

Potential of the 'Hall's Avoscan' as a Tool to Identify Soft Fruit during Packing for Export

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ABSTRACT

Non-destructive electronic on-line firmness checking is being used with great effectiveness in Europe to categorise ripened fruit in firmness categories before pre-packing. This effort has allowed retailers to offer the consumer a high quality 'ready-to-eat' product. The present study was conducted to establish the potential use of such an apparatus, the Hall's Avoscan system, in South African packing houses. The aim was to determine whether it is possible to identify problem fruit with a high chance of premature softening during the journey. In addition, the ripening patterns of the sound fruit were categorised to establish to what extent fruit retain their firmness ranking from packing to consumption. To do this 6 experiments were conducted, two each with Fuerte and Hass as well as one each with Edranol and Pinkerton. The results indicated that the Hall's Avoscan is effective in identifying soft fruit before packing and will enable the diversion of these fruit to alternative local markets. The category means of sound fruit further remained in the same order from packing until consumption. It will, therefore, be worthwhile to investigate appropriate cold storage regimes for the different categories. However, due to considerable overlapping between the categories during ripening, all fruit require rescanning before pre-packing.

UITTREKSEL

Nie-beskadigende elektroniese fermheidsmeting in die paklyn word met groot sukses in Europa gebruik waar vrugte gesorteer word in klasse van rypheid voor herverpakking. Die meting stel die handelaar in Staat otn 'n hoe gebalte 'reg om te eeC produk te verskaf. Die huidige studie is uitgevoer om die potensiele gebruik van die apparaat, die Hall's Avoscan sisteem, in Suid-Afrikaanse pakhuse re bepaal. Die doel was om vas te stel of dit moontlik is om probleemvmgte wat moontlik tydens verskeping te vroeg ryp word, te identifiseer. Terselfdertyd is die rypwordingspatroon van die vragte gekategoriseer om die tendens van fennlied te volg vanaf verpakking tot verbruik. Om dit te kon doen is ses proewe uitgevoer, twee elk met Fuerte en Hass asook een elk met Edranol en Pinkerton. Die resultate net getoon dat die 'Halls Avoscan' we) die vrugte wat te sag is voor verpakking kan identifiseer sodat die vrugte na altematiewe plaaslike markte gekanaliseer kan word. Die 'gesonde' vrugte het wel in hul betrokke volwassenheidsgroepe gebly vanaf verpakking tot verbruik, Dit sal dus die rnoeite werd wees om verskillende opbergingsisteme vir die verskillende groepe te ondersoek. As

gevolg van oorvleueling van die verskillende groepe tydens rypwording sal die vrugte egter weer getoets moet word voor herverpakking.

INTRODUCTION

Various means have been implemented in recent years to provide European customers with a quality guaranteed product. Avocados were previously sold in a hard state by retailers and ripening of the fruit was left to the housewife. In recent years a major proportion of the fruit supplied to department stores are ripened and pre-packed before delivery. This system has improved customer satisfaction to a great extent.

A critical step in the ripening and pre-packing chain, is the grading of fruit into firmness categories. To do this, a technique has been developed by H L Hall and Sons which is based on electronic firmness testing of the fruit. According to the company this device, the Hall's Avoscan, has proved to be exceptionally useful and is one of the reasons for negligible consumer complaint rates registered by retailers to whom they supply ready-to-eat fruit.

An aspect which is extremely worrying to exporters of South African avocados is the softening of fruit during the sea voyage. Soft arrivals influence the marketing process adversely and should be avoided at all costs. The identification of problem fruit during the packing process is therefore a high priority to the industry. Considering the success attained with the grading of ripened fruit with the Hall's Avoscan in Europe, it was decided to establish the potential of the apparatus in identifying problem fruit before packing.

In the present study the primary aim was to establish whether the Hall's Avoscan can be used to identify fruit with a high risk of softening during shipping. The softening patterns of the fruit were also used to make suggestions on future research as to further possible uses of the machine.

MATERIAL AND METHODS

A total of six trials were conducted, two each with Fuerte and Hass and one each with Edranol and Pinkerton. Between 120 and 150 fruits per trial were used.

A benchtop model of the Hall's Avoscan was used to grade the fruit. A hand-held densimeter for which avocado firmness data have been published (Melia-Kluber, 1996) was used as reference instrument. Five readings were taken with each instrument on the day of harvest after which the fruit were stored for 25 days at the storage regime used by the industry at the time. The measurements were repeated at the end of the storage period and at 2-3 day intervals during the shelf life period. A pattern was marked on each fruit before the first measurements were taken so as to ensure that the repetitions are comparable and that measurement sites were not superimposed.

