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Modified atmospheres for improved quality of air freighted asparagus

A report prepared for
New Zealand Asparagus Council

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1 SUMMARY

Tests were carried out to measure the potential benefits of modified atmospheres (MA) for air-freighted asparagus. This showed quite clearly that asparagus held for a short period retained quality much better if held in atmospheres with elevated carbon dioxide and reduced oxygen than if held in air.

Quality was expressed as residual shelf-life in air at 20°C after a four-day transit period at 20°C. Asparagus held in air during the first 4 days had 2.5 days residual shelf-life, whereas spears held in MA had between 4 and 4.8 days.

The next phase of the project is to design plastic film packaging which can generate these atmospheres around packed asparagus during air-freight consignments.

2 INTRODUCTION

Quality of asparagus arriving in export markets is a critical factor in the success of the industry. Development of technologies which can improve the performance of asparagus through the transport and distribution chain would overcome some of the deficiencies currently experienced in servicing export markets.

In this project we explore the opportunities for using atmosphere modification for improving quality retention in asparagus during air-freight. This period can extend to 4 days and temperature conditions can reach 20°C, although these conditions are considered severe. The project is an extension of work carried out in the previous season in which MA reduced loss of quality during simulated air-freight (Lill et al. 1992).

Those results were particularly encouraging because earlier tests using MA for cool-stored asparagus had indicated little benefit (King et al. 1986). Under the warmer conditions and shorter times associated with air-freight, MA appeared to have much more effect on the deteriorative processes. Provision of atmospheres during air-freight will not be straight forward but technology could be developed for this. It could, for example, be achieved using modified-atmosphere packaging based on plastic film technology.

In the experiment described here we tested a range of atmospheres over a simulated air-freight period, and assessed quality during a subsequent shelf-period in air at 20°C. From this we aimed to find out whether the benefit from MA is sufficient to warrant further development, and to determine the optimum atmosphere composition.

3 METHOD

Asparagus spears (cv Limbras 10) were harvested at Levin Research Centre. They were washed, trimmed and graded so that only spears which were healthy, undamaged, and with closed bracts, were used. Four bunches of ten spears (for assessment of shelf-life) and two bunches of twenty spears (for sensory analysis) were randomly allocated to each atmosphere treatment. The experiment was replicated twice in time.

Test atmospheres were established in gas-tight plastic tents, and maintained by flowing humidified gas (500 ml/min) through the tents. The gas mixtures were checked daily by gas chromatography and adjusted if required. Within six hours after harvest the spears were placed in the test atmospheres and stored for four days at 20°C. After storage each bunch was held at 20°C in air to assess shelf life.

The atmosphere treatments were three levels of carbon dioxide 5%, 10%, 15%, (v/v) and two levels of oxygen 5%, 10% (v/v) in a factorial combination, compared with air alone.

Change in weight was recorded when the spears were removed from four days of storage in MA. Visual quality was rated using a 9-point scale described by King et al. (1986), in which a rating of 1 is excellent quality, and 6 is the end of shelf-life .

Sensory quality was measured using an experienced panel to assess asparagus which had been held in air for two days at 20°C following the four day simulated transit period. Acceptability was rated on a 150 mm linear intensity scale by 20 panellists.

4 RESULTS

The effects of the atmosphere treatment on quality of asparagus spears were quite substantial (Fig. 1). When expressed as residual shelf-life, spears from the MA treatments had more than four days remaining after the four day treatment period. In contrast, spears stored in air (control) had only 2.5 days of residual shelf-life. This effect was very highly significant statistically. However the effects of the different atmosphere mixtures used were not significant statistically, and the positive response was observed over the entire range of atmospheres tested.

Sensory assessment of the treated spears after a 2-day shelf-period following the 4-day treatment indicated a similar pattern (Fig. 2). Control spears were markedly less acceptable than spears from the MA treatments. This was highly significant statistically, but there was no significant differences between the MA treatments. There was no clear optimum atmosphere composition amongst the mixtures used.

Weight loss of the spears was monitored over the treatment period and in all treatments was less than 3%. Differences in quality between treatments is not, therefore, likely to have been caused by differences in weight loss.

5 DISCUSSION

These results showed a spectacular response to atmosphere modification during a short period under warm conditions. This confirms observations made in the previous season and provides strong support for embarking on further development of packaging systems for modifying atmospheres in air-freighted asparagus.

It is particularly encouraging that the response occurs across a broad range of atmospheres. This makes the task of developing suitable packaging rather easier because the target atmosphere is not narrow.

The next phase of the project will involve using information on asparagus respiration rates over a range of atmospheres and temperatures to design plastic film packages which allow the development of an appropriate atmosphere mixture during conditions anticipated on air-freight shipments. The respiratory information is available from a Crown-funded project, and plastic films with a wide range of permeability is available from a number of film manufacturers and distributors. Using this information we will calculate pack dimensions and content of asparagus which give the best internal atmosphere. Testing of these packs will be necessary to verify that predicted performance matches actual performance.

