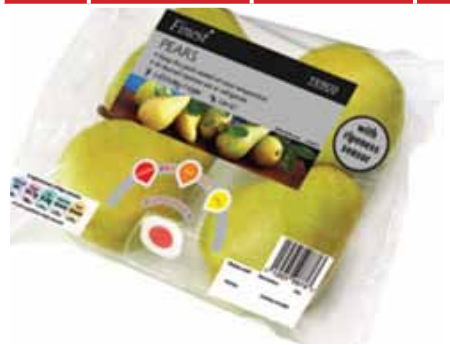
TECHNOLOGICAL PRACTICE CASE STUDY				JUNE 2009	
FOOD	MATERIALS	PRODUCTION	YEARS	7-10	11-13



SMART CHOICE: ripeSense

Over half of all supermarket customers prefer to buy fruit ready-to-eat, and often customers will handle the fruit to test its ripeness before making their selection which can result in damage and wastage – a major source of lost revenue for the vendor. RipeSense™ labelling removes the need to handle produce to determine ripeness, resulting in a significant reduction in wastage, as well as increased customer service and satisfaction, and therefore increased sales. Developed by New Zealanders, ripeSense™ is a sensor that changes colour to indicate the ripeness of specific fruit. It was named as one of TIME magazine's 30 greatest inventions of 2004.

DISCUSSION POINTS INCLUDE:

Nature of Technology

- Commercialisation of scientific research

Technological Systems

- intelligent packaging

For focus questions for classroom discussionon topics, see the **Curriculum Links** section of this case study, page 3.

ADDITIONAL SUPPORT MATERIAL

- www.ripesense.com
- www.ripesense.com/pdf_store/Product_Overview_old.pdf

Curriculum related questions:

- Collaborative commercialisation of scientific research
- The influence of regulatory restrictions and consumer preferences
- Growing importance of active and intelligent packaging

SMART CHOICE: ripeSense

What started as a question thrown around over dinner and a bottle of wine soon shot to fame when it was named one of TIME magazine's 30 greatest inventions of 2004. That question was: "How can you make a fruit label do more?" Hazel Penfold puts that same question to the designers of the intelligent fruit label now named ripeSense™.

'Ripesense' is a sensor which changes colour to indicate the ripeness of specific fruit. First used commercially on a package of pears, the ripeSense™ label changes colour, from red when the pears are "crisp", to orange when they are "firm" and finally to yellow, which indicates the fruit is "juicy".

The intelligent label is a collaborative effort between HortResearch – a crown research institute specialising in fruit science – and Jenkins Group – a supplier of adhesive labels and flexible packaging, and now the parent company of ripeSense.

Cameron McInness, who has been involved with the project since its commercialisation and is now General Manager of ripeSense, describes how the organisations came together. "It started over a dinner, with a few bottles of wine," he says. "It was people from Jenkins Group, a company called Sinclair International out of the United Kingdom and the then Chairman of HortResearch, a gentleman called Roger Davies.

"They were sitting around a table discussing how you could make a fruit label do more. At that stage Roger Davies says: 'you should come and talk to some of our scientists, they're playing round with melons at the moment'."

The first of those scientists – Ron Henzell – returned from an American conference on the consumption of pears with the idea implanted in his mind. With assistance from Keith Sharrock, the pair quickly demonstrated how a maturity indicator could work.

PRIMITIVE BEGINNINGS

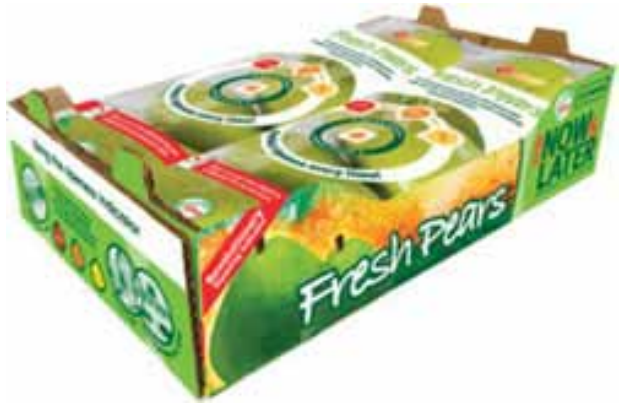
The lab research started with small-scale biochemistry, when they created a prototype with materials that came to hand before they had access to the film and adhesives that only a commercial label manufacturer could provide. Dr Sharrock describes their first attempts as primitive.

