post-harvest pathology, food safety and disease control

Clean can be overkill

It is entirely possible that by sterilising fruit, producers are killing the very organisms that can protect their produce against post-harvest diseases and decay. Talk about throwing babies out with the bathwater…

The study found that bad bacteria, such as *E. coli*, *Salmonella* spp. and *Listeria monocytogenes* colonies on peaches and pears can potentially be controlled with 'good' yeasts such as *Aeromonas* spp. and many other isolated from the fruit surface.

THE PERCEPTION EXISTS that fruit with a high microbial load is of inferior quality, represents a food safety risk and is an indication of poor hygiene practices. This is all unfounded. In fact, fresh produce from the field carries its own natural microbial population that reflects the diversity and species richness typical of an ecosystem in balance. The latter is called a climax community.

Prof. Lise Korsten from the University of Pretoria's Department of Microbiology and Plant Pathology, explains that in nature, 'good' microbes usually keep the 'bad' ones under control. "Therefore, if we can determine the microbial dynamics of fresh, safe and healthy fruit, it will help us to understand how best to protect fruit against post-harvest and foodborne pathogens."

Current legislated standards and guidelines for fresh fruit are outdated and do not take new scientific data of healthy natural microbial loads into consideration. This situation places South Africa's international trade profile at risk. "The worldwide trend towards green standards should reflect new microbial ecological thinking," says Prof. Korsten. "Science develops continuously and the time has come for plant health and food safety assessments to be based on new scientific information about microbial loads that occur naturally on fresh fruit."

1 Prof. Lise Korsten and Research Coordinator, Dr Erika du Plessis.
2 Zama Zulu at work in the laboratory.

But how do we know which microbes are which and where do we draw the line between enough and too much? To help provide the answers, Prof. Korsten led a study to ultimately develop microbial threshold guidelines for the quality and safety of fresh produce in South Africa.

To achieve this aim, the study set out to:

- Establish the microbial profile and load of fresh fruit after harvesting.
- Develop the best, quickest and most suitable method to identify foodborne pathogens.
- Determine, at a post-harvest level, the potential microbial hazards of selected crops.

HOW IT WORKED

To meet the first objective of the project, peaches were sampled in the orchard, from crates at the pack house entrance and from boxes after packing, to determine the natural total microbial load on the fruit surface. Yeast numbers were similar in all three samples, while more fungi were detected on peaches from the orchard, than on pack house peaches. The counts for one of the villains, the foodborne pathogen *E. coli*, were similar in the orchard and in boxes after packing. *Enterococci* were present on the surfaces of peaches from the orchard but none were detected on peaches at the pack house entrance or after packing.

In achieving the second objective, the team compared rapid diagnostic methods. They first isolated and identified different microorganisms to provide a profile of potential high-risk pathogens. The microorganisms selected were *Eschericia coli* 0157:H7, *Listeria monocytogenes*, *Salmonella enterica* sp. enterica serovar *Typhimurium* and *Staphylococcus aureus*. In this regard, the project was a continuation of previous studies that have resulted in the development of a new pathogen database.

To meet its diagnostic method objective, the project did development work, using MALDI-TOF (matrix assisted laser ionisation – time of flight mass

HOW THE RESEARCH ADDS VALUE

The value of this project for the industry is that it:

- proposes more realistic guidelines for fresh fruit;
- develops a more effective identification system for food-borne pathogens on fresh fruit surfaces; and
- provides a microbial baseline for fresh produce.

PROJECT TITLE
The impact of post-harvest microbial dynamics on the quality and safety of fresh fruit

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DURATION
Two years

PHI-2 CONTRIBUTION
R610 236

LEAD INSTITUTION
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BENEFICIARY
The deciduous and subtropical fruit industries

FOCUS AREA
Post-harvest pathology, food safety and disease control

HUMAN CAPITAL DEVELOPMENT
One BSc, one BSc Honours, one post-graduate and one BTech student

PRESENTATIONS AND PAPERS DELIVERED
Two

A combination of identification methods should be used to determine the presence or absence of food-borne pathogens. Although the *E. coli* levels in some of the irrigation water sources were found to be higher than the maximum of ≥1000 cfu/100ml stipulated in the irrigation water guidelines (DWAF 1996), the microbial load on fruit surfaces were much lower. This shows that a direct link between contaminated water and fruit health cannot always be made.

spectrometer) equipment and a new state-of-the-art molecular detection system called Multiplex PCR.

