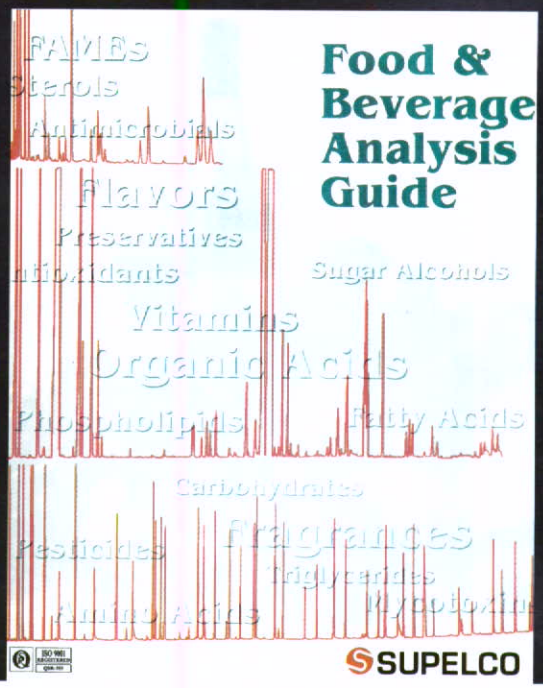
VOL 62 NO.2 MARCH/APRIL 1998

NZIC Chemistry IN NEW ZEALAND

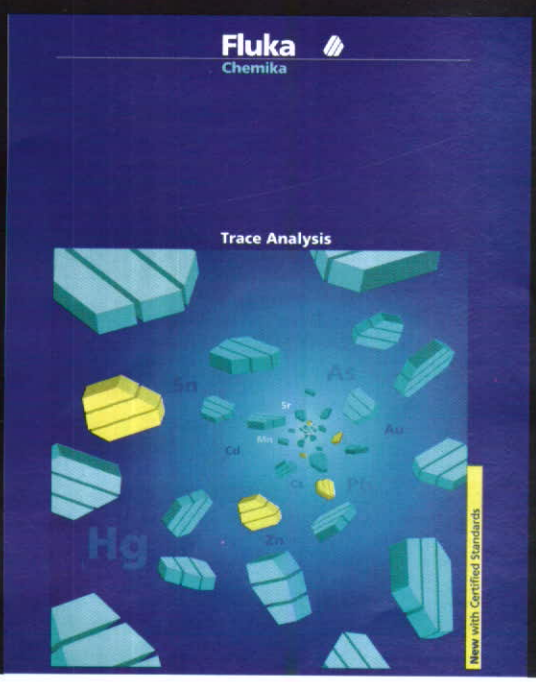
ISSN 0110-5566

Spotlight on Food and Beverage Manufacturing and Research
Focus on HPLC, IC, LC-MS

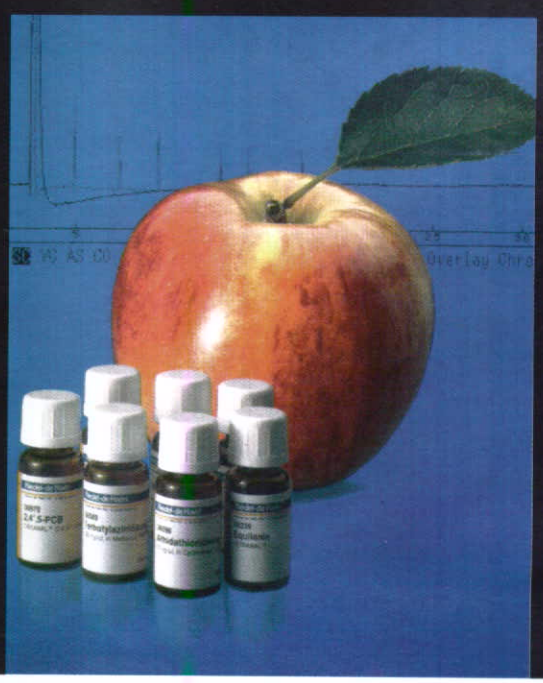
Riedel-de Haën
ELISA-Systems
for food, animal food-stuffs & water



SUPELCO
Food & Beverage Analysis



Fluka
Trace Analysis

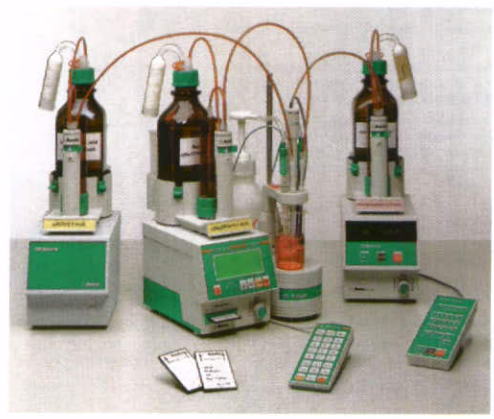


High Purity Standards
Chem Service, Riedel-de Häen,
Supelco

John Morris Scientific Ltd

NEW FROM METROHM - THE 736 GP TITRINO

- Compact, powerful, multi-purpose, titrator
- Memory card in credit-card format for transfer of user methods
- Large internal memory ensures order with methods and sample data
- DET, MET, SET, STAT, KF titrations and more ...



- Method development and routine analysis in:
  - ✓ Water, wastewater and environmental protection
  - ✓ Chemistry, pharmaceuticals, petrochemistry
  - ✓ Food, beverages
  - ✓ Fertilisers, basic materials and explosives
  - ✓ Power plants, energy

Auckland
Phone (09) 366 3999
Fax (09) 366 3060

Palmerston North
Phone (06) 355 5875
Fax (06) 355 5874

Christchurch
Phone (03) 365 3825
Fax (03) 366 6975

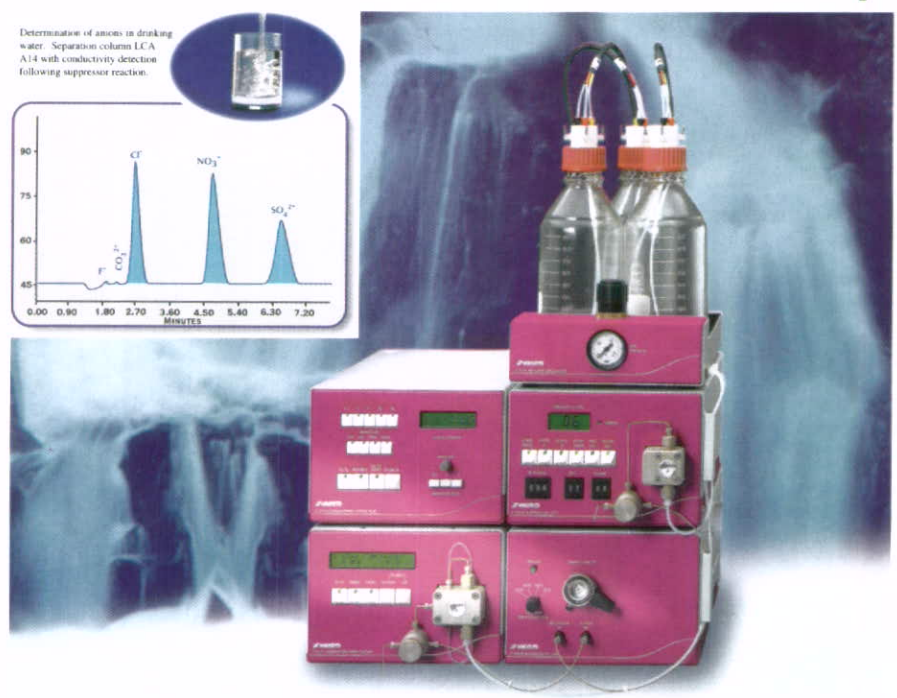
TOLL FREE 0800 651 700
Email: sales@jms.co.nz
Website : http://www.johnmorris.com.au

circle number 3 on the reader reply card

SYKAM Ion Chromatography
Most Sensitive Determination of Ions Becomes Simple

Demonstrations Now Available!

Contact Sci Tech Now For A Full Range Of Applications



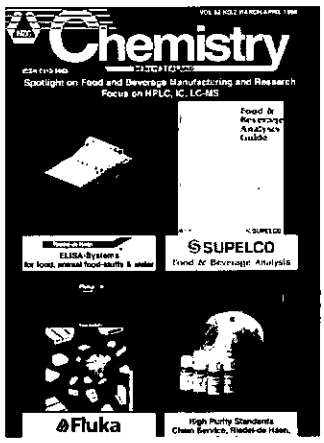
Glenn Grayston
Science & Technology (NZ) Ltd
P O Box 663, Dunedin
Phone: 03-477 7860, Fax: 03-477 7870
Email: grayston@scitech.co.nz

SYKAM CHROMATOGRAPHY

circle number 4 on the reader reply card

UP FRONT ...

Riedel-de Haën Laboratory Chemicals - ELISA-Systems, Supelco Food and Beverage Analysis Guide, Fluka Trace Analysis, and Riedel-de Haën Laboratory Chemicals High Purity Standards brochures describe the range of products available in these areas from Sigma-Aldrich.



For further information see the cover story article on page 2

NZIC Chemistry IN NEW ZEALAND

Published on behalf of the New Zealand Institute of Chemistry in January, March, May, July, September and November each year.

