

Solving the 'Hass' skin colouring riddle

When consumers feel they cannot trust the external appearance of an avocado to tell them when the inside is ready to enjoy, exports come under threat. Fortunately a recently completed three-year study provided some answers.

THE SKIN COLOUR of 'Hass' avocados changes from green to purple to almost black when they ripen. This movement through the colour spectrum has become an established ripening indicator for growers and consumers alike.

In recent years, however, this ripening guide seemed to have failed markets importing 'Hass' avocados from South Africa. In some consignments, variable colouring and colouring that did not correspond with the softening of the avocado flesh, have resulted in quality challenges.

Consequently, consumers in especially our most lucrative export markets have started questioning the reliability of colour changes as a ripening or softening indicator.

Realising the threat that such doubts pose to the South African avocado industry's credibility and ultimately market share, the South African Avocado Growers' Association (SAAGA) commissioned the Post-harvest Technologies Division of the Agricultural Research Council's Institute for Tropical and Subtropical Crops (ARC-ITSC) and Lowveld Post-harvest Services to determine the pre- and post-harvest factors that could be causing the problem.

Leading the study was Dr Nhlanhla Mathaba from the ARC-ITSC, assisted by Dr Thieho Mafeo from the University of Limpopo.

"Our local industry cannot afford to compromise its competitive position," says Nhlanhla. "It might not be able to reclaim lost ground, given that countries like Chile, Peru and Australia, whose production seasons are similar

to ours and that don't have the 'Hass' colouring problem, will only be too happy to step into the breach."

The industry and PHI Programme-funded study was done over two years, with each season's findings used to inform the objectives of the next year. The outcome was a cumulative set of results that painted a clear picture of the factors that influence variable colouring.

2014

In 2014 SAAGA funded the research. Building on previous studies that have indicated that skin colour change is affected by ripening temperatures, Nhlanhla designed a study to investigate the role of orchard block slope, harvest maturity and ripening temperature on variable colour change in 'Hass' avocado fruits.

'Hass' avocados were harvested in May, June and July – to represent early, mid and late season fruit – from two blocks, each with an upper and lower slope, in the Kiepersol area.

The fruit was taken to the ARC-ITSC post-harvest laboratory where it was sorted and graded, and then stored at 5,5°C for up to 28 days. After withdrawal from cold-storage, fruit samples were ripened at 16°C, 21°C and 25°C, respectively. During ripening, the avocados were evaluated at 0, 2, 4, 6 and 8 days for firmness, skin eye colour, chromatic skin colour, and external and internal chilling damage.

“The results from this study confirmed that variable skin colour development during ripening is predominantly an early-season occurrence, regardless of production area, orchard slope, fruit canopy position, ripening temperature or post-harvest treatment with 1-MCP.”



1 Dr Nhlanhla Mathaba, project leader.

2 From left: Mr Sakhile Mathe (PhD student), Dr Nhlanhla Mathaba (project leader), Mr Justice Mlimi (laboratory assistant) and Mr Jan Ntandane (field assistant).

3 Consumers are willing to pay more for the convenience of buying pre-ripened 'Hass' avocados.



The research team concluded that the incidence of variable colouring in 'Hass' avocados during ripening is prevalent mainly in early harvested fruit, irrespective of ripening temperatures.

Interestingly, fruit harvested from orchard blocks with slopes was found to be most susceptible to variable colouring during ripening. In addition, variable colouring is escalated by external chilling damage, and external chilling damage is associated with fruit harvested from lower slopes.

2015

The 2015 study, which was funded by the PHI Programme, built on the 2014 outcomes, mainly to verify the pre-harvest factors that had been identified. In addition, it took inspiration from studies that had found that 1-MCP (1-methylcyclopropene) had an insignificant effect on the colour development of 'Hass' fruit during ripening.

The aims of the continuing research were therefore to investigate the effects of:

- 1-MCP and harvest time;
- production region, harvest time and orchard slope; and
- production region, harvest time and fruit canopy position, on 'Hass' avocado skin colour development during ripening.

