AVOCADO QUALITY ON THE RETAIL SHELF: WE ALL HAVE A ROLE TO PLAY

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Summary

About 40% of 'Hass' avocado fruit sampled from the wholesaler, the distribution centre of the retail chains, on arrival at the retail store, or from the retail shelf, had at least 10 % of the flesh affected by defects. Body rots (caused mainly by anthracnose) and flesh discolouration caused mainly by bruising, were the most common defects. We consider the following practices require improvement if better quality fruit is to be offered to the consumer:

- Control of rots by the grower and packer.
- Reducing the time from picking to consumption by better co-ordination between the grower/packer, the wholesaler and the retailer, so that over-supply at the wholesaler is reduced.
- Better stock rotation at wholesale and retail level, to reduce the risk of lines being "forgotten" or lost. That is, increase the adoption of "first in-first out".
- Improving retail staff awareness that ripe fruit are very susceptible to bruising and disease, that near-ripe fruit must be sold quickly or displayed at 4°C, and that over-ripe fruit need to be removed from display.
- More attention to the risk of bruising during harvest and packing.
- Developing better packaging and handling practices to reduce impact damage after the farm gate.

Introduction

Numerous studies over the last 10 years have shown that 'Hass' avocados on the shelf in Australian retail stores have poor internal quality. There is little evidence that fruit quality has improved over these 10 years, despite extensive training programs ((Hofman and Ledger 1999). As a result the Australian Avocado Growers Federation, the Horticultural Research and Development Corporation (now Horticulture Australia Ltd; HAL) and the Avocado Industry Commission (NZ) commissioned a program which we call ***Avoca***re, to identify those practices causing poor quality on the retail shelf, and to help develop and implement better practices to improve quality on the retail shelf.

The project established a Supply Chain Improvement Group (SCIG) consisting of grower, wholesaler, retail chain, HAL and New Zealand representatives, to help develop methods for the surveys, and the best ways of encouraging improvements.

The project team conducted two retail surveys in June and September 2000. The results and observations are reported in this paper.

Methods used

In the first survey, fruit were sampled from selected lines on arrival at the retail store and from the retail shelf in a representative Woolworths, Coles, and Franklins store. The first sampling point provided an indication of fruit quality on arrival at the store, and the second provided an indication of the loss of quality due to store and consumer handling.

At the start of each day of the survey, before the shelves were re-stocked, the stickers on every fruit for each new delivery were colour coded. Fruit remaining in the cold room or preparation room and on the shelf were counted to track stock movement in the store. Fruit movement prior to the retail store was traced by recording the packing date or code from the end of the tray and the handling conditions at the wholesaler.

The second survey focussed on the potential for quality loss between the wholesaler and the retail store. Fruit were sampled from selected lines just before dispatch from the wholesaler to the retail distribution centres. Samples were also taken from the same lines at dispatch from the distribution centre and on arrival at the store, before being placed on the display shelf.

In both surveys, the sampled fruit were transported immediately to the postharvest laboratory at the Maroochy Research Station, Nambour. Skin colour and fruit firmness were assessed and a photograph taken. Fruit that were ripe were assessed immediately for internal quality, and the remainder placed at 20^{o}C and assessed at the eating soft stage. The severity of the defects was recorded using a percentage rating scale, based on the avocado defects manual developed for the project.

In both surveys, fruit samples were taken every day (except Sundays) for two weeks. A total of 3400 fruit from 33 growers/packers were assessed over the two surveys.

Photo 1. Typical discrete discolouration observed during survey 1

Photo 2. Discrete discolouration observed during survey 2

Findings

Fruit quality

Figure 1 shows the average incidence of internal defects for all lines sampled across all sampling points in the two surveys. The percentage of fruit with at least 10% of the flesh affected is presented for each defect, and for all defects combined.

In both surveys, almost 40% of the fruit had at least 10% of the flesh affected by defects. Discrete discolouration, caused mainly by bruising, was the most common defect in survey 1 (see photos 1 and 2). In the second survey, body rots caused mainly by anthracnose (see photo 3), were equally common.

