Experiments on Extended Controlled Atmosphere Storage of Heidi Mango: 1998

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ABSTRACT

Heidi mangoes were harvested at the recommended stage of maturation. Following the commercial packline treatment, the fruits were placed in cool-storage at 9.5°C, a temperature which usually causes chilling injury. After 3 days, some of the fruits were placed under controlled atmosphere storage. Two differing atmospheres were evaluated (Atmos. A - similar CO₂ and O₂ concentrations; Atmos. B - high CO₂ and low O₂ concentration). Conventional storage and controlled atmosphere storage occurred in the same cool-storage room. After a further 18 days, all of the fruits were removed from their storage environments and were placed in a well ventilated laboratory at 20°C to ripen fully. Quality evaluation was performed on a fruit when it attained the firm-ripe stage. Both atmospheres reduced the manifestation of disease. Atmos. B reduced the incidence surface scald (low temperature damage to the skin). Ground skin colouration and taste were slightly elevated by atmosphere storage. Total soluble solids content was greater following storage under Atmos. A. Differences in skin corking (russet), lenticel damage incidence, internal disorder incidence or pH in relation to treatment were not apparent. The results confirm a benefit of controlled atmosphere storage for Heidi mango.

INTRODUCTION

Heidi mangoes develop skin and pulp injury when placed in cool-storage for prolonged periods. The pulp becomes brown and the skin develops darkened indentations which are referred to as surface scald (Fig. 1).

In a previous study (Oosthuyse, 1997), no benefit of controlled atmosphere storage of Heidi mangoes harvested at an advanced stage of maturation was found. The out-turn of good quality fruits was generally poor. However, when fruits were harvested at the conventional maturation stage, atmosphere storage reduced the incidence of surface scald, pulp browning and internal breakdown, and enhanced shelf-life and taste. The out-turn of good quality fruits was relatively good. The fruits were stored at 12.5°C. The aim of the present study was to confirm the prior benefits of controlled atmosphere storage found, and to assess atmosphere storage at 9.5°C, a temperature which usually causes surface scald.

Fig. 1 Surface scald on Heidi fruits which often occurs as a result of low temperature storage.
Fig. 2 Differences in disease manifestation in relation to treatment. Bars headed by differing letters differ significantly (P<0.05).

Fig. 3 Differences in scald severity in relation to treatment. Bars headed by differing letters differ significantly.

Fig. 4 Differences in ground skin colouration in relation to treatment. Bars headed by differing letters differ significantly (P<0.05).

Fig. 5 Differences in taste in relation to treatment. Bars headed by differing letters differ significantly (P<0.05).

Fig. 6 Differences in total soluble solids content in relation to treatment. Bars headed by differing letters differ significantly (P<0.05).

MATERIALS AND METHODS

150 Heidi fruits were harvested from an orchard in the Tzaneen region. Average degree of pulp colouration was 0.2 (± 0.1; Heidi pulp colouration chart). The fruits were subjected to the commercially adopted packline treatment [fruit respectively washed in a 1% soap solution (ByProx), dipped in hot-water at 50°C for 5 minutes, dipped in prochloraz (180 ml Omega/100 l H2O) for 20 seconds, and hand waxed with TAG], and were placed in cool-storage at 9.5°C for three days [storage under normal atmosphere for three days prior to storage under atmosphere was done to effect commercial representation, i.e., pre-storage at a packhouse, followed by refrigerated trucking to Cape Town harbour, followed by cool-storage until ship loading when controlled atmosphere storage would commence]. After this period, 50 randomly selected fruits were placed in air containing CO2 and O2 at similar concentrations (Atmos. A), and 50 randomly selected fruits were placed in air containing CO2 at a high concentration relative to that of O2 (Atmos. B). The remaining fruits were stored in normal air (controls). All of the
fruits were placed in cool-storage [in a cool-storage room, the fruit under atmosphere being in especially designed Transfresh bins] for a further 18 days, after which they were placed, under normal atmosphere, in a well ventilated laboratory maintained at 20°C (+1°C) to continue ripening. During the latter period, the stage of ripening of each fruit was assessed daily with a densimeter (Heinrich Bareiss, Oberdischingen, Germany). Each fruit was evaluated when it was firm-ripe (densimeter reading of less than 60 and greater than 40).

The Completely Randomised Design, (comprising 50 single fruit replicates of three treatments), was employed.