"At that stage, things were made using materials that came to hand – Sellotape and Duraseal and things like this that you might use if you were doing it at home."

The researchers had to convince Jenkins Group to get involved with the project and invest in the necessary equipment to mass produce the labels. But even with primitive materials, they could demonstrate the concept.

"It wasn't an instant hit with them [Jenkins Group], we had to convince them over several years that it was viable and there was market demand," explains Dr Sharrock.

A niche in the market was recognised in the United States, where the pear industry cited trouble with consumers knowing when to eat the pears, particularly the Green Anjou variety. The pears are transported to supermarkets while hard, and people buy and eat them before they reach optimal flavour and juiciness.



THE TRADITIONAL LABEL AND MORE

The collaborating companies started by looking at the traditional label – one sticker on individual fruit. But they found that the gases released from a fruit as it ripens – the volatiles – could be localised. A difference in gas production occured between the stem and the base of the fruit. The issue of safe food-contact materials also caused significant barriers to individual label production.

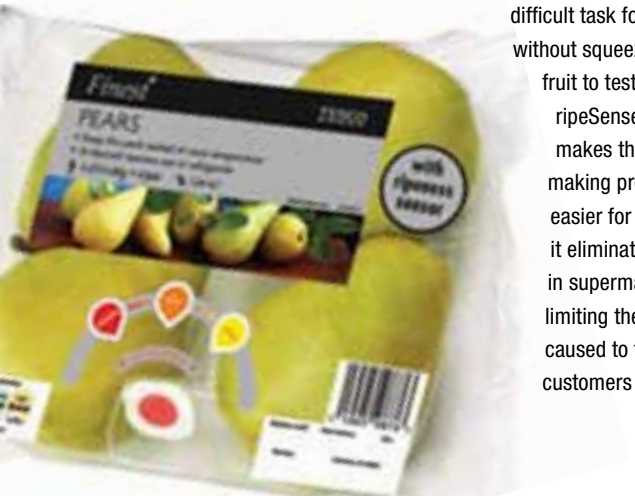
"We were testing them initially directly on fruit, there were quite a few hurdles to pass because direct food-contact regulations are much more demanding than those that relate to the packaging, and so we opted for the simpler route to market – put them on the package."

By placing the sensor inside a package containing four pieces of fruit, the aroma volatiles are trapped and the accumulative gases react with the sensor, causing the colour to change.

Consumers already use fruit aromas to select fruit, but using a more conventional method – sniffing.

"Melons are a good example. People try to determine the ripeness by smell – we're exploiting that, using the chemistry of the colour change involved in the sensors," says Dr Sharrock. Without giving away all the "secret herbs and spices", Mr McInness describes the sensor as a multi-laminate construction with a reagent that has natural compounds encapsulated in the middle. The reagent, when exposed to the volatiles from the fruit on an accumulative basis, causes a chemical reaction that creates the colour change in the label.

Although pears may not seem like the obvious choice to work with, the explanation is quite simple. Unlike other fruits, many varieties of pear do not change colour as they ripen. This makes choosing fruit a difficult task for customers without squeezing each fruit to test its firmness. ripeSense™ not only makes the decision-making process easier for consumers, it eliminates waste in supermarkets by limiting the damage caused to fruit by customers testing it out.



EDUCATING THE CONSUMER

Mr McInness explains the concept. "Using ripeSense™ is like turning a pear into a banana. Everyone knows what colour they like when they buy and eat bananas, and the ripeSense™ label effectively gives customers the same knowledge for other fruit."

By educating consumers about the produce, fruit sales are expected to rise, which is good news for both supermarkets and fruit growers.

"Our goal, underneath what we've got to do as a business, is to grow fruit sales," says Mr McInness. "So when we do our research we ask 'how much more would you buy?' And people say much more. Much more could mean I'm going to buy it twice this month instead of once, and that's doubling the volume."