Photo 3. Examples of body rots and stem rots observed during the retail surveys

The level of stem rots (photo 3) was similar for both surveys. Vascular discolouration was often associated with stem rots, but can also be caused by physiological disorders. Seed cavity browning often appeared to be associated with mild

impact damage from seed contact with the flesh, but may also be a physiological disorder. Diffuse discolouration of the flesh, usually caused by storing fruit at the wrong temperature for too long, was limited to a few specific lines.

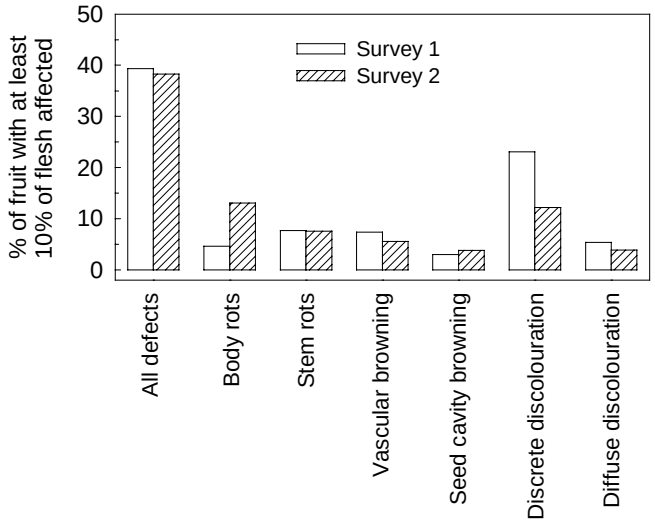

Figure 1. The average incidence of internal defects for all lines sampled across all sampling points in the two surveys. The percentage of fruit with at least 10% of the flesh affected is presented for each defect, and for all defects combined.

Where is bruising occurring?
In survey 1, we found significant bruising before the fruit were placed on the shelf. The damaged areas were often large with dark discolouration (see photo 1). There were also indications in some of the lines that damage was greater in fruit after several days on the retail shelf. We suspect that when consumers squeeze fruit they cause damage to soft fruit but little damage to firmer fruit. Therefore, firmer fruit showed little change in bruising damage with longer times on the shelf.

In survey 2, bruising was present at all sampling points from wholesaler dispatch to arrival at the retail store. The damage was often less severe with smaller areas affected (see photo 2). We think this may be partly caused by impact damage to firm fruit, as we have observed similar symptoms on fruit obtained directly from the end of the packing line.

These results indicate that bruising can occur at all steps in the chain, and that improvements are required by all fruit handlers. The softer the fruit, the more susceptible the fruit are to bruising.

What causes rots?
Growing and packing practices and delays in the supply chain affected the level of rots in both surveys.

Figure 2 shows the incidence of fruit with at least 10% of the flesh affected by body and stem rots for lines sampled on arrival at one store in survey 2. There were large

differences in both stem and body rots in fruit from different lines/growers. This would result from practices on the farm and in the packing shed, such as orchard spray programs, orchard age, nutrition, rootstock, and postharvest fungicide applications.

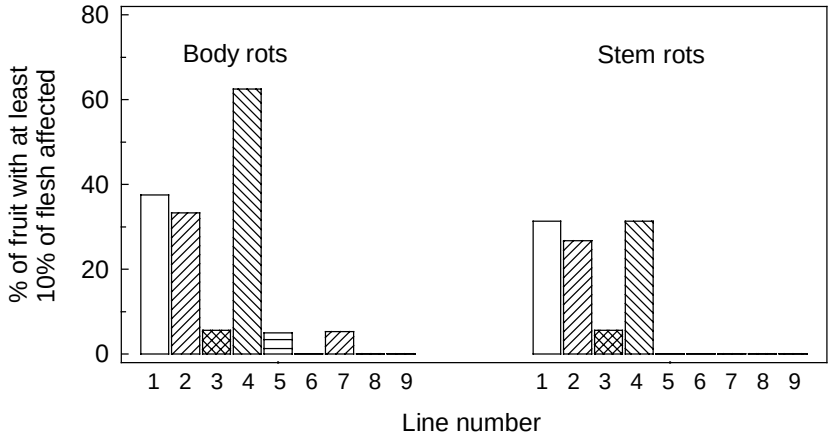

Figure 2. The incidence of fruit with at least 10% of the flesh affected by body and stem rots for lines sampled on arrival at one store in survey 2.