The New Zealand Institute of Chemistry Incorporated
P O Box 38-546, Howick, Auckland, New Zealand
Phone: +64-9-5356495, Fax: +64-9-5353476
Email: NZICOffice@nzic.org.nz
WWW: http://www.nzic.org.nz
President: Dr A MacGibbon, Hon Treasurer: Dr R S Whitney
General Secretary/Executive Officer: G Boston

Advertising Sales & Publisher:
Robert B Lyon
Ancat Holdings Limited
32 Murvale Drive, Bucklands Beach, Auckland
P O Box 38-546, Howick, Auckland, New Zealand
Phone: +64-9-5353475, Fax: +64-9-5353476
Email: chemistry@ancat.co.nz

Editorial Board:
Dr L J Wright • PhD, MNZIC
Dr R Whiting • PhD, MNZIC
L R McLeay • MPhil
R B Lyon • BSc, MNZIC

Managing Editor:
Louanne R McLeay
Ancat Holdings Limited
32 Murvale Drive, Bucklands Beach, Auckland
P O Box 38-546, Howick, Auckland, New Zealand
Phone: +64-9-5353475, Fax: +64-9-5353476
Email: chemistry@ancat.co.nz

Disclaimer
The views and opinions expressed in *Chemistry in New Zealand* are those of the individual authors and are not necessarily those of the Publisher, the Editorial Board or the New Zealand Institute of Chemistry. Whilst the publisher has taken every precaution to ensure the total accuracy of material contained in *Chemistry in New Zealand*, no responsibility for errors or omissions will be accepted.

Copyright © 1998
The contents of *Chemistry in New Zealand* are subject to copyright and must not be reproduced in any form, wholly or in part, without the permission of the Publisher and the Editorial Board.

IN THIS ISSUE ...

COVER STORY 2

IUPAC-SPONSORED SYMPOSIA IN 1998 3

LOCAL NEWS 4

WASTE NOT WANT NOT! PART 2. FOOD PACKAGING - BIODEGRADABLE AND EDIBLE ALTERNATIVES
By Sarah Donnelly, Allan Easteal and John Hay 8

LETTER TO THE EDITOR 14

A RAPID HIGH PERFORMANCE LIQUID CHROMATOGRAPHIC METHOD FOR THE QUALITY CONTROL ANALYSIS OF PHOLCODINE IN COUGH SYRUP
By Nicky Tjenderasa and Mark Duxbury 15

HPLC, IC, LC-MS -
QUICK REFERENCE BUYER'S GUIDE 18

HPLC, IC, LC-MS FOCUS FEATURE 25

AN IMPROVED METHOD FOR HPLC DETERMINATION OF ACIDIC HERBICIDES IN AQUEOUS SAMPLES
By Michael S Young 29

HPLC TROUBLESHOOTING TIPS
How to identify and isolate the most common HPLC problems
By Patrick Wesley 32

PATENT PROZE
By Jane Calvert and Greg Lynch 33

CONFERENCES & SEMINARS 34

NEW PRODUCTS 37

INDUSTRY APPLICATIONS:
Determining volatiles in beer with automated SPME and GC/MS/ECD
By Zelda Penton 41
GFAA determination of phosphorus in food oils
By Gregory M Bercowy and Robert Peile 43

VICTORIA UNIVERSITY GRADUATION CEREMONY SPEECH - 10TH DECEMBER 1997
By Dr Jeffery Tallon 46

INTERNATIONAL NEWS 48

NZIC NEWS:
NEWLY ELECTED FELLOWS 49
NZIC BRANCH NEWS 49

BOOK REVIEW 52

ADVERTISERS INDEX 52

COMING UP ...

May 1998 - Forensics, Toxicology, Clinical Chemistry
Centrifuges, Liquid Handling

July 1998 - Mining, Minerals, Steel, Geochemistry
AA, ICP, Particle Characterisation

Deadline for material:
5th of the month of publication

Contributions and enquiries to:
The Editor,
Chemistry In New Zealand,
P O Box 38-546, Howick, Auckland, New Zealand
Phone: +64-9-5353475, Fax: +64-9-5353476
Email: chemistry@ancat.co.nz

COVER STORY

Fluka

SUPELCO

Riedel-de Haën

Riedel-de Haën Laboratory Chemicals - ELISA-Systems

Food and feed stuff analysis, water analysis ... ELISA-quick

Riedel-de Haën Laboratory Chemicals offers a range of enzyme immunoassays for analysing foods, feed stuffs and water. The large number of samples required in residue analysis make safe and fast detection methods necessary, ELISA-Systems from Riedel-de Haën Laboratory Chemicals satisfy this requirement and guarantee the analyst simple, safe and fast detection.

The advantages for the user are the high degree of sensitivity, speed, simplified sample preparation, easy evaluation, high throughput of samples as well as low consumption of solvents in comparison to conventional methods.

- anabolics, hormones
- antibodies
- bacteria, toxins
- mycotoxins
- pesticides

ELISA-Systems Gliadin

Our newest test kit detects the causative agent of celiac disease (gluten, gliadin, prolamin). Its broad specificity allows the detection of nearly all proteins of this heterogeneous group.

Water Analysis

ELISA-Systems Enterobacteriaceae-*E. coli* and coliform bacteria in drinking water are detected within 24 hours. ELISA-Systems Legionella - after cultivation (3-4 days), this colony blot requires only 2 hours to detect Legionella among other bacteria.

Supelco - Food and Beverage Analysis Guide

Our technology takes the time, tedium and expense out of food analysis

- Carbohydrates / organic acids on specially tested HPLC columns
- Fatty acids / trans-fatty acids / sterols on specially tested capillary GC columns
- Flavours / fragrances by solid phase microextraction / capillary GC (faster and better than solvent extractions; capillary columns that set industry standards)
- Mycotoxins / pesticides by solid phase extraction / HPLC or SPE/GC
- Stereoisomers / positional isomers on modified-cyclodextrin capillary GC columns
- Highest-quality chemical standards from amino acids to vitamins

This guide gives detailed information on chromatographic conditions and sample preparation technologies, including solid phase microextraction and solid phase extraction.

Fluka Trace Analysis

Fluka Trace Analysis products can be used in three main areas:

Sample Preparation

Separation and Preconcentration of Trace Elements by Ion-Exchange
TraceSelect - Reagents for Wet Dissolution
Mercury and Arsenic-free Reagents

Instrument Calibration

Certified Calibrating Standards
Spectrometric - Ion Standard Solution, Single-Element
Instrument Calibration for Ion Chromatography - Standard Solutions (anionic and cationic)

Measurement

Spectroscopic Buffers for Flame-AAS
Matrix Modifiers for Graphite Furnace AAS
Supporting Electrolytes for Electrochemistry

Riedel-de Haën Laboratory Chemicals - High Purity Standards

In the Riedel-de Haën high purity standard range we offer more than 1200 standards and standard solutions of active substances:

PESTANAL® standards of active ingredients of pesticides, derivatives and metabolites,

OEKANAL® standards of substances of environmental concern,

VETRANAL® standards of active ingredients used by veterinarians,

GC standards as reference substances in gas chromatography.

All **PESTANAL®** and **OEKANAL®** solutions are offered in brown glass ampoules.

These ampoules have decisive advantages:

- Ready-for-use solutions to be applied in HPLC, possible dilution for gas chromatography.
- Quantities meeting customers' demands for one-way-use (rinsing of the syringe and calibration).
- Optimal quality preservation - as no sealing compounds in the tape have to be used.

For more information about any of these products, call Sigma-Aldrich toll-free on ***0800 936 666*** *and request your FREE copy of any of these publications.*

circle number 1 on the reader reply card

The SIGMA-ALDRICH Family

SIGMA — Biochemicals and Reagents for Life Science Research

ALDRICH — Organics and Inorganics for Chemical Synthesis

Fluka — Speciality Chemicals and Analytical Reagents for Research

SUPELCO — Chromatography Products for Analysis and Purification

Riedel-de Haën — Laboratory Chemicals and Reagents for Research and Analysis

IUPAC-SPONSORED SYMPOSIA IN 1998

4 - 7 May 1998
1st International Conference on Trace Element Speciation in Biomedical, Nutritional and Environmental Sciences
Venue: Neuherberg/Munich
Federal Republic of Germany

28 June - 2 July 1998
12th International Conference on Organic Synthesis
Venue: Venice, Italy

6 - 10 July 1998
7th International Chemistry Conference in Africa
Venue: Durban, Republic of South Africa

20 - 23 July 1998
18th Discussion Conference on Macromolecules: Mechanical Behaviour of Polymeric Materials
Venue: Prague, Czech Republic

2 - 7 August 1998
9th International Symposium on Novel Aromatic Compounds
Venue: Hong Kong

5 - 8 August 1998
8th International Symposium on Solubility Phenomena
Venue: Niigata, Japan

16 - 21 August 1998
14th International Conference on Physical Organic Chemistry
Venue: Florianópolis, Santa Catarina, Brazil

30 August - 4 September 1998
33rd International Conference on Coordination Chemistry
Venue: Florence, Italy

11 - 16 October 1998
21st IUPAC Symposium on Chemistry of Natural Products
Venue: Beijing, China

For further information, please contact:
The NZIC Secretariat
P O Box 38-546, Howick, Auckland
Tel: (+64-9)-5356495, Fax: (+64-9)-5353476
Email: NZICOffice@NZIC.org.nz

LOCAL NEWS

THE SWEET TASTE OF SUCCESS

A one-horse town it might be, but from the North Waikato hamlet of Tatuanui, have come some of the most remarkable findings in the food industry in recent history.

While we mere mortals take such products as aerosol whipped cream and flavoured mousses for granted, Tatua Biologics, a subsidiary of one of the smallest dairy companies in New Zealand, the Tatua Co-operative Dairy Company, has worked hard, smart, and solidly towards developing niche market products through a dedicated research and development programme.

"We've got to be innovative to survive," claims Tatua development manager, Dr Rex Humphrey. "We account for just 1% of the country's milk supply, and without the economies of scale of the mega-companies we need to work in niche products and be flexible in manufacturing."