6 REFERENCES

King, G.A.; Henderson, K.G.; Lill,R.E. 1986: Asparagus: effect of controlled atmosphere storage on shelf-life of four cultivars. *New Zealand Journal of Experimental Agriculture 14*: 421-424.

Lill, R.E.; Corrigan, V.; van der Mespel, G.J. 1992: Asparagus - controlled atmospheres for air shipment. *Report to the New Zealand Asparagus Council, April 1992: 7.*

Figure 1: Residual shelf-life of asparagus after atmosphere treatments at 20°C for four days. Atmosphere mixtures ranged from 5% oxygen with 5% carbon dioxide to 10% oxygen with 15% carbon dioxide.

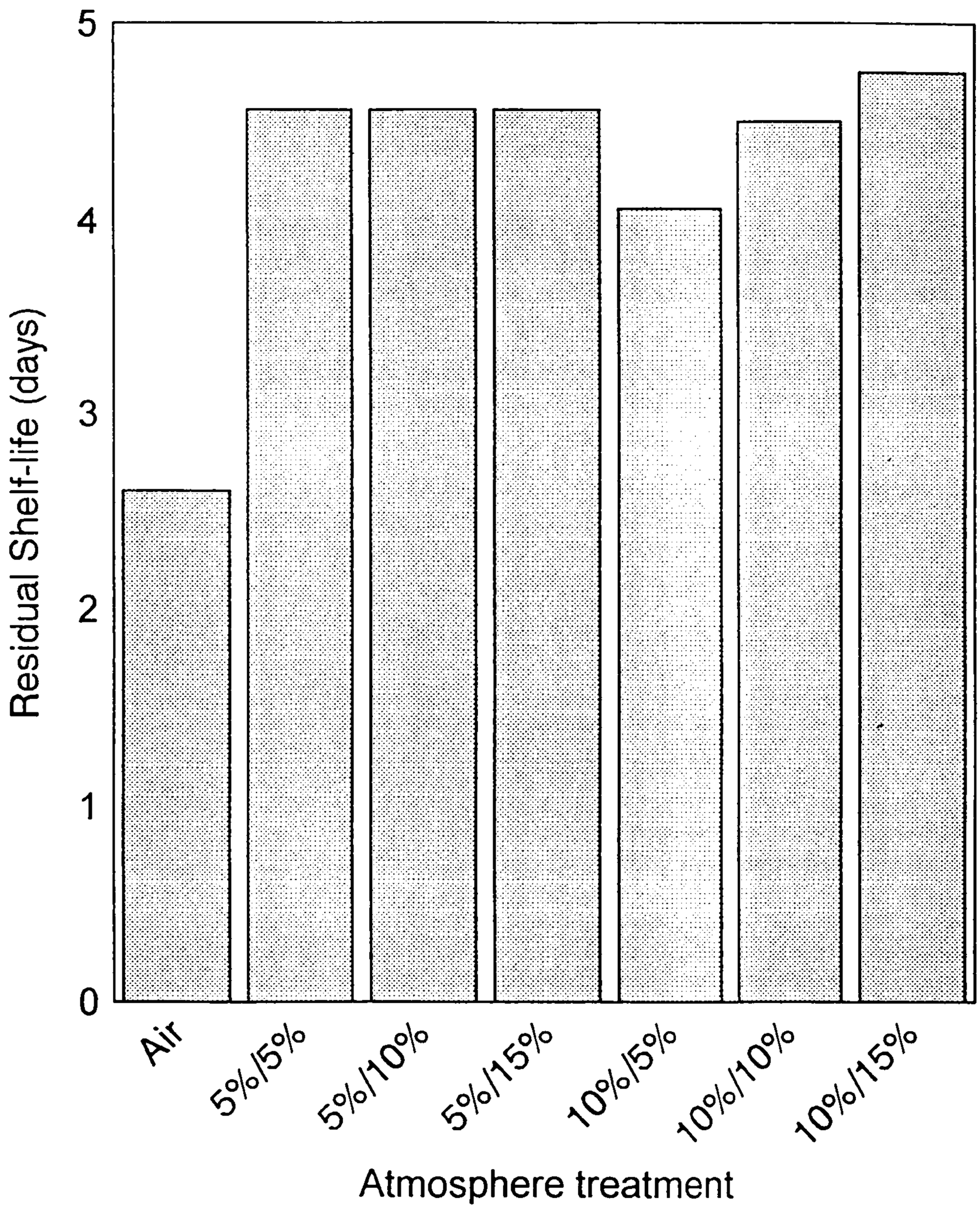

Figure 2: Acceptability of asparagus to panellists after four days of atmosphere treatment at 20°C followed by 2 days in air at 20°C. Acceptability ratings were on a scale of 0 = low to 150 = high. Atmosphere mixtures ranged from 5% oxygen with 5% carbon dioxide to 10% oxygen with 15% carbon dioxide.