Mitigation Technologies for Sanitary and Phytosanitary Compliance

SA plums head for the Big Apple

Thanks to a successful partnership between gamma rays and insect barrier bags, a greater variety of local plums could soon be welcome in the United States.

As a result of this work, the option to export more plum cultivars from South Africa to America is now a real possibility.

IN AD 541-542, the so-called Plague of Justinian killed thousands upon thousands of people in the Eastern Roman Empire. It all started when the Emperor Justinian imported vast volumes of grain from Egypt to feed his people. The ships that docked in Constantinople off-loaded more than food…

Food safety has improved immeasurably since Justinian's days, but concerns around inadvertently importing pests and diseases along with boxes of juicy table grapes or fragrant pears remain. As a result, countries impose strict phytosanitary regulations on fruit exporters. These are government regulations that restrict or forbid the importation of certain plant species, or their products, to prevent the introduction or spread of plant pests or pathogens that these plants may be carrying.

Cold sterilisation is an example of a phytosanitary regulation. Currently, South Africa can export some plum cultivars to the USA, but only if a cold sterilisation treatment can be strictly maintained. The requirement is uninterrupted storage at -0,5°C for three weeks. This treatment is unfortunately too harsh for some plum cultivars and may cause chilling injury that shows up as internal flesh browning.

IRRADIATION AS AN OPTION

The United States Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS) is responsible for the control of phytosanitary pests on fruit entering the USA. When the authority published legislation some years ago that allowed the importation of fruit treated by low-dose gamma irradiation, it gave exporters an alternative to cold sterilisation.

Gamma irradiation sterilises insects, thereby providing an alternative to cold sterilisation and methyl bromide fumigation mitigation treatments.

In 2004, South Africa started exploring irradiation as a feasible alternative mitigation treatment for locally produced table grapes at the Hepro Cape irradiation facility. Hepro Cape has been operating for the past 20 years in Montague Gardens, Cape Town. The business provides high-energy processing for the sterilisation of disposable medical equipment and the treatment of imported garlic and spices. It can also handle pallet loads of fruit.

Before Hepro's facilities could start playing a role in fruit exports, it had to be approved by the USDA. This involved a long process of inter-governmental agreements, facility design, operational work plan evaluation and table grape quality research. Through the combined efforts of the South African Table Grape industry, HORTGRO^Science, the research organisation ExperiCo Agri Science, the Department of Agriculture, Forestry and Fisheries (DAFF) and Hepro Cape, the facility received APHIS certification from the USDA in 2011. Hepro Cape is the first APHIS-certified facility in the Southern Hemisphere.

A year later, the first irradiated table grapes left South Africa for the US market – a significant development towards creating additional market potential for the South African fresh fruit export industry.

THE PLAN WITH PLUMS

USDA-APHIS approval is fruit-specific. Every type of fruit has to receive its own agreements, approved facilities, protocols and certification of packaging formats. Table grape approval therefore did not mean that all other South African exports had been cleared for irradiation.

Based on the grape success, the Innovation Programme and HORTGRO^Science co-financed a project

MORE ABOUT FOOD IRRADIATION

Food irradiation is a processing technique that exposes food to high-energy rays. The process produces a similar effect to pasteurisation, cooking or other forms of heat treatment, but with less effect on look and texture. Gamma irradiated food has been exposed to radioactivity but does not become radioactive itself.

Food absorbs energy when it is exposed to irradiation. The amount of energy absorbed, or the absorbed dose, is measured in units called Gray (Gy).

The energy absorbed by the food causes the formation of short-lived molecules known as free radicals, which kill bacteria that cause food poisoning. They can also delay fruit ripening and help stop vegetables, such as potatoes and onions, from sprouting.

Scientists have been experimenting with irradiation as a method of food preservation since 1950. They have found irradiation to be a controlled and very predictable process.

Food irradiation is currently permitted by over 50 countries, and the volume of food treated is estimated to exceed 500 000 metric tons annually, worldwide.

In a variety of product-specific applications, irradiation is most useful for:

- Preservation. It destroys or inactivates organisms that cause foodstuff to spoil, thereby extending their shelf life.
- Sterilisation.
- Control of sprouting, ripening and insect damage.
- Control of foodborne illnesses.