While Tatua's history of pioneering food solutions for consumer and restaurant markets is impressive, the company's most recent advance into innovative technology, with funding assistance from Technology New Zealand, has broken new ground and the implications are considerable.

Through previous work with Tatua, University of Waikato scientist, Associate Professor Peter Molan knew that in isolating antibacterial proteins from milk, the effective use of the resulting lactoperoxidase required a source of hydrogen peroxide to generate its antibacterial properties. Being a honey scientist of international repute he also knew that honey was a source of hydrogen peroxide.

Tatua's aim was to combine two natural products in a synergistic way to produce a natural antibacterial action which can kill bacteria and enhance the shelf life of health and dairy foods. Sounds simple enough, but what followed was more than a year of painstaking research undertaken by Lynne Bang, undergraduate and now PhD student at the University of Waikato.

Describing the research project as 'a nice piece of technical work', Dr Humphrey says there are thousands of components in both products. "Identifying, isolating, and combining them has been a mammoth job and one which has given us a number of unique outcomes we can now exploit commercially."

"It's been a hugely challenging project with an extremely positive outcome. Lynne is an outstanding biochemistry and microbiology student and I was keen to offer her the opportunity to work on a project with significant commercial potential as her thesis study," says Peter Molan.

The first development of its type in the world, the project has wide ranging potential applications for the future of natural food hygiene, preparations, and storage. The next stage for Tatua includes further food technology product development such as formulations and shelf life studies.

"We can now begin work with customers. We know by adding lactoperoxidase to yoghurt, that with a little honey present the shelf life can be extended while maintaining an even flavour, and using a lot less sugar," says Molan. "We can also extend the concept to other food processes such as providing a wholly natural application to kill salmonella bacteria in poultry, for food and salad bars and other bacterial risk areas."

"We've been producing lactoperoxidase since 1991 but to combine the two natural produce extracts is totally new."

And with her sights firmly set on a career in Biochemistry, Lynne's first encounter with the restraints and realities of a commercial venture has been a positive one. Made possible by funding from the GRIF (Graduates in Industry Fellowships) Programme of Technology New Zealand, it has, she says, proved rewarding, though not without its frustrations.

"It's been fascinating - challenging but fascinating, trying to get the preservative effect to occur quickly enough before the system was destroyed. But it works! Biochemistry has a hugely exciting future, particularly with the public perception of chemicals in foods as it is. Natural compounds and preservative systems are of huge importance and significance."

"The Technology New Zealand funding has meant that I've been able to concentrate solely on this research study without the distraction and worry of having to find holiday work. It's really given me the chance to commit to the work."

Technology New Zealand funded student Lynne Bang into a 'honey of a research job', pictured with Tatua's Rex Humphrey.

John Manning, Manager of the Technology New Zealand Scheme, says Tatua's R&D philosophy is a perfect fit with the aims of Technology New Zealand. "We provide funding to assist companies who want to find, develop, and use new technology to make a difference to their organisation. It might open up new markets with new products, as in the case of Tatua, or it might even change the whole emphasis of the business."

He says whilst Tatua is an example of a technologically sophisticated company, Technology New Zealand is also keen

to hear from companies who are at the early stages of technological evolution.

For further information contact,
Dr Res Humphrey, Phone: (07) 8893999
Associate Professor Peter Molan, Phone: (07) 8384148
John Manning, Technology New Zealand at the Foundation for Research, Science and Technology, Phone: (04) 4987800

SCIENCE STUDY FUNDS 'LACKING'

The organisation and funding of New Zealand scientific research has been found wanting in an investigation by the leading international science journal *Nature*. Its report, published in January 1998, is critical about the effects of the radical reorganisation of scientific research and funding with the advent of the Crown Research Institute model six years ago.

The author, Sydney-based Peter Pockley, says interviews with science leaders, officials, and politicians in New Zealand show the overall effect of the changes is mixed. While officials are positive about the system and its tightly targeted funding, the Minister of Research, Science and Technology, Maurice Williamson, has acknowledged there will be no increase in the coming year's budget for science and technology.

The journal says New Zealand has slipped down the scale of science funding internationally, but supporters of the model point out that research is now more tightly targeted to areas likely to benefit the county. It notes a marked shift in employment in Crown Research Institutes from research staff to non-scientists, with the number of researchers falling while support staff have tripled.

Private sector investment in research and development, which those responsible for instituting the new model had claimed would be stimulated, has failed to eventuate, the article says. It criticises the profit-making requirement of the institutes, saying research in New Zealand is now seen as a commodity to be bought by organisations from research institutes.

Also under threat, the report says, is the promise by the Minister for Crown Research Institutes, Simon Upton, to increase the Marsden Fund next year, a scheme launched in 1994 that provides competitive grants for basic, non-targeted research.

Source: NZ Herald, Friday January 30, 1998.

NEW ZEALAND BEE PROPOLIS COULD EARN MORE

Bee propolis is probably the second most important product which beekeepers get from their hives after honey, Industrial Research's Ken Markham says. He has developed a way to analyse the qualities of New Zealand propolis to gain competitive advantage for local industry.

Propolis is a resin which bees collect from the surface of plant leaves and use to sterilise and block up holes in their hives. It is very high in flavonoids and has important properties such as being antifungal, antibacterial, antiviral, and anti-inflammatory. It is commonly used as an ingredient in products like cough mixtures, toothpastes, tinctures, and face creams and in the treatment of ulcers, colitis, inflammation, and immune deficiency. Ken Markham says Brazilian sellers of propolis to Japan get many times the price that New Zealand producers do, because they define and guarantee their product.

He believes the local industry could go one better by presenting buyers with analytical data on their propolis using the method Industrial Research has developed. This uses high pressure liquid chromatography to obtain information about the flavonoids which are central to the therapeutic and financial value of the propolis.

"Propolis from New Zealand has some fairly unusual properties which are good promotional features. For example, our propolis is high in dihydroflavonoids such as pinocembrin which is known to be very active against *Staphylococcus aureus*, a methacillin resistant bacterium."

He says the work the Industrial Research team has undertaken to date is widely acclaimed, with the United Kingdom including it in national propolis regulations, and the possibility that the rest of Europe and the USA may adopt the methodology as a standard.

Source: Industrial Research Limited, Innovate, Issue 26.

PURAC OPENS OFFICE IN NEW ZEALAND

The Purac group is extending its activities, opening an office in Wellington. Purac, a leading process contractor to the world's water and wastewater industry, with an annual turnover of $270 million, is part of Anglian Water International, fully owned by Anglian Water PLC.

In New Zealand Purac will offer a full range of services to both municipal and industrial sectors from specialist equipment supply to a full design and build capability. In addition Anglian Water International (NZ) Limited and Purac will work together on DBO and BOT type projects. Anglian Water International (NZ), responsible for the design, construction and operation of the $149 million Clearwater Wellington Wastewater facility, has been operating in New Zealand since 1992.

Fraser Sparks, General Manager of Anglian Water International (NZ) Limited comments, "The arrival of Purac in New Zealand will greatly enhance our capabilities and reinforces our long-term commitment to the New Zealand market."

POSTHARVEST RESEARCH - TOWARDS 2000

New Zealand's horticultural export industry received a boost in 1998 with the opening of HortResearch's new, purpose-built postharvest facility at the Mt Albert Research Centre, Auckland. This is the Padfield Building named after Scott Padfield, an international pioneer of controlled atmosphere (CA) research.

Floriculture trials that can be carried out at the new facility include optimisation of storage and transit temperatures for different flower and foliage crops, development of treatments to extend storage life to allow the option of seafreight to overseas markets, and development of treatments to extend vase life and improve quality.

With 20 coolstores, 10 CA rooms, 20 controlled temperature rooms, 2 freezers, 4 ripening rooms, 3 evaluation rooms, 1 vase

life room, specialist laboratories and gas analysis rooms to utilise, the scope and size of the trials in the new facility are almost limitless.

It brings together under the same roof the Postharvest Science and Market Access groups. While the primary research focus of these groups is fruit, there is active involvement in research on flowers, vegetables, *Sphagnum* moss and pine trees.

Research areas cover:

- physiology of fruit and flower responses to storage conditions,
- development, maturation and ripening of fruit,
- storage and handling technology,
- biochemical and molecular basis of the control of fruit ripening, plant senescence and responses of plants and fruit to stress,
- control of pests of quarantine importance on New Zealand horticultural and forestry exports to allow access to overseas markets,
- sensory qualities of flowers, including texture and appearance.

Source: HortResearch Seasons, Number 23.

ADDING VALUE TO POLLEN

The pollen which bees collect has long been heralded as having extraordinary medicinal properties because of its abundance of vitamins, minerals and amino acids. Astronauts eat it, athletes swear by it, and some enthusiasts describe it as a complete food.

Worldwide it is becoming big business. But commercial bee pollen comprises of batches collected by bees from many sources. Ken Markham of Industrial Research is keen for the New Zealand health food industry to capture the full potential of local bee pollen by quantifying the specific make up and properties of individual batches, and using this as a marketing strength.

He says bee pollen is a highly variable mix of floral pollens with different floral sources such as gorse, dandelion and five finger giving different qualities to the product. Some pollens are high in antioxidant properties, whereas others have good antimicrobial properties.

"I've been saying to the health food companies that we ought to be able to market a premium product which has its composition and qualities guaranteed. Although the colour of bee pollen can be an indicator to its source, it can also be misleading. Our aim is to characterise bee pollens and analyse how much of each floral pollen is in a particular batch to give buyers a true picture."