Fruit evaluation on ripening comprised the following:

Skin corking (russet) in each fruit was rated according its severity. A rating of 0 was given if symptoms were absent, a rating of 1 if symptoms were present but were localised to a small portion of the fruit’s surface, a rating of 2 if approximately 1/3 of the fruit’s surface showed symptoms, a rating of 3 if 2/3 of the fruit’s surface was affected, or a rating of 4 if the entire fruit’s surface was visibly affected.

Skin colour in each fruit was rated. A rating of 0 was given when signs of skin colouration were absent, a rating of 1 if a transition to a lighter green was apparent, a rating of 2 if regions of the skin had become yellow but the total area which was yellow was less than the total area which was green, a rating of 3 if regions of the skin had become yellow and the total area which was yellow exceeded the total area which was green, or a rating of 4 if the skin was completely yellow. The skin area covered with red-blush was not considered.

Disease manifestation in each fruit was rated according its severity. A rating of 0 was given if a fruit was disease free, a rating of 1 if symptoms were present but were localised to a small portion of the fruit’s surface, a rating of 2 if approximately 1/3 of the fruit’s surface showed symptoms, a rating of 3 if 2/3 of the fruit’s surface was affected, or a rating of 4 if the entire fruit’s surface was visibly diseased.

Lenticel damage and surface scald were rated by approximating the percentage of the skin surface over which symptoms could be seen. The percentages designated were either 0, 25, 50, 75 or 100.

To assess internal quality in each fruit, each was first cut through twice; longitudinally along the flattened margins of the seed. In each fruit, juice from the cheeks thus obtained was evaluated by measuring its pH (Mettler Toledo 120 pH meter) and total soluble solids content (Euromex RF 0232 hand held refractometer), and by assessing its taste.

Taste was rated. A rating of 1 was given if taste was deemed appealing, a rating of 0 if taste was deemed satisfactory but not appealing, or a rating of -1 if taste was deemed unsatisfactory.

Physiological disorder manifestation in each fruit was rated as was disease manifestation, except that the degree to which the mesocarp as opposed to the exocarp (skin) was affected, was taken into account.

The date were subjected to non-parametric analysis of variance (Kruskal Wallis).

RESULTS

Disease manifestation was markedly reduced by atmosphere storage (Fig. 2). Storage under Atmos. B reduced the severity of surface scald (Fig. 3). No apparent effect on surface scald was found following storage under Atmos. A. Ground skin colouration was slightly elevated by atmosphere storage (Fig. 4). Taste was markedly elevated by atmosphere storage (Fig. 5). Storage under Atmos. A gave rise to a slight elevation in total soluble solids content (Fig. 6). Differences in skin corking (russet type symptom), lenticel damage incidence or physiological disorder incidence in relation to treatment were not apparent. The incidence of these disorders was acceptably low (10% of fruits affected; data not shown). Differences in pH in relation to treatment were not apparent (data not shown).

DISCUSSION AND CONCLUSION

Atmosphere storage reduced surface scald and the extent of disease manifestation, and increased skin colouration, taste, and total soluble solids content. These results are in agreement with those found in a previous study where reductions in surface scald and increases in taste were observed (Oosthuys, 1997).

O’Hare, and Prasad (1993) specifically associated the alleviation of chilling injury symptoms to atmospheres having elevated concentrations of CO₂. In their study, reduced O₂ concentrations had no significant effect on chilling injury. The results of the current study are consistent with those of these workers.

An enhancement in taste following atmosphere storage has also been found in fig (Turk et al., 1994), apple (Jankovic and Drobnjak, 1992), kiwifruit (Sawada et al., 1993) and plum (Ben and Gaweda, 1992).

The fungistatic effect of controlled atmosphere storage of fruits has often been documented, and is generally ascribed to the action of the high CO₂ concentrations (Ertan et al., 1990; Skrzyinski, 1990; Ben-Arie et al., 1991; Brash et al., 1992; Sugar, et al., 1994).

In view of the beneficial results obtained in storing Heidi mangoes under atmosphere, semi-commercial adoption for export to Europe might be considered. A storage temperature of 11°C is recommended in view of the results of previous research aimed at ascertaining the optimum cool-storage temperature for this cultivar (unpublished).

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LITERATURE CITED


Marilyn Mango in France with TECTROL TEK

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"Gee thanks Tek! Thanks to you I've enjoyed five-star luxury and comfort throughout my journey, and I'm as fresh as when we left South Africa. Those poor chaps over there looked great when we left - they must have had a terrible journey!"

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