripening in a modified atmosphere and high humidity increased the ripening time by about 100%. An increase in the ripening time is associated with a significant increase in the incidence and severity of stem end rot and body rots (Darvas, 1984; Dixon *et al.*, 2003a). The increase in rots has been up to twice that found in the untreated control fruit and represents a significant commercial risk to fruit quality. One option to control the increased incidence and severity of rots when ripe is to incorporate a

fungicide treatment in addition to the treatment that increases ripening time.

Alobua™ FC-12 is a fruit coating consisting of natural and plant based polymers that is claimed to delay the ripening of a number of sub-tropical and temperature fruits and can be applied by spraying, dipping or wiping (Allen Roche pers. comm.). There are no specific recommendations for application of Alobua™ FC-12 to avocados and the Alobua brochure suggests that the effective concentration be determined by field trials. Due to the fast ripening of late season New Zealand 'Hass' avocados a treatment that delayed the ripening of the fruit would increase the length of time available market and sell the fruit. Alobua™ FC-12 has potential to delay the ripening of avocado fruit to allow a longer shelf-life provided ripe fruit quality is not compromised. To determine if Alobua™ FC-12 can delay ripening without affecting ripe fruit quality late season 'Hass' avocados were treated with Alobua™ FC-12 at different rates and with and without the addition of prochloraz fungicide.

MATERIALS AND METHODS

Five hundred fruit were harvested on 10/2/2005 2005. Within 4 hours of harvest the ungraded fruit were treated and packed into trays of 20 fruit.

There were five treatments each consisting of 100 fruit (5 trays of 20 fruit):

Treatment 1: Control. Fruit were stored in standard single layer cardboard trays on cardboard plixes.

Treatment 2: Water dip. Fruit were dipped in clean tap water for 2 minutes. The fruit were air dried for 1 hour at ambient before being placed into standard single layer cardboard trays on cardboard plixes.

Treatment 3: Alobua™ FC-12 dip. The Alobua™ FC-12 was diluted 1:1 with clean water due to the small volume of Alobua™ FC-12 available at the time of the experiment. This is half the recommended concentration in the Alobua™ FC-12 brochure and was

comparable to that recommended for mangos and papayas. The fruit were dipped for 2 minutes instead of 10 minutes to be comparable with the prochloraz treatment. The preferred method of application is by spraying Alobua™ FC-12 on fruit therefore a 2 minute dip should be sufficient to effectively coat the fruit. The fruit were air dried for 1 hour at ambient before being placed into standard single layer cardboard trays on cardboard plixes.

Treatment 4: Fungicide dip. Fruit were dipped for 2 minutes in a solution of Sportak (prochloraz at 45% a.i.) at the recommended rate of 55 mls per 100 L or 1000 ppm a.i. The fruit were air dried for 1 hour at ambient before being placed into standard single layer cardboard trays on cardboard plixes.

Treatment 5: Combination of Alobua™ FC-12 and prochloraz. The diluted Alobua™ FC-12 and prochloraz were combined 1:1 giving a prochloraz concentration of 500 ppm a.i. and Alobua™ FC-12 at one quarter the recommended concentration. Research has shown prochloraz can be effective at 10 ppm a.i. in controlling the main avocado pathogenic fungi (Everett, 1999). The fruit were dipped for 2 minutes before air drying for 1 hour at ambient before being placed into standard single layer cardboard trays on cardboard plixes.

The fruit were placed into a commercial coolstore at 4°C ± 0.5°C, 85% ± 5% relative humidity for 28 days. After removal from storage the fruit was assessed for disorders according to the Avocado Industry Council Fruit Assessment Manual (Dixon, 2003) then placed back into trays and ripened at 19.5°C ± 1°C, 60% ± 5% RH. Each day the fruit were assessed for firmness by hand feel. Once the fruit had reached eating ripeness, equivalent to a firmness reading of at least 85 using a firmometer with a 300 gram weight the fruit were cut and assessed for disorders according to the Avocado Industry Council Fruit Assessment Manual (Dixon, 2003).

The results were analysed as a complete randomised block design using tray average values as replicates for each treatment by MINITAB version 13.31.