In a world first Ken Markham and a Portuguese colleague have developed a new method for specifying its individual characteristics. Using high pressure liquid chromatography he is able to match individual flower pollen patterns with bee pollen patterns and quantify how much of each flower type is present in a batch.

The only hold-up for the project is the limited available data on the patterns of different flower pollens. "Basically we need the help of observant beekeepers to supply us with samples of pollens which they know have come from particular flower stock. Only the beekeepers can tell us what the bees are gathering in a particular season or areas," Ken Markham says. He estimates that there are probably only 20-30 different pollens which bees collect in New Zealand. So far they have characterised ten of these.

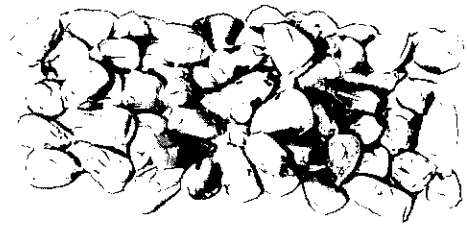
Source: Industrial Research Limited, Innovate, Issue 26.

AN A-MAIZE-ING BATTLE FOR QUALITY

One of the biggest problems facing the maize industry is mycotoxin contamination, causing crop quality fluctuations and even making the end product toxic to animals and humans.

HortResearch is battling the problem on two fronts, studying processing to find treatments with the potential to reduce toxicity of the finished product, and enabling a mycotoxin "rating" system of hybrids to be drawn up to aid growers.

The Biological Chemistry Group at Ruakura studied samples from incoming trucks at a drying plant and found that as little as five to ten percent of "poor" grain - small, shrivelled and discoloured kernels - can contribute to more than 50 percent of the toxin content of the whole sample.



GOOD

POOR

Processing only marginally affected the mean levels of contamination, even though the cob sections, screenings, fines and flour flakes which were removed during the process contained high levels of mycotoxins.

"All samples of maize tested contained combined toxin levels that could cause problems in animal feed if they were the sole source, or a major proportion, of dietary intake. The screening out of cob sections, fines, and flakes is essential to prevent even higher contamination," said organic chemist Denis Lauren.

"Improved density segregation techniques capable of removing small and heavily contaminated kernels is necessary to have a substantial impact on the overall toxin content."

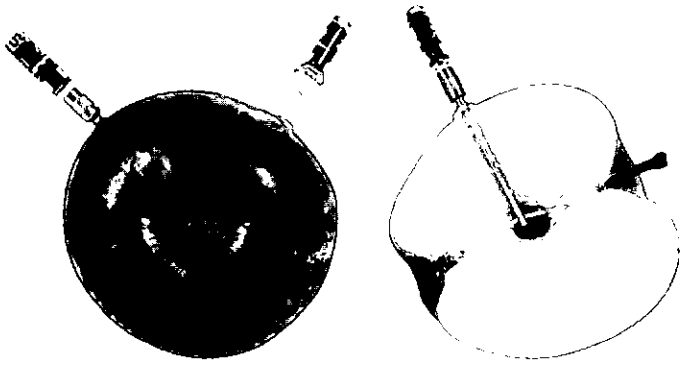
The group also found that some maize hybrids are more susceptible to infection by *Fusarium* fungi, and subsequently to *Fusarium* mycotoxin accumulation, than others.

Genetic Technologies Limited the New Zealand producer distributor of Pioneer Brand hybrid maize seed, worked with the group to determine mycotoxin levels in their yield comparison trials and build a susceptibility data base. As a result the 1996-97 catalogue produced by Genetic Technologies Limited contains a mycotoxin rating for most hybrids offered, a first worldwide.

"The rating is positive proof of successful technology transfer from the mycotoxin research programme."

Source: HortResearch Seasons, Number 20.

TESTING APPLES TO THEIR LIMITS



Well grown fruit needs to be complemented by good storage. One approach to optimising atmospheres for controlled or modified atmosphere storage of fruit is to identify the level of oxygen at which the fruit begins to ferment. Sustained fermentation results in accumulation of compounds toxic to the fruit and causes off-flavours.

The traditional method of finding fermentation thresholds has been to use the level of oxygen surrounding the fruit. However in a recently completed PhD study HortResearch's Chris Yearsley, in collaboration with Professor Nigel Banks at Massey University, used an alternative approach using internal atmospheres of apples.

Internal oxygen atmospheres in apples will always be lower than that surrounding the fruit because of uptake of oxygen by cells and the barrier the skin poses to gas exchange. This has important consequences for an apple like 'Braeburn' which has a poor and highly variable gas exchange capability.

Dr Yearsley was able to develop mathematical tools for estimating lower oxygen limits. He found that lower oxygen limits based on internal atmospheres were relatively constant over cool storage and room temperatures regardless of the level of carbon dioxide and stage of ripeness. However, lower oxygen limits based on external atmospheres were strongly temperature dependent.

Modified atmosphere packages may experience "temperature abuse" during distribution. By knowing the gas exchange properties of an apple cultivar, lower oxygen limits based on internal atmospheres can be used to predict safer package designs to prevent fermenting.

Source: HortResearch Seasons, Number 20.

CHANGES TO THE OPERATION OF THE NICKEL DEVELOPMENT INSTITUTE

Michael O Pearce, President of the Nickel Development Institute, NiDI, is pleased to announce the appointment of Dr David Jenkinson to the position of Director NiDI Australasia, based in Melbourne and effective immediately. The appointment follows the retirement of Mr Noel Herbst who established NiDI Australasia in 1988. Noel will continue as a consultant to NiDI and to the stainless steel and high nickel alloy industries.

As well as a change in director, NiDI is also to have permanent presence in New Zealand. Les Boulton & Associates Limited has been appointed as the New Zealand representative for NiDI and will work as part of the NiDI Australasia office from Les Boulton & Associates's Auckland office. New Zealand requests for NiDI services, including technical literature and technical advice on applications and use of nickel, nickel alloys, and nickel-containing stainless steels, can now be directed to Les Boulton. As before all of the services of the Nickel Development Institute are provided without cost or obligation.

By combining the services of David and Les it is hoped that architects and engineers in the Australasian region will have a greater opportunity to benefit from NiDI's International activities. If you are not on the NiDI mailing list, you may wish to contact David or Les and have your name added so that you will receive *Nickel* (a quarterly free magazine) and learn more concerning the technical publications and services NiDI provides.

NiDI is a non-profit association of International Nickel Producers dedicated primarily to expanding nickel consumption worldwide. With the Head Office in Toronto, Canada, NiDI has offices in Australia (and New Zealand), Brazil, China, India, Japan, South Korea, and the United Kingdom. The Nickel Development Institute is comprised of 15 member nickel producers, including two in Australia and NiDI has led the development and defence of nickel in its end-use markets since it was established in 1984.

For further information on NiDI,
Contact: Les Boulton at the NiDI New Zealand Office
Tel: (09) 3034146 or 021 478300, Fax: (09) 3034415

CHROMATOGRAPHY SURVEY PRIZE WINNERS ANNOUNCED

The prize winners in the draw of respondents in the recent New Zealand Chromatography Market Survey carried out by Ancat Holdings Limited have been announced. They are:

Major Prize (Air New Zealand Mystery Weekend For Two)
Mrs Cherie Hitchcock, Contact Energy, New Plymouth
Consolation Prize (Bottle of French Champagne)
Ms Alex Wnorowski, Envirolab Geotest Limited, Auckland

Ancat Holdings Limited would like to express their thanks to all survey respondents.

WASTE NOT WANT NOT!

Part 2. Food Packaging - Biodegradable and Edible Alternatives

Sarah Donnelly[*], *Allan Easteal*[**] *and John Hay*[***]
University of Auckland, Private Bag 92019, Auckland

Introduction

Driven by awareness of the implications of exhausting non-renewable natural and physical resources, research into new materials for food packaging films is heading beyond the realm of synthetic polymers, which are derived from non-renewable petrochemicals (Anon. 1997, Guilbert *et al.* 1996). Edible films can offer similar mechanical and barrier properties to those of existing materials used in food packaging applications. They have several advantages in terms of the environment: they are derived from biodegradable, renewable and abundant raw materials (biopolymers); they can be consumed along with the food product; and they reduce the requirements, and thus improve recyclability, of synthetic packaging. This article explores the development and application of edible films, and addresses the particular challenges involved in using edible films to prolong the shelf life of agricultural produce. Research in this field is currently being carried out both in New Zealand and overseas, where abundant and economical raw materials used to produce these films have significant environmental advantages over conventional synthetic materials. The potential benefits, and problems, of using these films commercially are considered. Biopolymers can also be used to manufacture 'biodegradable plastics': potential applications are in applications other than food packaging. This concept is also reviewed. Current research findings are presented.

What are edible films?

An edible film or coating is a thin layer of edible material, placed on or between foods, that acts as a barrier to the external conditions (Torres 1994; Guilbert *et al.* 1996). Films are structures which are applied after being preformed, while coatings are applied and formed on the product. However, unless otherwise stated, in this article the term "film" refers to both films and coatings.

The concept of an 'edible film' is not new. Patents on edible films developed for food use have been available since the 1950s (Cuppett 1994; Guilbert *et al.* 1996). Examples are wax coatings for fruits and vegetables, casings on meat products and chocolate coatings on confectionery and nuts (Guilbert *et al.* 1996). Materials used to produce edible films today are derived from naturally occurring polymers ('biopolymers') with desirable film-forming abilities: proteins, lipids or polysaccharides. Natural biopolymers, in contrast to synthetic polymers, are a biodegradable and renewable resource. Although commonly used in the pharmaceutical industry to coat tablets, commercial utilisation of edible films in the food industry has been limited, partly because information about their properties is relatively sparse (Kester and Fennema 1986). As their complex properties are further defined, the potential applications of edible films are expanding.