In addition, excessive delays between harvest and consumption can result in more rots. Figure 3 shows that as the time from packing to dispatch from the wholesaler increased for survey 2, so did the level of body rots. Similar results were obtained for diffuse discolouration,

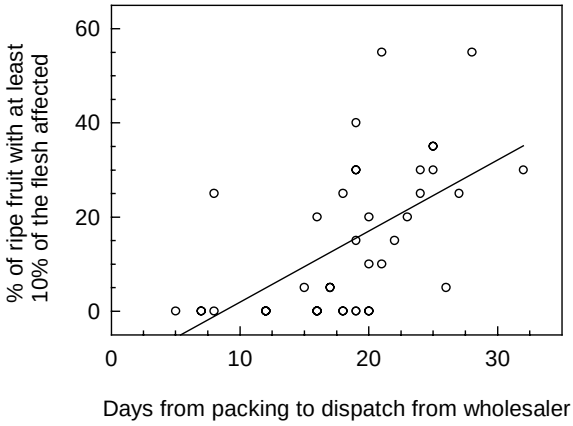

Figure 3. The relationship between the number of days from packing to dispatch from the wholesaler, and the percentage of the fruit with at least 10% of the flesh with body rots.

In survey 1, the average time from packing to retail sale was 22 days (Table 1), but the time at each step varied considerably between lines.

Table 1: The time that Hass avocados were held at each step in the supply chain during survey 1.

Step	Number of days at each step	
	Average	Range
Grower to wholesaler	4	1-12
Holding before ripening[1]	4	0-14
Ripening	4	2-6
Ripening to dispatch to retail DC	3	0-21
Retail distribution centre	1	1-5
Retail store cold / preparation room	2.5	1-7
Retail shelf	3.5	1-11
Total time	22	

[1]Ripening here means the period that the fruit are placed at the ripening temperature (often with ethylene) to start the ripening process.

On average, the fruit spent 6 days in the retail store, with some lines taking up to 11 days to sell. Delays were usually due to:

- poor stock rotation in the cold room, so that recently delivered lines were placed on the retail shelf before lines that were delivered in previous days. This was especially obvious when sales were slow or when excess supplies were delivered to the store.
- over-supply of fruit to the store.
- reduced sales because of backward fruit on display.
- placing stock in parts of the display that are not frequently picked over by the consumer, especially when this is combined with poor stock rotation on the shelf.

Delays in consumption of ripe fruit can have a significant effect on quality. Previous studies (Ledger and Barker 1995) have shown that quality can deteriorate rapidly once the fruit have reached the eating soft stage, and in some cases will start to decline before this stage. For example, in one study no body rots were present when fruit first reached eating ripe. After a further 3 days at 20°C, 16% of fruit had body rots while after another 2 days, the level increased to 60%.

The thick skin of 'Hass' can sometimes make it difficult to determine if the fruit has reached the eating soft stage. Skin colour is not a good indicator of ripeness as fruit often reach eating ripe before the skin is completely black, particularly if the fruit are ripened at lower temperatures (about 15°C) and with early season fruit. This means that fruit rots can develop in the retail store if fruit is not rotated and sold quickly. The most effective way of alleviating this problem is to hold fruit at low temperatures (<4°C) once fruit are near-ripe.

Packaging effects

During the surveys, we noted that there was less body rots and diffuse discolouration in fruit from the open top tray (usually the P84 tray) than the two piece lidded tray. This may

be due to better airflow with the open top tray, resulting in improved temperature control and ripening. It may also be a grower effect, as only a few growers were using this tray and they may produce better fruit.

Package collapse was noticeable in the two piece lidded tray, particularly towards the bottom of the pallet. The collapse was caused by mis-alignment of the trays on the pallet and insufficient stacking strength for the high humidity conditions during ripening. In the collapsed packages, compression damage to the top of fruit was obvious but it did not cause flesh discolouration. However, considerable expense was incurred by the wholesaler in re-stacking the collapsed pallets, since these pallets are not accepted by the retail chains.