RESULTS AND DISCUSSION

Effect on ripening time

Untreated control fruit and fruit dipped in water or prochloraz took on average about 5 days to ripen while fruit dipped in half strength Alobua took about 7 days to ripen and the combination treatment of one quarter strength Alobua and prochloraz took about 6 days to ripen (Table 1). Both treatments using Alobua were very effective in delaying ripening despite dilution by one-half and one-quarter and dipping for only 2 minutes instead of the recommended 10 minutes (Table 1). Regression analysis suggests that the ripening time of full strength Alobua would be 9.15 days (Figure 1). Such an increase in ripening time is in general agreement with that reported for mango,

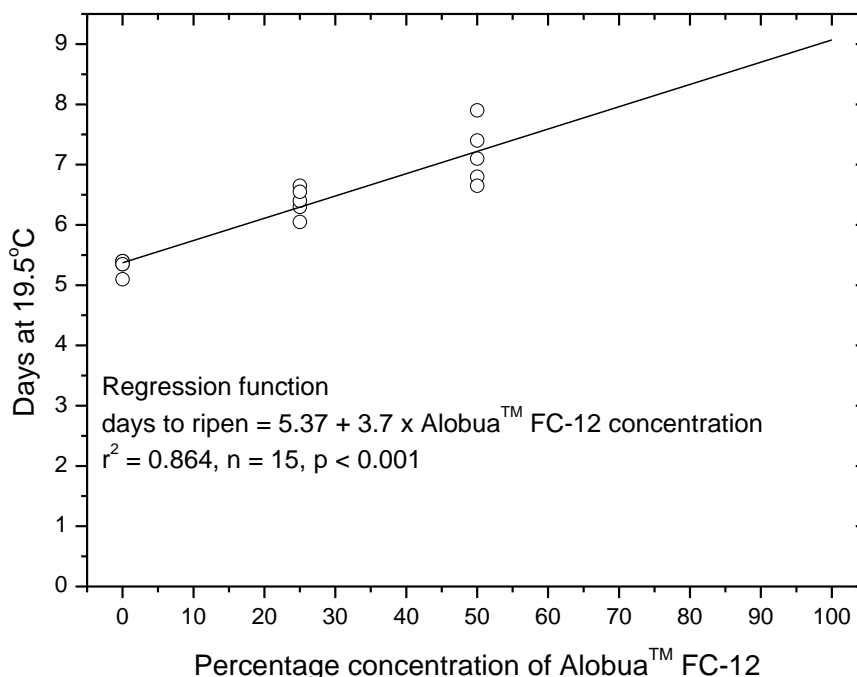


Figure 1. Average ripening time of ‘Hass’ avocado fruit at 19.5°C following dipping in different concentrations of Alobua™ FC-12 for 2 minutes and storage at 4°C ± 0.5°C, 85% ± 5% relative humidity for 28 days. The line represents a linear regression of the ripening time with the concentration of Alobua™ FC-12.

banana, papaya, starfruit and guava fruits in the Alobua brochure. The delay in ripening even when diluted and dipped for a short duration suggests that application of Alobua is a robust treatment to delay ripening.

Table 1. Average days to ripen at 19.5°C, incidence and severity of stem end rot and brown patches and incidence of unsound fruit at a 5% disorder threshold.

Treatment	Days to ripen	Disorder		Incidence ¹		Incidence Sound fruit ²
		Severity		Stem end rot	Brown patches	
Alobua	7.2a ³	2.0a	14.6	50.0a	78.0a	45.0a
Combination	6.4b	0.8b	12.5	17.0b	74.0a	57.0ab
Control	5.3c	1.7ab	11.5	33.0ab	68.0ab	65.0b
Prochloraz	5.2c	1.6ab	8.3	32.0ab	56.0b	63.0ab
Water	5.5c	2.1a	15.9	41.0a	69.0ab	44.0a

¹Percentage of fruit; ²The incidence of ripe fruit with disorders greater than 5% severity; ³Means followed by the same letter with a column are not different according to a One-way analysis of variance using a Tukeys family error rate of 5%.

Effect on fruit quality

The fruit treated with Alobua alone had a lower incidence of sound fruit than untreated control fruit (Table 1). There was a non-significant trend for the incidence and severity of stem end rot and brown patches to be greater in the Alobua treated fruit than in the untreated control fruit. Dipping fruit in water resulted in fruit that had similar incidence and severity of stem end rot and brown patches to the Alobua treated fruit (Table 1) but at a shorter ripening time. This suggests that wetting avocado fruit before storage increases rots when compared to untreated control fruit. The incidence and severity of stem end rot of fruit dipped in prochloraz was not different to the levels of stem end rot in untreated control fruit (Table 1). Fruit dipped in prochloraz had a lower incidence of brown patches than untreated control fruit. The incidence of sound fruit in prochloraz treated fruit was similar to the untreated control fruit suggesting that the addition

of a fungicide to a dipping solution can overcome the increase in rots that wetting the fruit may induce. A combination treatment of Alobua (at one quarter concentration) and prochloraz had an incidence of unsound fruit that was intermediate between untreated control fruit and fruit treated with Alobua at half concentration (Table 1). The combination treatment also had a lower incidence and severity of stem end rots than the Alobua treatment alone but was no different to the control fruit.