In fact, ripeSense™ consumer research shows that when people buy the product, they will inevitably buy more fruit. Sales figures of pears from test markets in the United Kingdom have shown five to seven per cent growth. Although those figures don't sound like much, in a spontaneous purchase category like pears it is significant.

Mr McInness believes that the greatest barrier to making the product a global success is awareness.

"The biggest challenge is to clearly indicate there's a sensor on this product, because people aren't walking into a supermarket expecting to see it."

Educating the customer is a primary focus. However, even those customers who inadvertently pick up a ripeSense™ product are more than likely to buy it again, once they realise what it is and that it actually works.

THE INTERNATIONAL MARKET

The product was trialled in New Zealand supermarkets in 2003 and then again in a number of American stores a year later. "Everyone knows what colour bananas they like and ripeSense™ gives customers the same knowledge for other fruit."

In 2004, exposure in TIME magazine threw ripeSense™ into the international scene while it was still at the commercialisation stage. "In 2004 we were still test marketing, making sure we could manufacture, get the consistency we wanted, developing our systems and processes to support our customers around the world," says Mr McInness.

"We had this whole plan that we would slowly start in the markets and be quite careful about how we went ahead. Then we rolled up in TIME and the phone and E-mails just didn't stop." The product now has a strong market in the United States and the United Kingdom, and is also available in Germany, Switzerland and parts of France, but it has not yet been seen on supermarkets shelves in New Zealand. Apparently, ripeSense™ has found New Zealand a very hard market to crack.

"One of the biggest challenges for us in this market is that we're dealing with a packaged product," says Mr McInness. "If you look around our supermarkets we're not a heavily packaged market, as you see in Europe."

PROBLEMS WITH PACKAGING

For the environmentally concerned fruit buyer, plastic packaging does nothing to spur a purchase, so ripeSense™ has done much to reduce their environmental footprint and customer preconceptions. The package was originally a rigid clamshell pack, but due to market feedback, ripeSense™ has now migrated to a flexible base, which is recyclable and uses an overwrap film.

The company also had to convince regulatory agencies that all the materials used in the sensor were food safe, something particularly difficult to do in the United States where Food and Drug Administration (FDA) standards limit the materials that can be placed directly on food. Ultimately, ripeSense™ opted for a workaround, endeavouring to use materials already appearing on the FDA's generally recognised as safe (GRAS) list.

"If you can't find a solution using that list, you need to make an application to have a new compound approved. That's quite difficult – a hoop we'd rather not go through," says Dr Sharrock. Still, developing successful product and processes has taken over ten years, four years for HortResearch to come up with the concept, two years of prototype demonstrations, and a further six years to get the manufacturing processes running reliably. Jenkins Group had to design a bi-spoke piece of machinery specifically to manufacture the sensors.

But with the hard yards done, Mr McInness says the company now has programmes in place for the next generation of sensors. One of these, a label used for avocados, was released in 2008 after a further two to three years of development by HortResearch scientists.

"We've got a completely different chemistry for the avocado sensors than we used for pears, and that reflects the fact that they produce different volatiles as

they ripen," says Dr Sharrock. The product clearly meets a need in the market when it comes to avocados – a product you only ever want to eat when it is ripe. For consumers to purchase ready-to-eat avocados without squeezing shows a high level of trust in the accuracy of the ripeSense™ label.

Market research shows that around 98 per cent of respondents say that they think the sensors are accurate. Mr McInness found that to start with people would buy the fruit when the label was red or orange, but after purchasing the ripeSense™ fruit and seeing how accurate the sensor is, people start to buy the produce at the yellow stage, ready to use as soon as they get home.

Not only is the ripeSense™ label winning over consumers, it has already won Jenkins Group two top print and packaging awards, including a gold medal in the World Label Awards and a gold medal in the Pride in Print Awards. But the work doesn't end there.

Dr Sharrock currently leads a team at Plant and Food Research called Active and Intelligent Packaging, which is continuing to investigate sensor labels. The team is simultaneously investigating several new approaches, one involving a sensor for inventory management to help retailers and people in pack houses know when to move stock. Another possibility is a sensor that can indicate when fruit is diseased or rotting, and they also plan to revisit the direct-to-fruit label idea.