This part of the study proved the complexity of determining whether or not harmful bacteria are present on fruit. For example, the *Salmonella* colonies isolated on chromogenic media and considered presumptive 'baddies' were proved to be false positives when using the MALDI-TOF system. However, the MALDI-TOF could not be used to confirm the identities of the presumptive *Listeria* colonies. This was done through sequencing.

It was also found that when it came to *Escherichia coli*, *Salmonella spp*, *Staphylococcus aureus* and *Listeria spp*, selective enrichment and plating onto chromogenic selective media could not be considered a reliable method. MALDI-TOF analyses correctly identified 94% of the pathogens. The molecular detection system can determine the presence of the foodborne pathogens quicker and more accurately.

WHAT THEY FOUND

The study confirmed that the current microbial specifications used as guidelines for raw fruit and vegetables (issued by the Department of Health Directorate, Food Safety, South Africa) are not based on new scientific data of actual healthy, natural microbial loads. For example, existing microbiological specifications for raw fruit and vegetables state that there should be no *E. coli* per 1g of product. It is proposed that the guideline should rather specify 'human pathogenic' *E. coli*, since environmental, non-pathogenic *E. coli* exists everywhere in nature. This example underscores the value of the project's proposal to set more realistic guidelines for fresh fruit.

Furthermore, existing diagnostic methods are not fit for purpose, as Prof. Korsten explains. "Traditional methods that are currently used are based on selective media and provide only presumptive organisms. It is proposed that a multi-method approach be used – as was done in the study – to confirm pathogen prevalence. This will certainly benefit food safety risk management systems in the supply chain."

Now that the study has been completed, the data from all the trials must be compared to calculate a national average that will represent a natural microbial load on a fresh product. From there, fruit quality and safety standards and guidelines can be established for the South African fresh fruit export industry.

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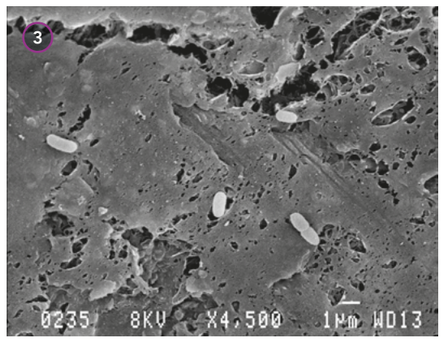

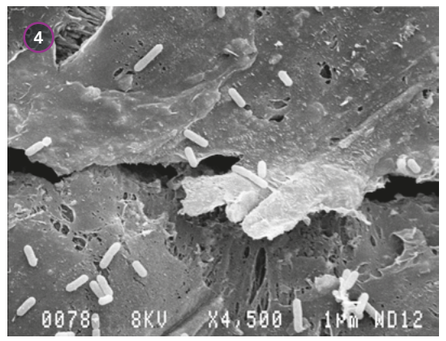

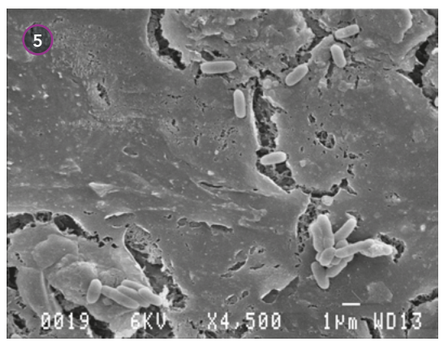

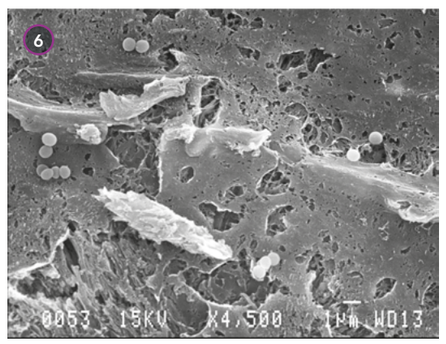

1 Quinton Volschenk (BSc Honours student) and Francois Duvenage (research assistant).
2 *Salmonella enterica* on selective chromogenic media.
3-6 Scanning electron micriscopy (SEM) photos of human pathogenic microorganisms: *E coli* on pear surface [3]; *Listeria monocytogenes* on pear surface [4]; *Salmonella Typhimurium* on pear surface[5]; *Staphylococcus aureus* on pear surface [6].