Effect of increased ripening time on rots

The incidence of unsound fruit was positively correlated to the number of days the fruit took to ripen ($r = 0.769, n = 15, p < 0.001$). The greater the concentration of Alobua solution the fruit were dipped in the longer the ripening time and the greater the incidence of unsound fruit (Figure 2). Almost all of the fruit that took longer than 7 days to

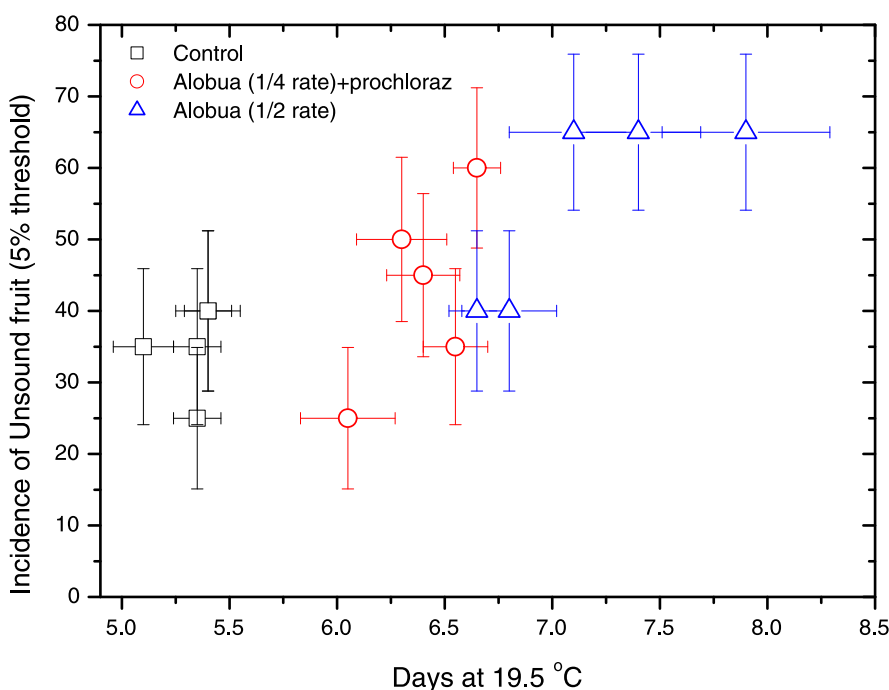


Figure 2. Average ripening time of individual trays of ‘Hass’ avocado fruit at 19.5°C following dipping in different concentrations of Alobua™ FC-12 for 2 minutes and storage at 4°C ± 0.5°C, 85% ± 5% relative humidity for 28 days. The horizontal error bars represent the standard error of the average ripening time within a tray and the vertical error bars represent the standard error of the average incidence of unsound fruit per tray of fruit.

ripen had ripe rots at greater than 5% severity (Figure 3) and could be considered to be commercially unacceptable. About 30% of the fruit dipped in half strength Alobua™ FC-12 took longer than 7 days to ripen which explains why on average fruit quality was poor for Alobua treated fruit in comparison to other treatments. These results are in agreement with previous research where avocado fruit treated to delay ripening have greater amounts of ripe rots than avocado fruit that ripen quickly (Darvas, 1984; Dixon *et al.*, 2003a; Dixon *et al.*, 2004a; Johnston and Banks, 1996).

The authors speculate that dipping for 10 minutes in a solution of full strength Alobua™ FC-12 would

delay ripening to 9 days (Figure 1). If most of the fruit ripening was delayed for more than 7 days the results presented in this report would suggest all of the fruit would have unacceptable levels of rots when ripe.