"All of our current commercial labels are applied to the packaging. We're working on systems that will make them compatible with direct fruit contact."

As well as these new innovations, ripeSense™ is focusing on technology along the same lines as the pear and avocado packaging with a sensor for mangoes, melons and stone fruit. And why change a concept when it is a world-first in its field? From concept to commercialisation, ripeSense™ is worldleading science, and currently there is no other technology like it available.

Hazel Penfold is Writer/Editor at IPENZ.

Curriculum related activities

These Curriculum Links pages provide discussion points for teacher groups and senior students on the following concepts addressed in the Techlink ripeSense™ case study.

COLLABORATIVE COMMERCIALISATION OF SCIENTIFIC RESEARCH

Question 1: The full development process of the ripeSense™ product took almost five years, from 2003 to 2008 – why did it take so long? In answering this question, explain the ongoing interaction of the two principal developers – HortResearch and Jenkins Group – in the development process in terms of the balance of knowledge and skills required. Additional references:

- Jenkins Group website www.jenkinsgroup.co.nz/showcase/portfolio/ www.jenkinsgroup.co.nz/eco-labelling/
- HortResearchscience programme: Biosensors & biomeasurement www.hortresearch.co.nz/index/page/389 "RipeSense™ was launched in 2004 with technology for packaging pears in a clear clamshell pack. In 2008, ripeSense™ introduced its new convenient free flow packaging, which allows for the automation of the packing process and reduces the overall amount of packaging required. Following 18 months of product development and laboratory testing, ripeSense™ will be commercially releasing its new avocado indicator in January 2009."

Question 2: Despite its success in overseas markets, ripeSense™ labels have yet to be seen on New Zealand supermarket shelves. How is this explained in the following Telegraph article? Do you consider that this technology has a future in New Zealand? Explain your answer. "TESCO (UK) is planning to launch the packaging shortly and other supermarket chains are believed to be weighing it up….Richard King managing director of Fresh Technologies UK told the magazine "The technology is both new and exciting for the UK sector and complements our existing business activities perfectly. We look forward to introducing this technology through our existing marketing channels." www.telegraph.co.uk/search/?queryText=ripesense&Search=Search

REGULATORY RESTRICTIONS AND CONSUMER PREFERENCES

Question: What influences have regulatory restrictions and consumer preferences had on the way in which the ripeSense™ labeling has been developed? Explain.

INTELLIGENT PACKAGING

Research and report on how far things have progressed since the following short article was written.

Intelligent Packaging Arrives

Packaging that prolongs shelf-life, or monitors and changes colour to indicate the freshness of a product, or packaging that contains oxygen? Scavengers that absorb gas as food releases it? Sound too good to be true? Well 'intelligent' or 'active' packaging may not be a thing of the future for much longer. Food regulations in Europe may be changing soon to allow packaging to interact with food items in ways not previously allowed. Any packaging of this sort will have to comply with established food safety principles, which require materials coming into contact with food to be traceable and identifiable. *Biscuit World,* February 2004 – www.bakeinfo.co.nz/industry/innovation/article.php?id=15

Additional references:

- *Packaging and the Environment*, a global Nielsen consumer report. www.packaging.org.nz/packaging_info/documents/NielsenGlobalPackagingEnviroReportMar08.pdf Conducted in mid 2007, this study surveyed 26,486 Internet users in 47 markets – from Europe, Asia Pacific, the Americas, the Middle East and Africa – on the factors that influenced their choice of grocery store and their preferences in packaging.
- *HortSource Express* – Active and Intelligent packaging update – May 2008 www.hortsource.co.nz/article.aspx?id=850
- GrowingFutures case study series (2005) www.growingfutures.com/files/food_trends.pdf This case study cites nine important trends that scientists, producers and exporters must consider if New Zealand is to maintain its very successful level of fruit and vegetable exports.
- Telegraph.co.uk www.telegraph.co.uk/news/newstopics/howaboutthat/5330690/Shoppers-of-the-future-will-pick-fruit-from-supermarket-shelves.html Shoppers of the future will 'pick' fruit from supermarket shelves Supermarket shoppers in the next decade will be able to pick fruit and vegetables from plants still growing on the shelves, according to a report into the future of retailing.
- BBC TV website for school GCSE programmes www.bbc.co.uk/schools/gcsebitesize/design/foodtech/packaginglabellingrev1.shtml This is a

concise and very readable introduction to food packaging and labelling. The labelling requirements applies to UK, but students could be asked to research differences in the labelling requirements in New Zealand.