Research into developing edible films has intensified in recent years (Torres 1994), with 90% of research papers on this subject being published after 1980 (Anon. 1995a). Interest in their use as packaging films is partially due to environmental concerns related to existing packaging materials (Donnowe and Fennema 1994; Guilbert 1994; Guilbert *et al.* 1995; Guilbert *et al.* 1996). Current research findings on edible films have recently been summarised (Guilbert and Gontard 1994; Guilbert *et al.* 1996; Kester and Fennema 1986; Krochta and De Mulder-Johnston 1997; Krochta *et al.* 1994). Several research programmes have edible films development and evaluation as their focus. In New Zealand, research is being carried out to develop edible and biodegradable films formed from proteins[1]. Elsewhere, major centres involved in this field include the US Department of Agriculture, where much research has been carried out investigating the use of edible films to extend the shelf life of fresh produce; and a European Union sponsored research project exploring techniques in modified atmosphere packaging (MAP), which includes biodegradable and edible films, to improve the safety and quality of processed foods (Guilbert *et al.* 1996).

Why use edible films?

The most significant advantage of edible films is that they are derived from renewable raw materials. For example, in New Zealand the biopolymer 'corn-zein' used to produce films is extracted from protein meal, which itself is formed as a by-product from wet-milling operations used to obtain starch (Holding *pers. comm.* 1996). Thus, provided extraction costs can be kept to a minimum, and no additional wastes are produced, zein compares favourably in this respect to synthetic materials such as plastics, which exploit limited and non-renewable resources. There are several advantages of edible films over non-edible films (Guilbert 1986).

These include:

- *they can be consumed along with the food product*
- *in some cases the edible film can completely dissolve in water during cooking*
- *their production costs are relatively low*

[*] Current address: Institute of Environmental Science and Research Limited, Wellington Science Centre, P O Box 30-547, Lower Hutt, Fax: (04) 5605595, Email: sarah.donnelly@esr.cri.nz
[**] Department of Chemistry, University of Auckland, Private Bag 92019, Auckland.
[***] School of Environmental and Marine Sciences, University of Auckland, Private Bag 92019, Auckland.

[1] Currently the focus of a joint study between Auckland University (Chemistry Department) and Industrial Research Limited (Auckland).

- *they are made from biodegradable and renewable raw materials*
- *their use may reduce waste and environmental pollution from existing synthetic packaging materials*
- *they can enhance a food's sensory, mechanical and nutritional properties*
- *they can give individual protection to small portions of food material.*

To function efficiently as a packaging film, an edible film must meet precise requirements, including being able control the moisture content and gas levels in the food product (Baker *et al.* 1994). In general, to compete successfully with existing synthetic materials, an edible film is required to possess suitable moisture barrier, gas barrier and mechanical properties, and desirable sensory properties (Guilbert 1986). The important mechanical and barrier properties are outlined below.

How are edible films made (and what properties are important)?

Important Properties

Important functions of food packaging are maintaining public health and prolonging the product shelf life. The design of any new packaging system must ensure that these functions are not compromised. Prolonging the shelf life is a complex issue, and techniques used to achieve this are advanced, such as controlled atmosphere storage and use of 'smart' packages [where permeability to a particular gas is altered in response to changes in internal atmosphere or temperature (Baldwin 1997a)]. The choice of package depends on the requirements of the product: for example, some products require the complete elimination of oxygen and carbon dioxide, while for others some permeability to these gases is essential. Properties of interest to food packaging applications include mechanical and barrier properties:

• Edible films ideally will improve the mechanical handling properties or structural integrity of a food product, and also provide physical protection for food products during transport (Donhowe and Fennema 1994). Mechanical properties of edible films depend on the type of material used to form the film, additives, degree of structural cohesion, film forming conditions and external environmental conditions (Guilbert and Gontard 1994; Encyclopaedia of Polymer Science and Engineering 1994). Flexibility is improved by the addition of plasticisers, which weaken intermolecular forces between polymer chains (Cuppet 1994). Plasticisers that have potential food applications are polyethylene glycol, polypropylene glycol, sorbitol, acetylated monoglyceride, ester derivatives and surfactants (Cuppet 1994; Guilbert 1986; Food Regulations 1984).

Tensile strength is a measure of the maximum stress developed in a film during testing. Elongation is the maximum change in length of a film before breaking. Tensile strength and percent elongation at break are the two most commonly measured mechanical properties of edible packaging films (Gennadios *et al.* 1994). Another relevant mechanical property is the glass transition temperature, the temperature at which a polymer changes from a glassy to a viscoelastic state (Haines and Wilburn 1995). Eisenberg (1993) comments that the glass transition temperature is the most important parameter which determines the application of many polymers.

• Important barrier properties include water vapour transmission, gas permeability (oxygen and carbon dioxide), water and water vapour sorption (Guilbert 1986). Permeability and sorption values can be used in product shelf life predictions. Defining these properties is important for tailoring films to specific applications such as fresh fruit and vegetables, which are characterised by an active metabolism (McHugh and Krochta 1994; Wong *et al.* 1994). It is crucial to be aware of the effect of the environmental conditions surrounding the film on permeability properties (Jasse *et al.* 1994). The requirements depend on the product, which will have an optimal range of internal gas concentration, which needs to be maintained. Lightly processed[2] agricultural products generally require higher humidity conditions (Baldwin 1995). In the case of agricultural produce, if oxygen levels are too low, undesirable anaerobic respiration can occur (Baldwin *pers. comm.* 1997b; Park *et al.* 1994).

Factors such as chemical structure, degree of crystallinity, polymer chain length, density, molecular weight, degree of polymerisation and double bonds influence the permeability properties of a film, as does the presence of additives (Pascat 1986). The nature of the permeating gas also has an effect: values are influenced by the size, shape and polarity of the permeant molecules (Pascat 1986; deV Naylor 1989).

The method of film-formation, solvent characteristics, additives and usage conditions of the films (relative humidity, temperature) can substantially alter the ultimate properties of the film (Guilbert *et al.* 1996). For example, humidity of the surrounding environment has an effect on hydrophilic films due to a plasticising effect of water molecules[3], and increased solubility (Gennadios 1993; Guilbert *et al.* 1996; McHugh and Krochta 1994). Humidity also has an effect on the glass transition temperature of a film (Beck *et al.* 1996). In general, permeability values are expected to increase with temperature (deV Naylor 1989; McHugh and Krochta 1994; Pascat 1986; Rogers 1985; Weng 1993). Classical methods of evaluation of mechanical and barrier properties of non-edible films are used for edible films. It is difficult to produce films which simultaneously possess satisfactory mechanical properties, water vapour resistance and gas barrier properties (McHugh and Krochta 1994). To date, most of the research has been carried out at a single temperature and humidity. Temperature can also change the barrier properties of the films. This may be an advantage if the films are used as packages for horticultural products, because temperature affects respiration rates, changing the barrier requirements (Baldwin 1997a).

---

[2] Light processing encompasses minimal processing operations such as cutting, trimming, peeling that do not extensively affect the fresh-like quality of the produce (Wong *et al.* 1994).

[3] This is due to a nonlinear moisture sorption isotherm (a function relating the amount of water vapour absorbed by a material to the humidity of the surrounding environment). The effect of this is a dependence of the barrier and mechanical properties on the humidity of storage conditions and/or water activity of the food product.

Materials Used

Edible films and coatings are prepared from natural biopolymer materials. The materials studied to date for their development can be divided into the three categories: proteins, polysaccharides and lipids (Gennadios 1993). Properties of common edible films are summarised in Table 1. Barrier properties of low density polyethylene and ethylene vinyl alcohol, common synthetic packaging materials, are included for comparison.

• ***Proteins***: Proteins commercially marketed for edible films include corn-zein, collagen and gelatin (Krochta 1992). Other proteins, including casein, keratin, peanut protein, soy protein isolate and wheat gluten, are also being investigated (Gennadios *et al.* 1994). Films based on proteins are relatively poor water vapour barriers due to their inherently hydrophilic nature (Torres 1994; Park and Chinnan 1995). The oxygen and carbon dioxide barriers of such films are appropriate for food packaging uses, although these properties are dramatically compromised in high humidity environments. An advantage of proteins over other edible film forming materials is the potential for nutritional enhancement of a food product. This is not automatically the case, however, and the nutritional quality of proteins may be adversely influenced by film forming methods (Gennadios *et al.* 1996). The possible intolerance of certain individuals within the general population toward some proteins must be considered, and appropriate labelling provided.

• ***Polysaccharides***: Polysaccharide film-forming materials include cellulose derivatives, alginates and carrageenan (both extracts from varieties of seaweeds), pectin (polysaccharides found in plant cells), and starch derivatives (Anon. 1997; Donhowe and Fennema 1994; Krochta 1992; Krochta and De Mulder-Johnston 1997). As with proteins, these materials display minimal moisture barrier properties due to their hydrophilic nature (Kester and Fennema 1986), but do possess suitable mechanical and optical properties (Guilbert *et al.* 1996). In contrast to most proteins, many polysaccharides have the advantage of being water soluble.

• ***Lipids***: Lipid films (usually derived from waxes) are moisture resistant (Herrandez 1994; Kester and Fennema 1986). Their mechanical properties are inferior to those of protein and polysaccharide films (Donhowe and Fennema 1994; Kester and Fennema 1986; Krochta 1992), and the resultant films can be fragile and unstable (Guilbert *et al.* 1996). They are best applied as coatings, used to regulate moisture transfer.