CONCLUSIONS

Dipping late season 'Hass' avocados in half or quarter strength Alobua™ FC-12 significantly increased the time the fruit took to ripen. About 30% of half strength Alobua treated fruit took more than 7 days to ripen and had almost no fruit with ripe rots at less than 5% severity. Alobua™ FC-12 is a very effective treatment to delay 'Hass'

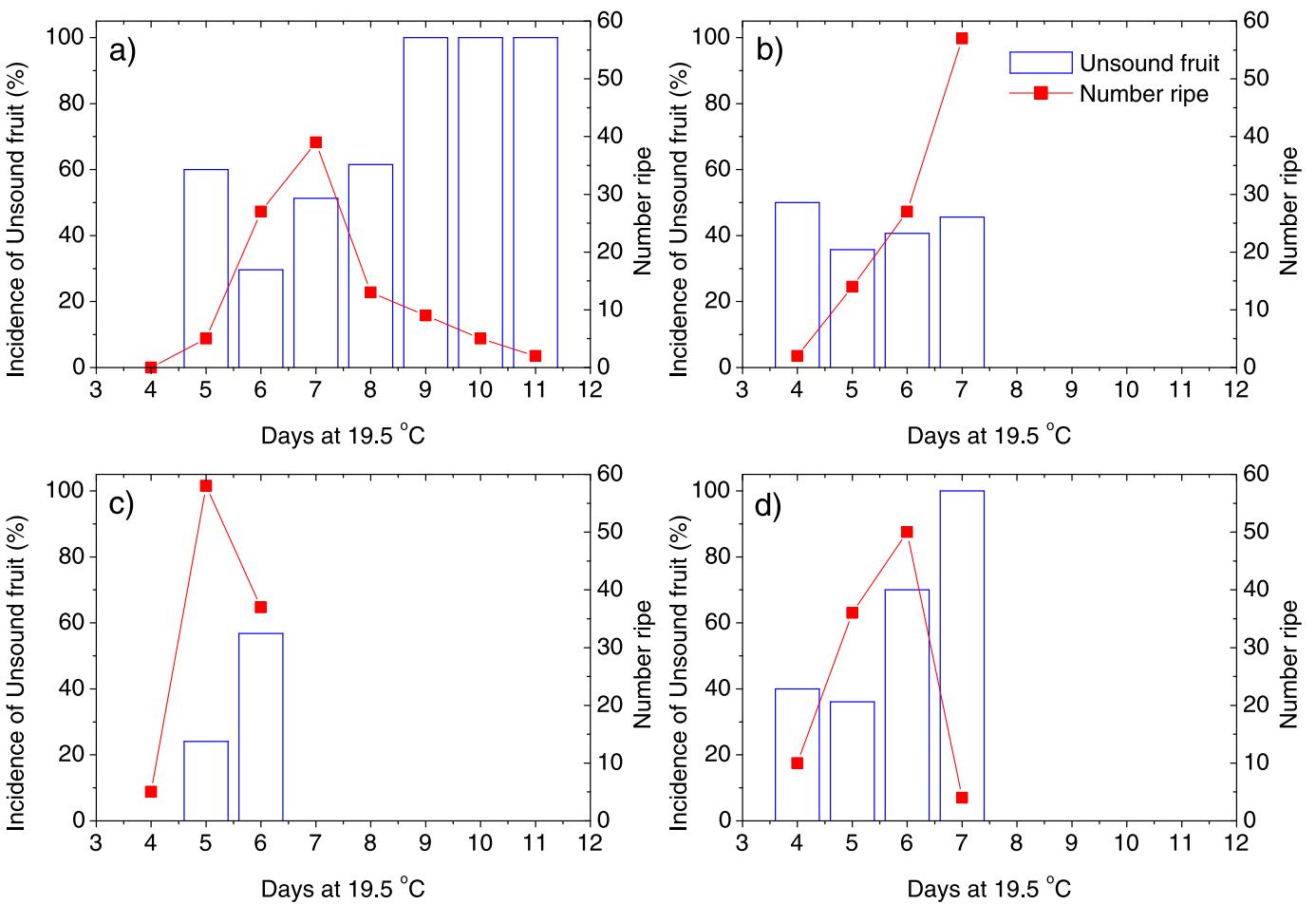


Figure 3. Average incidence of Unsound fruit using a 5% disorder threshold and the number of fruit ripe on each day of ripening for fruit dipped in a) half strength Alobua™ FC-12 or b) a combination of quarter strength Alobua™ FC-12 plus prochloraz; c) untreated control fruit and d) clean water for 2 minutes.

avocado ripening but the delay in ripening results in greater incidence and severity of rots when ripe than untreated control fruit.

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