For the 1-MCP and harvest time experiment, avocados were harvested in mid and late season in the Tzaneen area. They were sorted and treated with 1-MCP, and then placed in cold-storage at the ARC-ITSC post-harvest laboratory.

For the production area, harvest time and orchard slope experiment, avocados were harvested in early, mid and late season in the Tzaneen and Hazyview areas. The harvested fruit was sorted, graded and placed in cold-storage at the ARC-ITSC post-harvest laboratory.

For the production area, harvest time and fruit canopy position experiment, avocados were harvested in early, mid and late season in the Tzaneen and Hazyview areas, from both inside and outside the tree canopy. They were transported to the ARC-ITSC post-harvest laboratory in Nelspruit for sorting, grading and storage.

In all cases, the fruit was cold-stored at 5,5°C for 28 days, and then ripened at 21°C. During ripening, the fruit was evaluated for firmness, and subjective and objective colour.

The results from this study confirmed



PROJECT TITLE

Colour change problem in 'Hass' avocado

PRINCIPAL INVESTIGATOR

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CONTACT DETAILS

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DURATION

Two years

PHI PROGRAMME & INDUSTRY CONTRIBUTIONS

R627 200 & R247 200

LEAD INSTITUTION

ARC-Institute for Tropical and Subtropical Crops

BENEFICIARY

The subtropical fruit industry

FOCUS AREA

Post-harvest physiology and pre-harvest aspects

HUMAN CAPITAL DEVELOPMENT

One PhD student and one MSc student

PRESENTATIONS AND PAPERS DELIVERED

Four

PUBLICATIONS

Three

1 The impact of 1-MCP on the colour development of 'Hass' fruit during ripening is illustrated by the poor skin colour development of untreated avocados during early season.

that variable skin colour development during ripening was predominantly an early-season occurrence, regardless of production area, orchard slope, fruit canopy position, ripening temperature or post-harvest treatment with 1-MCP. The researchers did find that production site played a role, given that fruit from Tzaneen showed a higher de-synchronised colour change even during mid and late season. Similarly, inside canopy fruit seemed to display skin colour de-synchronisation even during mid and late season, as did fruit harvested from the lower parts of orchard slopes. The latter, however, was production site dependent.

2016
In the 2016 season, Nhlanhla and his team investigated whether girdling, which is a pre-harvest cultivation practice, drives sugars towards the fruit skin and, therefore, enhances anthocyanin synthesis. However, they found that



girdling only improved fruit size. The team concluded that the environment had a minimal impact on how colour developed in 'Hass' avocados, and that colour development could mainly be manipulated at protein and enzyme level. Consequently, a new research proposal on the impact of proteins and enzymes on anthocyanin synthesis and skin colour change will be drafted and submitted to the industry for consideration.

KNOW YOUR AVOCADO OIL

As the worldwide drive to live healthier lifestyles gathers momentum, avocado oil is becoming increasingly popular. It is not surprising, considering that the oil is derived from a fruit known for its health properties.

Avocado oil is packed with mono-unsaturated omega-3 and omega-6 fats, and is naturally cholesterol free.

Its high smoking point of 250°C means avocado oil is safe for high temperature cooking methods, such as frying, baking and roasting, and makes it a good substitute for sunflower and canola cooking oils.

Because of its neutral flavour, avocado oil can be used for a virtually unlimited variety of dishes without influencing the taste of the food.

In South Africa, Westfalia makes avocado oil from locally grown 'Hass' avocados.



2 For the 1-MCP and harvest time experiment, avocados were harvested in mid and late season. They were sorted and treated with 1-MCP, and placed in cold-stored at 5,5°C for 28 days, and then ripened at 21°C. During a six day shelf life simulation period it became evident that variable skin colour development during ripening was predominantly an early-season occurrence, regardless of treatment with 1-MCP. The team also found that fruit from orchards planted on slopes was more prone to variable colouring during ripening.