RESULTS AND DISCUSSION

The means recorded per arbitrary category during the Pinkerton trial are displayed as

an appropriate example of the general trend in figure 1. From the figure it is clear that the interval means retained their sequence at removal from storage during the subsequent ripening phase. The standard deviations, however, indicated that considerable overlapping occurred between the various categories, especially during ripening. The differences between the means of the categories further narrowed as the fruit softened. This effect was most notable in Edranol (figure 2), probably because of uniform hardening of the skin in all firmness categories of this specific cultivar during ripening.

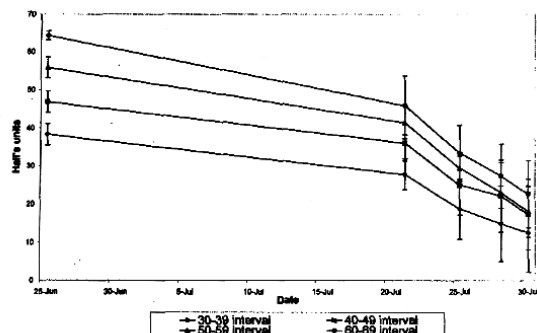


Figure 1. Mean Hall's Avoscan firmness readings with standard deviations (vertical bar = 1 SD) per interval recorded for Pinkerton stored under export simulation conditions

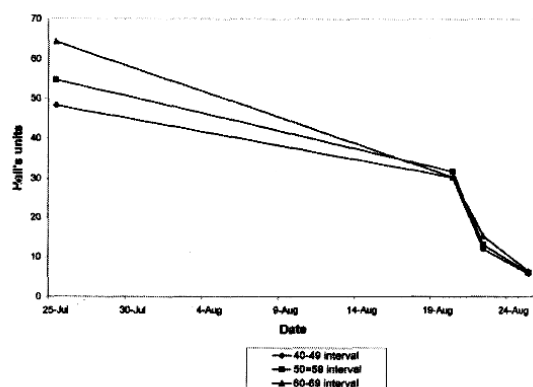


Figure 2. Mean Hall's Avoscan firmness readings per interval recorded for Edranol stored under export simulation conditions

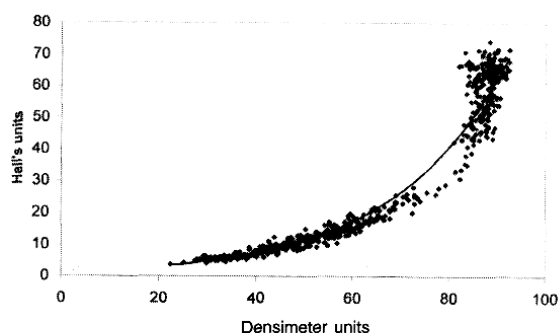


Figure 3. Relationship between the Hall's Avoscan and the Densimeter as recorded during the second simulation trial with Fuerte ($R^2=0.876$)

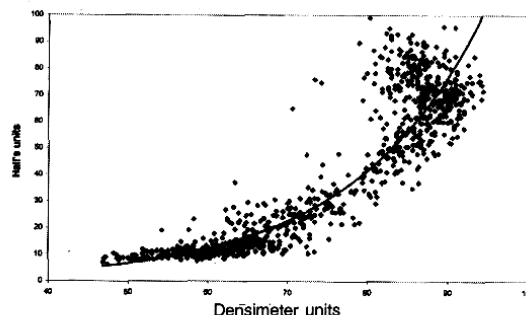


Figure 4. Relationship between the Hall's Avoscan and the densimeter as recorded during the second simulation trial with Fuerte ($R^2=0.803$)

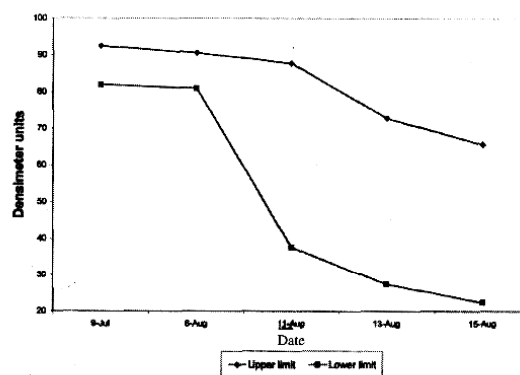


Figure 5. Firmness range recorded with the Hall's Avoscan for Fuerte (second experiment) when stored under export simulation conditions