The choice of material depends on the requirements of the food product. In some cases the resultant films may be combinations of the materials described above, where the different advantages of each component are combined, and the disadvantage of individual materials lessened (Anon. 1997; Donhome and Fennema 1994). This technique has been utilised in the production of multilayer synthetic packaging films, where moisture sensitive oxygen barriers (for example, ethylene vinyl alcohol) are used in conjunction with moisture resistant polymers (Gennadios *et al.* 1994). Krochta (1992) comments that "*multi-component films containing lipid as moisture barrier and polysaccharide and/or protein as oxygen/carbon dioxide barrier and cohesive structural matrix have much potential*".

Various additives may be incorporated into edible films to influence mechanical, protective, sensory or nutritional properties. Examples of such additives include plasticisers, flavours, antimicrobial agents, vitamins, antioxidants and pigments (Guilbert 1986). For more information on additives the interested reader is referred to the review article "*Edible Coatings as Carriers of Food Additives, Fungicides and Natural Antagonists*" (Cuppet 1994).

Methods of Film Formation

Many different techniques are used for forming films as coatings on food surfaces or as free, self-supporting films. These primarily involve separation of the material from solution (the technical term is 'coacervation') by applying heat, altering pH, introducing further solvents or altering the charge of the biopolymer (Donhowe and Fennema 1994; Guilbert *et al.* 1996).

Table 1. *Properties of Common Edible Films (Krochta and De Mulder-Johnston 1997).*

Material	Film Preparation	Moisture Barrier	Oxygen Barrier	Mechanical Properties (Tensile Strength and Elongation)
Proteins				
Zein	Aqueous Ethanol	Moderate	Moderate	Moderate
Gluten	Aqueous Ethanol	Moderate	Good	Moderate
Polysaccharides				
Methyl Cellulose	Aqueous Suspension	Moderate	Moderate	Moderate
High Amylose Starch	Aqueous	Poor	Moderate	Moderate
Lipids				
Beeswax	Melt	Good	Poor	Poor
Shellac	Ethanol	Moderate	Poor	Poor
Low Density Polyethylene		Good	Poor†	Good
Ethlyene Vinyl Alcohol		unspecified	Good	unspecified

Test Conditions: Moisture Barrier - 38 °C, 90/0% Humidity; Oxygen Barrier - 25 °C. 0-50% Humidity; Mechanical Properties - 25 °C, 50% Humidity.
Note: Film composition was unspecified, and is a variable which can have a large effect on properties.
†Reference: Billing 1989.

Free self-supporting films can be obtained by the same techniques used to produce non-edible films, for example, extrusion or rolling mill procedures. Coatings can be applied directly onto a product by dipping, painting or spraying (Grant and Burns 1994). In addition to altering film composition to optimise mechanical and barrier requirements, another critical challenge is the necessity to produce homogenous films of even thickness and reproducible properties (Torres 1994).

How safe are edible films to eat?

The composition of edible films must conform to the regulations that apply to the food product they protect (Guilbert *et al.* 1996). In New Zealand, they are thus controlled by the Food Act (1981) (Mitchell *pers. comm.* 1996). New Zealand Food Regulations (1984) contain information on what ingredients and additives are permissible under the Act. The Regulations also permit the use of certain processing aids including solvents. Solvent systems for edible films are limited primarily to water, ethanol, or a combination of the two (Kester and Fennema 1986). For additives not listed in the Regulations, a provision in the Regulations is required before they can be used. A body has been established by the Australia-New Zealand Food Authority to review applications for provisions to the Act (Anon. 1996; Mitchell *pers. comm.* 1996).

If an edible film is to be the sole packaging material for a food product, one additional function is to protect the food from contamination. Protecting food from contamination is the realm of the Food Hygiene Regulations (1974), and edible films must conform to those requirements in addition to those mentioned above (Mitchell *pers. comm.* 1996).

Additional Packaging Applications of Biopolymers

Biodegradable plastics were conceived in the early 1970s, and hailed as a potential solution to the environmental problems associated with synthetic plastics (Omichi 1992). The concept, however, has created many sceptics. Several 'biodegradable' plastics have been developed over the decades to meet niche markets, but the biodegradability of these materials has been the subject of much uncertainty (Day *et al.* 1994). In early studies, the environmental conditions were not clearly defined, and tests failed to simulate 'real' conditions (Day *et al.* 1994). A material is considered truly biodegradable if, when consumed by enzymes and/or microorganisms, it is reduced to simple compounds such as carbon dioxide, water and carboxylic acids, and methane (Krochta and De Mulder-Johnston 1997; Omichi 1992, Encyclopedia of Polymer Science and Engineering 1994). Biodegradation involves three elements: appropriate microorganisms, a moist environment with an acceptable range of pH, nutrients and oxygen, and a vulnerable starting material (Kaplan *et al.* 1993, cited in Krochta and De Mulder-Johnston 1997). Tests for biodegradability include studies of weight loss, mechanical property changes, oxygen consumption, methane and carbon dioxide evolution (Jane *et al.* 1994; Spence *et al.* 1996).

Despite the early setbacks, biodegradable packaging is here to stay. Utilisation of biodegradable plastics makes most sense when recovery of synthetic plastics for recycling or energy recovery is difficult (Krotcha and De Mulder-Johnston 1997). Ennis (1992) comments that "*biodegradable plastics could find legislative avenues to increased use*". Two approaches to producing truly biodegradable plastics[4] have been used by researchers: the first, to synthesise biodegradable polymers, and the other, to use natural biopolymers such as proteins and starch (Omichi 1992, Yamada *et al.* 1995). Of these two options, only the latter has the added advantage of being considered 'acceptable' by consumers (Yamada *et al.* 1995) and is considered here.

Biodegradable plastics prepared from biopolymers using various agricultural sources have been investigated. Examples are given in Table 2. The main problem with biodegradable packaging is

Table 2. *Properties of Biodegradable Films Formed From Biopolymers (Adapted from Krochta and De Mulder-Johnston 1997).*

Material	Preparation	Moisture Barrier	Oxygen Barrier	Mechanical Properties	Potential Applications
Cellophane	Aqueous suspension	Moderate	Good	Good	Decorative wrap Tapes
Cellulose Acetate	Extrusion	Moderate	Poor	Moderate	Fresh Produce Wrap Labels
Zein	95% Ethanol	Moderate	Moderate	Moderate	Edible films
Starch	Aqueous suspension	Poor	Moderate	Moderate	Edible films
Zein/Starch Composite*		Good	Unspecified	Good	Disposable utensils and containers** Outdoor sporting goods such as golf tees

* *Reference: Jane et al. 1994. The composite films exhibited faster degradation rates than either of the sole parent materials. The reason cited is the balanced nutrient mixture of starch (carbon source) and protein (nitrogen source).*

** *can be collected and used as animal feed or soil containers.*

[4] Synthetic polymers mixed with degradable material such as starch to factilitate distintegration do not satisfy the definition given above of 'biodegradable'.

achieving a controlled lifetime. Products must remain stable and function as intended during product shelf life, but biodegrade efficiently later (Kaplan *et al.* 1993, cited in Krochta and De Mulder-Johnston 1997). In effect, this means minimising those conditions which encourage biodegradability during storage and usage (Yamada *et al.* 1995). Thus, biodegradable plastics produced from biopolymers for use in food packaging applications are best suited for use with dry products, and stored in dry environments.

Conclusions

Edible films prepared from biopolymer materials have great potential within the food packaging sector. Previous research in this field has centred on using the films to retard moisture transfer between heterogeneous food components (for example, cereals containing dried fruit). Only recently, however, has the development of such films as packaging materials been explored. This research is driven, in part, by an awareness of the limited supply of resources used to manufacture existing materials, and growth in solid waste production. Films can be prepared from renewable and abundant biopolymers, and by carefully controlling mechanical and barrier properties, their potential applications are wide ranging, extending outside the food packaging sector to include biodegradable packaging. One problem with edible films is their sensitivity to environmental conditions, which somewhat limits their use. In some cases, where barrier requirements change in response to external conditions, this sensitivity may be used to advantage. A reason cited for the limited commercial utilisation in the past is the success of the polymer industry in supplying the food industry with a range of high-quality synthetic packaging materials (Anon 1995b; Torres 1994). Even if edible films cannot surpass these synthetic materials, they do offer a way of reducing the amounts of synthetic packaging needed to protect a food product. By reducing the requirements for existing packaging systems, they can increase package recyclability. The future of edible films appears to lie in the successful development of composite films, where advantages of individual film forming materials are combined.

References

Anon. (1995a) *Trends in Food Science and Technology* **6**:337.

Anon. (1995b) *European Packaging News*, December, p12.

Anon. (1996) Transtasman Food Code. *Food Technology in New Zealand*, February, p3.

Anon. (1997) Bio-Plastic Packaging. *Food Packaging Bulletin* **6(2)**:10.

Baldwin, E (1997a) Packaging, 22nd Australasian Polymer Symposium February 2-5 1997, Auckland, New Zealand. Polymer Division, Royal Australian Chemical Institute.

Baldwin, E (1997b) *Personal Communication*, US Department of Agriculture, Agricultural Research Service. Citrus and Subtropical Products Laboratories, Winter Haven, Florida, USA.

Baldwin, E A (1995) Use of Edible Coatings to Preserve Quality of Lightly (and Slightly) Processed Products. *Critical Reviews in Food Science and Nutrition* **35(6)**:509-524.

Baker, R; Baldwin, E and Nisperos-Carriedo, M (1994) Edible Coatings and Films for Processed Foods. In Edible Coatings and Films to Improve Food Quality. (Krochta, J; Baldwin, E and Nisperos-Carriedo, M, eds.) Technomic Publishing Company Inc., USA.

Beck, M; Tomka, I and Waysek, E (1996) Physico-Chemical Characterisation of Zein As a Film Coating Polymer: A Direct Comparison with Ethyl Cellulose. *International Journal of Pharmaceutics* **141**:137-150.