The effects of irradiation on food, and on animals and people eating irradiated food, have been studied extensively for more than 40 years.

Sources: Iowa State University website (http://www.extension.iastate.edu/foodsafety/irradiation/); Wikipedia; www.food.gov.uk

PROJECT TITLE
Certification of plum packaging formats for export of South African fruit to markets that accept irradiation in combination with insect barrier bags, as mitigation treatment

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DURATION
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FOCUS AREA
Mitigation technologies for sanitary and phytosanitary compliance

PRESENTATIONS AND PAPERS DELIVERED
Three

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to obtain USDA certification of irradiation technology for export plums. The project was a collaborative effort between ExperiCo Agri Science and Hepro Cape.

The ExperiCo research team, led by Dawie Moelich, conducted plum fruit quality and packaging tests and coordinated the research project. The Hepro facility was responsible for the dosimetry trials in conjunction with APHIS. Dosimetry tests are done to measure the irradiation dosage and whether the limitations as set by USDA-APHIS and the US Food and Drug Administration are met. The tests have to be done on actual pallet stacks of fruit, per packaging format and according to each kind of fruit.

The plum study involved more than just determining the effectiveness of irradiation. Mr Moelich explains that, since gamma irradiation does not leave any residue on the fruit, insect re-infestation is a possibility. "We therefore had to include insect barrier packaging in our study and determine the impact of the combination of irradiation and micro-perforated insect barrier bags on the post-storage quality of plums."

APHIS regulations stipulate that the pores in insect barrier bags should not be bigger than 0,6mm in diameter and that the barrier must not influence the regular oxygen and carbon dioxide levels surrounding the fruit. Because the insect barrier bags should avoid

atmosphere modification, commercially available modified atmosphere packaging (MAP) could not be used. To complicate matters, the research team discovered that the insect barrier material was not manufactured on a large scale, locally or internationally, because of the specific pore size requirement. "Our solution was to involve a South African manufacturer to produce the packaging we needed," says Mr Moelich.

The plum cultivars used in the study were 'Songold', 'Laetitia' and 'African Delight'. Before irradiation at Hepro, the fruit was packed in the newly developed insect barrier bags and in standard commercial packaging, inside 400 x 300 x 118mm cartons.

Sub-treatments of the 'Songold' and 'African Delight' plums were also subjected to SmartFresh™, an ethylene receptor blocking technology, prior to irradiation. SmartFresh™ was applied to the plums after being stored for five days at -0,5°C and the fruit was irradiated at Hepro after six days at -0,5°C. Both the SmartFresh™ and irradiation treatments were therefore applied to the different fruit lots within one week of being harvested.

The post-storage quality was evaluated after the cultivar-specific commercial export protocols were simulated at the ExperiCo experimental cold storage facility.

THE RESULTS

One of the study's main findings was that SmartFresh™ can control the risk of internal disorders associated with the irradiation treatment and the insect barrier bag, especially in 'Songold' plums.

A further exciting result was that USDA-APHIS has accepted the locally designed and manufactured insect

barrier bag. "As a result of this work, the option to export irradiated South African plums to America, which is considered a special phytosanitary market, is now a real possibility," says Mr Moelich.

The dosimetry recorded at the Hepro Cape facility during December 2013, using mini-pallets according to the commercial stacking patterns, indicated conformance to the APHIS requirements and the data will soon be submitted to the USDA, via DAFF, for approval.

The abovementioned successes are likely to pave the way for local fruit to be exported to other markets that accept irradiation.

At Hepro fruit is exposed to the energy emitted by encapsulated cobalt-60 to sterilise fruit flies and other insects. As such, the dosages are extremely low. Much higher dosages are needed to treat bacterial or fungal infections.

1 Dawie Moelich.
2 An 'African Delight' plum ready to be picked.
3 Gamma irradiation kills fruit flies that may be present on the plums when they are harvested.
4 Left: Plums packed in an insect barrier bag inside a 400 x 300mm carton. Right: Plums in punnets, enclosed in an insect barrier bag, inside a 600 x 400mm carton.