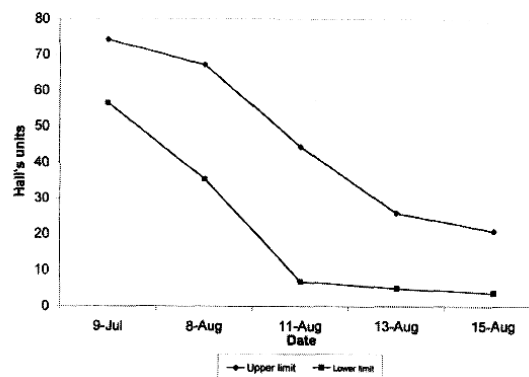


Figure 6. Firmness range recorded with the Densimeter for Fuerte (second experiment) when stored under export simulation conditions

A good correlation existed between the readings taken with the Hall's Avoscan and the densimeter. The R values proved to be higher in a smooth skinned variety such as Fuerte (figure 3) than in a rough skinned variety such as Hass (figure 4). In both varieties, the correlation was particularly good at the soft end of the scale and not that good at the hard end of the scale. The span of measurements recorded by the densimeter (figure 5) prior to storage was narrower than that of the Hall's Avoscan (figure 6). This and other observations led us to believe that the densimeter is more sensitive on the soft end than on the hard end of the scale.

In five of the six trials conducted, few or no soft fruit were encountered during the prestorage evaluation. The Pinkerton sample was the only one to contain fruit which were considerably softer than the bulk. These fruit further retained this status at the conclusion of the storage period when expressed as a category based on sequence (figure 7). On account of the above and the other data presented in this paper it would be fair to make the deduction that the Hall's Avoscan has the potential to sort out problem fruit which are too soft to be exported. However, it is not at this stage possible to provide accurate information on cultivar specific cut-off points to be used in a packinghouse. Nevertheless, preliminary information does exist. Melia-Kluber (1996) conducted an evaluation of the densimeter during which Fuerte and Hass were categorised into semantically described categories. In an attempt to define corresponding categories, the listed values in table 1 were calculated using the relationship recorded between the densimeter and the Hall's Avoscan.

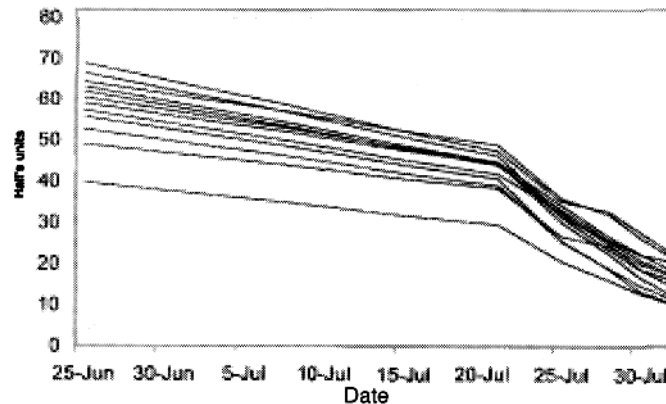


Figure 7: Mean Hall's Avoscan firmness readings per group of ten Pinkerton fruit which were stored under export simulation conditions. Note that the softest group at packing was clearly discernible from the other groups at the end of the storage period. During the ripening phase the gap between the latter group and the firmer fruit gradually closed

From the results it is clear that, in addition to the soft fruit identification feature, the packinghouse sort can be used to temporary categorise the fruit without replacing the post-ripening sorting process. Experimentation on category specific temperature regimes seems to be warranted at this stage, albeit on condition that the differences between the regimes are not too great. Our future research will cover the above, but will initially concentrate on refining the cut-off points for potentially problematic fruit.

Investigations into the application of the technique to specific problems currently encountered in the South African export industry, e.g. the internal browning problem of Pinkerton, will also be a high priority.

Table 1. Categorized relationship between the Hall's Avoscan and the densimeter. The category classification for the Hall's Avoscan was derived at by comparing the work done on the densimeter by Melia-Kluber (1996) with the current results (two trials conducted on each cultivar)

Category	Fuerte		Hass	
	Densimeter	Hall's Avoscan	Densimeter	Hall's Avoscan
Very hard	>90	>62.4	>96	>92.9
Hard	85-89	50.3-62.4	92-95	79.9-92.9
Firm	82-84	43.9-50.2	90-91	73.8-79.8
Breaking	77-81	34.7-43.8	86-89	62.2-73.7
Soft	61-76	16.2-34.6	74-85	33.7-62.1
Very soft	49-60	8.9-16.1	65-73	18.4-33.6
Eat-ripe	<48	<9.8	<64	<18.4

REFERENCE

MELIA-KLUBER, M. 1996. Tests on the experimental variation and non-destructive measurement of flesh firmness in the avocado. M.Sc. thesis: Institute for Fruticulture, University of Hohenheim, Germany.