Our observations suggest that the lidded tray provides handlers with a false impression that the lid offers protection to the fruit. In contrast, the open top tray appears to be handled more carefully as it needs to be located correctly. The main constraint with the open top tray is that it can be difficult to inter-stack with other produce packages when assembling pallets for dispatch to retail stores.

Presenting better fruit to the consumer – challenges and opportunities

The surveys have identified bruising and fruit rots as the main defects causing quality loss of 'Hass' fruit. Bruising can potentially occur at all steps in the supply chain. Growing and packing practices and delays in the chain affected the level of rots. To increase the quality of 'Hass' fruit on the retail shelf, improvements need to occur at all steps in the chain.

Rots

- Improved farm and packhouse practices are needed to control rots. The avocado industry is investing heavily in this area already, with a multi-pronged approach involving improved fungicides, fruit nutrition and rootstocks.
- Better coordination of supply and retail sales is required to improve product flow and reduce times in the supply chain. For example, we observed that retail sales generally doubled during sales weeks compared to non-sales times, but fruit supply to the wholesaler remained relatively constant. Also, lines were delivered to the wholesaler without notice from the grower, and from growers unknown to the wholesaler. These practices require that the wholesaler retain a stock of fruit to "buffer" against these supply/sale fluctuations. The larger these fluctuations, the larger the buffer of fruit required, and the longer the time for picking to retail sale.
- Better co-ordination and communication is required between grower, packer/marketer, wholesaler and retailer to match the delivery of fruit to the wholesaler with retail sales.
- One approach to reducing the average time from packing to sale is to reduce the risk of lines being "lost in the system", which is one of the causes for the extended delays at each step as listed in Table 1. Practices that help achieve the objective of "first in-first out" at the grower/packer, wholesaler and retail store would assist in reducing such delays. Some way of clearly labelling lines with information such as the packed date, received date and conditions on receival would help in making decisions about which lines need to be sold first. The AAGF are considering obtaining input from experts from manufacturing and other industries to assist in this area.
- Improved understanding by retail handlers of the interaction between the stage of ripeness and the development of rots is required. Also, stock movement needs to be improved on the retail shelf to ensure that:

- near ripe fruit are displayed at about 4°C.
- ripe fruit are sold quickly by ensuring that they are placed in the location where the consumer is most likely to buy them.
- over-ripe fruit are quickly removed from the shelf.

These practices will also reduce the levels of stem rots, vascular browning and diffuse discolouration.

Bruising
More careful handling is required at all steps to reduce bruising from impact damage.

At farm/packing house
The perception that firm avocados are resistant to impact damage is probably not correct, and more attention needs to be given to minimising impacts during harvest and sorting/packing. The effect of handling during harvesting and packing on internal bruising will be investigated in future AAGF/HAL projects.

After the farm gate
Further investigations are required to develop practices which reduce impact damage during distribution. Several approaches can be taken:

- We believe that lidded trays are more likely to be mis-handled at wholesale and retail level because of the false impression that the lid offers some protection, and that it prevents fruit from falling out of the tray if the tray is roughly handled. We intend to investigate this in more detail in future projects.
- Better packaging by improving the tray or the liner, may provide more protection against impact damage. This will be discussed with suitable packaging companies.

Consumer education
'Hass' avocados generally can be eaten about 3-4 days after being sprung. The flesh is "spreadable" though firm, and eating quality is acceptable. We believe the Australian consumer eats avocados 3-4 days after this stage, when the flesh often tastes better but is more likely to have defects. Therefore, educating consumers to eat firmer avocados when defects are less, may be worthwhile.

We also need to educate them that skin colour is not a good indicator of ripeness, since early season fruit do not colour as well as more mature fruit, and lower ripening temperatures result in lighter coloured skin (but less rots). In fact the message is to avoid black fruit, since they are likely to be over-ripe. A better test of ripeness is firmness, but we need to develop smart ways of getting this message across without encouraging the consumer to squeeze every fruit on the shelf.

Literature cited

Hofman, P.J. , Ledger, S.N. 1999. Retail surveys show little quality improvement. Talking Avocados, 10, 22-23.

Ledger, S.N. , Barker, L.R. 1995. Black avocados - the inside story. Proceedings of the Australian Avocado Growers' Federation Conference "The Way Ahead", p. 71-77.