Billing, O (1989) Flexible Packaging. Akerland & Rausing, Sweden.

Cuppet, S (1994) Edible Coatings as Carriers of Food Additives, Fungicides and Natural Antagonists. In Edible Coatings and Films to Improve Food Quality. (Krochta, J; Baldwin, E and Nisperos-Carriedo, M, eds.) Technomic Publishing Company Inc., USA.

Day, M; Shaw, K and Cooney, D (1994) Biodegradability: An Assessment of Commercial Polymers According to the Canadian Method for Anaerobic Conditions. *Journal of Environmental Polymer Degradation* **2(2)**:121-127.

deV Naylor, T (1989) Permeation Properties. In Comprehensive Polymer Science: The Synthesis, Characterisation, Reactions and Applications of Polymers. 2:643-668.

Donhowe, G; and Fennema, O (1994) Edible Films and Coatings: Characteristics, Formation, Definitions, and Testing Methods. In Edible Coatings and Films to Improve Food Quality. (Krochta, J; Baldwin, E and Nisperos-Carriedo, M, eds.) Technomic Publishing Company Inc., USA, pp1-24.

Eisenberg, A (1993) The Glassy State and the Glass Transition. In Physical Properties of Polymers. (Mark, J; Eisenberg, A; Graessley, W; Mandelkern, L; Samulski, E; Koenig, J and Wignall, G, eds.) American Chemical Society, USA, pp61-97.

Encyclopedia of Polymer Science and Engineering (1994) 2nd Edition, New York, Wiley.

Ennis, R (1992) Controlled Degradation of Plastics: Environmental Toxicology. In Handbook of Polymer Degradation. (Hamid, S; Amin, M and Maadhah, A, eds.) Marcel Dekher, Inc., New York.

Food Act. (1981) Government Printer, Wellington, New Zealand.

Food Hygiene Regulations. (1974) Government Printer, Wellington, New Zealand.

Food Regulations. (1984) Government Printer, Wellington, New Zealand.

Gennadios, A; Weller, C; Gooding, C (1994) Measurement Errors in Water Vapour Permeability of Highly Permeable, Hydrophilic Edible Films. *Journal of Food Engineering* **21**:395-409.

Gennadios, A; Weller, C and Testin, R (1993) Temperature Effect on Oxygen Permeability of Edible Protein-Based Films. *Journal of Food Science* **58(1)**:212-219.

Grant, L and Burns, J (1994) Application of Coatings. In Edible Coatings and Films to Improve Food Quality. (Krochta, J; Baldwin, E and Nisperos-Carriedo, M, eds.) Technomic Publishing Company Inc., USA.

Guilbert, S (1986) Technology and Applications of Edible Protective Films. In Food Packaging and Preservation: Theory and Practice. (Mathlouthi, M, ed.) Elsevier Applied Science Publishers, Great Britain, pp371-394.

Guilbert, S and Gontard, N (1994) Biopackaging: Technology and Properties of Edible and/or Biodegradable Material of Agricultural Origin. In Food Packaging and Preservation. (Mathlouthi, M, ed.) Blackie Academic and Professional, Great Britain.

Guilbert, S; Gontard, N and Cuq, B (1995) Technology and Applications of Edible Protective Films. *Packaging Technology and Science* **8(6)**:339-346.

Guilbert, S; Gontard, N and Gorris, L (1996) Prolonging the Shelf-life of Perishable Food Products using Biodegradeable Films and Coatings. *Food Science and Technology* **29**:10-17.

Haines, P and Wilburn, F (1995) Differential Thermal Analysis and Differential Scanning Calorimetry. In Thermal Methods of Analysis: Principles, Applications and Problems. (Haines, P, ed.) Blackie Academic and Professional, Great Britain, pp63-132.

Hernandez, E (1994) Edible Coatings from Lipids and Resins. In Edible Coatings and Films to Improve Food Quality. (Krochta, J; Baldwin, E and Nisperos-Carriedo, M, eds.) Technomic Publishing Company Inc., USA.

Holding, R (1996) *Personal Communication*. Marketing Manager. New Zealand Starch Products Limited, Auckland, New Zealand.

Jane, J; Lim, S; Paetau, I; Spence, K and Wang, S (1994) Biodegradable Plastics Made from Agricultural Biopolymers. *American Chemical Society Symposium Series* **525**:92-100.

Jasse B; Seuvre, A and Mathlouthi, M (1994) Permeability and Structure in Polymeric Packaging Materials. In Food Packaging and Preservation. (Mathlouthi, M, ed.), , Blackie Academic and Professional, Great Britain, pp1-22.

Kaplan, D; Mayer, J; Ball, D; McCassie, J; Allen, A and Stenhouse, P (1993) Fundamentals of Biodegradable Polymers. In Biodegradable Polymers and Packaging. (Ching, C; Kapplan, D and Thomas, E, eds.) Technomic Publishing Co., Inc., Lancaster, PA.

Kester, J and Fennema, O (1986) Edible Films and Coatings: A Review. *Food Technology*, December, pp47-59.

Krochta, J (1992) Control of Mass Transfer in Foods with Edible-Coatings and Films. In Advances in Food Engineering. (Paul Singh, R and Wirakartakusumah, M A, eds.) CRC Press Limited, USA, pp517-538.

Krochta, J and De Mulder-Johnston, C (1997) Edible and Biodegradable Polymer Films: Challenges and Opportunities. *Food Technology*, February, **51(2)**:61-74.

Krochta, J; Baldwin, E and Nisoperos-Carriedo, M (eds.) (1994) Edible Coatings and Films to Improve Food Quality. Technomic Publishing Company Inc., USA.

McHugh, T and Krochta, J (1994) Permeability Properties of Edible Films. In Edible Coatings and Films to Improve Food Quality. (Krochta, J; Baldwin, E and Nisperos-Carriedo, M, eds.) Technomic Publishing Company Inc., USA.

Mitchell, J W (1996) *Personal Communication*. Managing Scientist (Food). Institute of Environmental Science and Research Limited, Auckland, New Zealand.

Omichi, H (1992) Degradable Plastics. In Handbook of Polymer Degradation. (Hamid, S; Amin, M and Maadhah, A, ed.) Marcel Dekker Inc., New York, pp335-363.

Park, H and Chinnan, M (1995) Gas and Water Vapour Barrier Properties of Edible Films from Protein and Cellulosic Materials. *Journal of Food Engineering* **25**:497-507.

Park, H; Chinnan, M and Shewfelt, R (1994) Edible Corn-Zein Film Coatings to Extend Storage Life of Tomatoes. *Journal of Food Processing and Engineering* **18**:317-331.

Pascat, B (1986) Study of Some Factors Affecting Permeability. In Food Packaging and Preservation. Theory and Practice. (Mathlouthi, M, ed.) Elsevier Applied Science, London, pp6-24.

Rogers, C (1985) Permeation of Gases and Vapours in Polymers. In Polymer Permeability. (Comyn, J, ed.) Elsevier Applied Science Publishers Limited, London.

Spence, K; Allen, A; Wang, S and Jane, J (1996) Soil and Marine Biodegradation of Protein-Starch Plastics. In Hydrogels and Biodegradable Polymers for Bioapplications. (Ottenbrites, R; Huang, S and Park, K, eds.) American Chemical Society Symposium Series, USA.

Torres, J (1994) Edible Films and Coatings from Proteins. Technical Paper No. 10,277, Agricultural Experiment Station at Oregon State University, USA.

Weng, Z (1993) Measuring Oxygen Transmission Rate For Food Packaging Films By Using The Spectrophotometric and Gas Chromatographic Method. MSc Thesis. The University of New South Wales, Australia.

Wong, D; Camirand, W and Pavlath, A (1994) Development of Edible Coatings for Minimally Processed Fruits and Vegetables. In Edible Coatings and Films to Improve Food Quality. (Krochta, J; Baldwin, E and Nisperos-Carriedo, M, eds.) Technomic Publishing Company Inc., USA.

ABOUT THE AUTHOR

Sarah Donnelly graduated from the University of Auckland in August 1997 with a joint MSc degree in Environmental Science and Chemistry. Her thesis involved developing edible films for potential use as packaging materials. Since completing her degree she has completed an internship with the United Nations Environment Programme. Currently Sarah is working at the Institute of Environmental Science and Research Limited, Wellington Science Centre, Lower Hutt.

LETTER TO THE EDITOR

I enjoyed the article "Waste Not Want Not" by Donnelly, Easteal and Hay in the January/February 1998 issue of *Chemistry in New Zealand*. While the functions of packaging are well enunciated, the initiatives to minimise environmental impacts are in my view not so well covered. In this aspect I have long believed that the second law of thermodynamics has a contribution to make.

Readers will recall that the two most commonly quoted laws of thermodynamics are:

1. *The law of conservation of energy* which is concerned with AMOUNTS of energy and says that the energy of the world is constant and

2. *The entropy law* which is concerned with QUALITY of energy and says that in any actual change some of the ability of the process to do mechanical work is lost. The loss depends on the efficiency (reversibility) with which the change takes place. This reduction in quality or availability of energy is often expressed by the increase of the property called ENTROPY.

One can imagine these aspects of energy in terms of water flowing from the mountains to the sea. In its flow the amount of water stays constant but as it falls to sea level its ability to generate electricity in a hydrostation is reduced. We can waste the potential work by letting the water flow freely or we can recover some by passing the water through a power station on the way down.

The same concepts (of efficiency, reversibility or minimum degradation) can be applied to the use of materials in general and packaging in particular.