- Institution of Food Technologist's fifth Research Summit www.ift.org/divisions/food_pack/newsevents/1206packagingresearch.pdf This research summit identified key research areas such as materials science and sensing technologies for improving food packaging.
- Packaging Council of NZ website www.packaging.org.nz This site includes a series of short videos on packaging including;
  - Packaging in a modern society
  - Towards sustainable packaging
  - Resource efficiency – The bigger picture
- Packaging – Australian packaging news website www.packagingmag.com.au/Video.aspx This site includes a comprehensive news section and short informative video clips.
- *Packaging Digest* – international packaging news www.packagingdigest.com
- *Packaging Digest* – digital www.packagingdigest.com/info/CA6462285.html

BAR CODING

35 years later, bar codes, and scanning, are everywhere
computerworld.co.nz/news.nsf/tech/A19E76CFD969D129CC2575E0001B98E6
"Tomorrow marks the 35th anniversary of the first time a laser scanner was used to "read" a bar code, according to Motorola. The company has a few of the pertinent facts from that day, including that the first scan occurred at 8:06am, June 26, 1974, at a Marsh supermarket in Troy, Ohio. The bar code was imprinted on a 10-pack of Wrigley's Juicy Fruit gum…" June 2009.

What is a bar code?
www.dataid.com/whatisbarcode.htm
"Every day you see bar codes in the world around you. You see them in supermarkets, on labels, greeting cards and consumable goods…" Data identification Online

A history of the bar Code by Stephen A Brown, Uniform Code Council
eh.net/encyclopedia/article/brown.bar_code
In 1949, a young graduate student was wrestling with the concept of automatically capturing information about a product. He believed that the dots and dashes of Morse code would to be a good model, but he could not figure out how to use those familiar patterns to solve his problem. Then, one day as he relaxed at the beach, he idly drew dots and dashes in the sand. As his fingers elongated the dashes he looked at the result and said, "Hey, I've got it."

'Barcodes Sweep the World' by Tony Seideman
www.barcoding.com/information/barcode_history.shtml
"Supermarkets are a perilous business. They must stock thousands of products in scores of brands and sizes to sell at painfully small markups. Keeping close track of them all, and maintaining inventories neither too large nor too small is critical."

How UPC Bar Codes Work
electronics.howstuffworks.com/upc.htm
"Nearly every item that you purchase from a grocery store, department store and mass merchandiser has a UPC bar code on it somewhere. Have you ever wondered where these codes come from and what they mean? This Howstuffworks article solves the mystery."

Thanks bar codes, you've really delivered the goods
www.nzherald.co.nz/technology/news/article.cfm?c_id=5&objectid=10558771 NZ Herald article, 26 February 2009, celebrating 30 years of bar coding and pointing to its future when paired with RFID technology.

RFID TECHNOLOGY

"Radio-frequency identification (RFID) is the use of an object (typically referred to as an RFID tag) applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves." From Wikipedia: en.wikipedia.org/wiki/Smart_labels

- The queue at Pack and Save homepages.paradise.net.nz/arthurh/2004/04/art04.htm An article about developments in retail computing by John Thompson. "RFID tags (also called smart labels) are intelligent barcodes that can talk to a computer system to track products that you put into your shopping trolley."
- BRANZ Study Report No 178 [2007]: Indicator materials www.branz.co.nz/cms_show_download.php?id=160 Building Research Association of New Zealand (2007)

FOR JUNIOR STUDENTS

PAC-IT: An Introduction into Packaging in New Zealand is a boxed resource kit supporting packaging projects which can realistically be undertaken in a Year 1-10 classroom environment. The resource also addresses environmental issues associated with packaging together with the benefits of packaging and the processes and methodologies associated with its production. For a more comprehensive Techlink Resource Review visit: PAC-IT Resource kit review.

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