BIZCOMMUNITY

Pomegranate PhDs: Research into the super fruit's quality, packaging and shelf life

Both Ebrahiema Arendse from Surrey Estates in Athlone and chemical engineer and food scientist Zinash Assefa Belay hails from Addis Ababa received their PhD in Food Science from Stellenbosch University's Faculty of AgriSciences. Both did their research on pomegranates.

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One of their fellow students and research compatriots, Karen Munhuweyi, was also scheduled to formally receive her PhD (also for work related to pomegranates) in December. Late into her second pregnancy and on doctor's orders, she decided not to travel from Johannesburg to Stellenbosch for the graduation ceremony, but to defer receiving her own doctorate until March next year.

Theirs would otherwise have been the largest group of students so far to simultaneously receive PhDs from Stellenbosch University for work about this so-called "super fruit". Pomegranates are becoming increasingly popular worldwide because of the health benefits and aesthetics attached to them.

The three students each worked on different aspects of the fruit's quality, packaging and shelf life. Dr Arendse adapted existing scanning techniques into a non-destructive quality control method for pomegranates. Dr Belay established the optimal temperature conditions, gas combinations and the type of packaging film material that maintains the quality and shelf life of pomegranate arils. Dr Munhuweyi developed a method to trap essential oils like cinnamon into a fume, which then could provide the fruit with a protective layer against fungi like Botrytis that often cause decay and rot. This leads to postharvest losses and reduced profitability.

> *If we can provide excellent science, we can help our producers gain an edge.*

Part of a bigger plan

Their work forms part of the endeavours of the DST-NRF South African Research Chair in Postharvest Technology in the SU Department of Horticultural Science. Under the leadership of agricultural engineer Prof Umezuruike Linus Opara, scholars and students have over the past eight years established the best ways to handle and market pomegranates once these fruits are harvested. They have among others established protocols for when varieties such as "Wonderful", "Acco"

and “Herskowitz” should be harvested, what the best packaging materials and methods are, what the optimum storage conditions should be and tested ways to increase shelf life.

“South Africa competes with countries such as Chile and Argentina to supply in the off-season demand for pomegranates for consumers in the Northern Hemisphere,” says Opara, who is recognised globally as the leading researcher on pomegranate-related postharvest technology. "If we can provide excellent science, we can help our producers gain an edge."

Opara and his multi-disciplinary research team have already contributed a wealth of knowledge about best practices to South Africa’s emerging pomegranate industry. The past six years have also seen the graduation of 20 MSc students and 14 PhD students from a variety of interdisciplinary fields – from food science to engineering and horticulture. These efforts are not only funded through the Department of Science and Technology’s South African Research Chair Initiative but also through the Postharvest Innovation Fund, the Pomegranate Growers’ Association of South Africa (POMASA), the Perishable Products’ Export Control Board and Biogold International (Ltd).

Arendse: Quality control without having to cut fruit open

Dr Ebrahiema Arendse. Photo: Engela Duvenage

Dr Arendse matriculated from Athlone High School in 2002. His aunt, a lecturer in nursing, motivated him to enrol at New Hope School of Nursing. He excelled in his studies but had his heart set on becoming the first member of his family to gain a university degree. However, he first had to overcome a significant hurdle: to improve his physics and mathematics matric marks so that he could gain university access. After successfully completing evening classes at Garlandale High, he enrolled at the age of 23 years old at Stellenbosch University.

He received his first degree in 2009 – a BSc in Life Science, followed by an BSc Honours in Microbiology. A stint as a researcher in Prof Opara's postharvest team was just the impetus he needed to first complete a MSc degree in Food Science, and now also a PhD. His wife, Zuraida, will receive her nursing qualifications this year from CPUT.

This father of two young boys already has eight peer-reviewed publications under his belt. One of these received the Douglas Bomford Award from the Institution of Agricultural Engineers (IAgrE) for the best paper published in 2017 in the leading agricultural engineering journal Biosystems Engineering.

He says that consumers are not pleased when they pay a premium for a whole pomegranate, only to find it to be rotten inside once they open it up to eat. To help producers sift quality fruit from the sub-optimal ones during the packaging process, Arendse turned to existing X-ray computed tomography and near-infrared spectroscopy methods to look inside the fruit without damaging them.

Arendse tailored these types of scans for use on "Wonderful" pomegranate. This variety often has unsightly superficial brown on the peel (so-called husk scald) on the outside, but in most cases is still perfectly edible. "These scanning methods can also be used to trace whether miniscule pests are hiding inside the fruits," he says.

Knowing the actual volume of fruit that can be processed helps producers of value-added products like jams and juices to plan their manufacturing processes. As part of his PhD, Arendse also developed models with which to predict the edible volume of each fruit. "The husk often makes up half the volume of a pomegranate fruit, with the rest being the arils and juice," he explains.

Further work needs to be done before the scanning methods can be rolled out to the industry.

Belay: Storing it better to keep it longer on the shelf

Dr Zinash Assefa Belay. Photo: Engela Duvenage

Belay, whose home language is Amharic, grew up in the Ethiopian capital of Addis Ababa. This former lecturer in food science at the university in her hometown has a keen interest in food security and nutrition, and her Master's degree was in Food Engineering. A fellowship from UNESCO's Organization for Women in Science for the Developing World (OWSD) allowed her to pursue a PhD at an African university. Within hours of first contacting Opara via email, her place was secured in his research team at Stellenbosch University.

As part of ongoing collaboration with the DST-NRF SARChI Chair in Postharvest Technology, part of her PhD research was also conducted at the Leibniz Institute for Agricultural Engineering and Bio-economy in Germany. The opportunity to work in another well-equipped laboratory with different instruments has allowed her to gain valuable practical experience.

She says that the bulk of all pomegranate harvested each year in South Africa is exported in one form or another. Most often, producers take the trouble to remove the arils from the fruit, to provide pre-packaged, ready-to-eat and convenient product to consumers. “Once the arils inside a fruit are removed, they spoil easily and have quite a short shelf life,” explains Belay, who took up the challenge to find ways to extend the shelf life of pomegranate arils.

Thanks to her research, guidelines are now available on the best type of packaging material to use when sending pomegranate arils overseas and retailing under active modified atmosphere packaging conditions, and the premium concentration of oxygen and carbon dioxide at which it should be kept. This method entails more than just vacuum packaging, but also a constant altering of the air composition in which the fruit is kept.

She found that the optimal gas composition to keep pomegranate arils at during active modified atmosphere storage is 6 to 7% oxygen and 7 to 8% carbon dioxide.

“By using this method, the shelf life of arils can be extended from seven to ten days,” she says.