One can wrap a product for sale in a way that ensures that opening the package renders the wrapping unfit for any future use and can even generate a disposal problem, as is the case with some blister wrapped products. Alternatively one can use a wrapping which has a secondary use (ice cream sold in plastic containers with fitted lids) or in a container that is reusable (milk bottles). I note that Donnelly has already studied the use of edible food packaging for which there are notable precedents in the sandwich and the ice cream cone.

I once worked at an abattoir where pelts were exported packed in brine in wooden barrels. At their destination the barrels were opened by rolling then down a ramp into a concrete block. The skins were picked up and the shattered remnants of the barrels were swept up and dumped. This is a very irreversible (high entropy) packaging and delivery method.

In contrast to this there is a story about Henry Ford which illustrates reversible (low entropy) packaging. Ford is reputed to have called tenders for the supply of components in which the exact construction of the wooden packing cases in which the parts were to be delivered was specified down to the positions of the screw holes. When the components were delivered the packing cases were carefully dismantled and became the floorboards for Ford trucks already cut to size with the screw holes already drilled.

The use of paper is another situation where the principle of low entropy (multi-step, reversible)° packaging can be applied. It is not difficult to imagine paper having several successive uses on its journey from high quality paper to carbon dioxide. In the worst case paper (say newsprint) is used once to produce a newspaper and then taken to a landfill where it decomposes to produce carbon dioxide and methane (which is a worse greenhouse gas than carbon dioxide). On the other hand one can imagine a sequence such as:

1. newspaper
2. recycle to wrapping paper
3. recycle to egg carton or cardboard
4. burn as fuel for heating or power production.

The reason usually given that such measures are so rarely adopted is that they are "not economic". I would suggest that this conclusion is often reached because the complete system from raw materials to disposal is not analysed and that some of the real costs of the use of certain types of packaging (e.g. the costs of collection and disposal of waste) are externalities which are ignored in the comparisons of various types of packaging.

The first person to co-ordinate the first and second laws of thermodynamics was Clausius (in 1850). I'm not sure that the thermodynamic pursuits would appreciate it but I have long thought that there should be a Clausius Award for practical implementation of the laws of thermodynamics in everyday life. This is especially relevant to packaging where there is great potential for the development of "reversible" systems incorporating reuse and/or secondary use.

A few years ago one of my nominees for such award would have been the company which packaged peanut butter in tumblers so that when the peanut butter had been eaten there remained a useful household utensil. I have recently read of a plumbing fitting which is packaged in a plastic foam box which is designed to become the foam fitting insulation for the unit when it has been installed.

There must be many other candidates that I haven't noticed and I am sure that there are a great many opportunities going begging for more sensible packaging of everyday products, including food, so that the quantity of material going to landfills would be reduced and the quantity of material used in manufacturing would be reduced by the existence of secondary use items. I am equally sure it is not beyond the capability of package designers to combine these features with the other requirements outlined by Donnelly et al.

A G Williamson (FNZIC)

A Rapid High Performance Liquid Chromatographic Method For The Quality Control Analysis Of Pholcodine In Cough Syrup

Nicky Tjenderasa[Ψ] and Mark Duxbury[τ]
[Ψ]Pharmaceutical Sales and Marketing, 14 Norman Spencer Drive, Wiri, Auckland
[τ]Department of Applied Science, Auckland Institute of Technology, Private Bag 92006, Auckland

Introduction

Pholcodine is a cough suppressant used in approximately forty-five different medications (1). The synthesis of pholcodine was first reported in France in 1950, the molecule itself being, like codeine, an analogue of morphine (Figure 1). Pholcodine has several advantages over codeine as a cough suppressant, including the absence of side effects such as constipation and in contrast to codeine, pholcodine is not converted to morphine in humans and so is not addictive. It is also metabolised and eliminated much more slowly than codeine. Conversely pholcodine appears to have a greater depressant effect on the respiratory and cardiovascular system than codeine in animals, although these effects have not been observed in humans after administration of therapeutic doses.

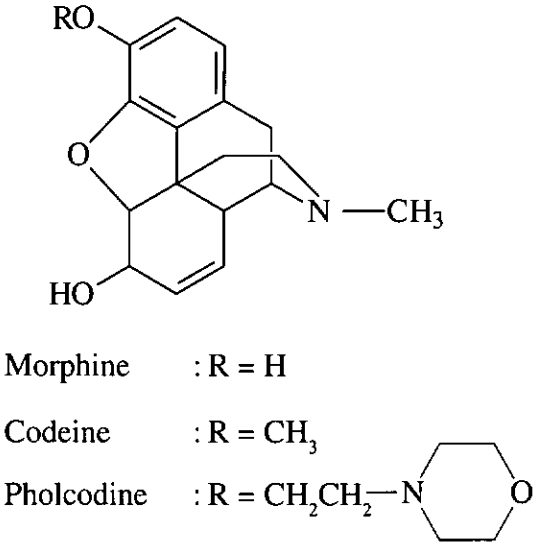


Figure 1.

The Analytical Chemistry of Pholcodine

The primary focus in the analysis of pholcodine has been its determination at low concentrations in biological fluids such as blood and urine, which are complex mixtures containing many components that can interfere in the analysis. This has necessitated the development of complex extraction procedures coupled with chromatographic methods, including gas chromatography (2-5) and high performance liquid chromatography (6-9), utilising sensitive and selective fluorescence, electrochemical and mass spectrometric detectors. Capillary electrophoresis (10-11) and enzyme immunoassay (4, 12) have also been used to determine pholcodine in biological fluids and other biological matrices.

In contrast to the analysis of pholcodine in biological fluids, the analysis of pholcodine in pharmaceutical preparations such as cough syrups is relatively simple, as pholcodine is usually present in relatively high concentrations and the other sample components are known. The standard method used by the pharmaceutical manufacturing industry in New Zealand is the British Pharmacopoeia (BP) assay (13), which involves successive extractions of pholcodine from the cough syrup with chloroform, evaporation of the chloroform extract to a low volume and determination of the pholcodine by non-aqueous titration.

The BP method is reliable, requires only simple equipment and has been used effectively for several decades. However, in recent years there has been increasing concern about the safety of prolonged exposure to chloroform and also about the adverse environmental effects of halogenated hydrocarbons. In addition chloroform as a solvent is relatively expensive to purchase and dispose of after use, leading to relatively high analysis costs per sample. A further disadvantage of the BP assay is that it is laborious which lowers sample throughput, increasing costs and analyst time.

An alternative method for the analysis of pholcodine in cough syrups is based on a colour forming reaction between pholcodine and *p*-dimethylaminobenzaldehyde (14). However this spectrophotometric method also requires extraction with chloroform to separate the pholcodine from other components which may interfere.

Two HPLC methods have been published specifically for the analysis of cough medications containing pholcodine (15-16). These methods were designed for the analysis of complex mixtures of drugs similar in structure to pholcodine so relatively long analysis times are involved and the methods use complicated gradient and flow changes. For example the method of Lau *et al.* (15) involves a programmed change of mobile phase flow rate during the analysis and pholcodine itself has a retention time of 13 minutes as it is the last of eight drugs separated to elute. This lowers the sample throughput rate to four samples per hour, making the method less suitable for quality control analysis. However most medications are simpler than this mixture, often containing only pholcodine as the active alkaloid. Therefore the goal of the present study was to develop a simple, rapid, automated HPLC method for the analysis of pholcodine in a cough syrup manufactured in New Zealand that is suitable for quality control and to validate the method against the standard BP assay.

Experimental

A typical composition of the Pholcodine cough syrup (linctus) to be analysed is given in Table 1. It consists of the active ingredients pholcodine and ethanol, methyl paraben as a

preservative, sugar and citric acid for taste and the dyes amaranth and sunset yellow for colouring. The quality control limits for pholcodine are 0.18-0.22 %w/v.

Table 1. Typical Composition of Cough Syrup.

Component	%w/v
Sugar Premium Liquid	86.0155
Ethanol	8.5324
Water	3.2000
Citric Acid	1.4284
Glycerol	0.5427
Pholcodine	0.1562
Amaranth	0.0016
Sunset Yellow	0.0055

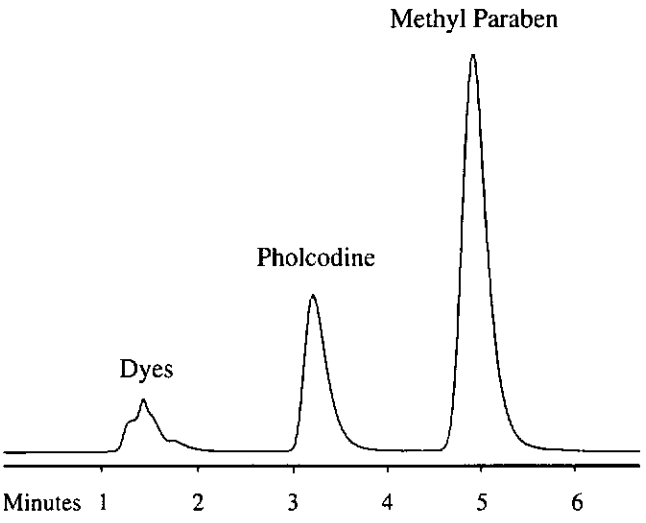
HPLC Method Development

The object of chromatographic analysis is to separate those molecules in solution that absorb at the same wavelength as the analyte, in this case pholcodine. An initial spectrophotometric analysis indicated that the optimum wavelength for the determination of pholcodine was 284 nm. Methyl paraben and the two dyes present in the cough syrup also absorb at this wavelength.

Figure 2 shows the optimised instrumental parameters and the chromatogram for the analysis of the pholcodine cough syrup. Initially the separation was undertaken without an ion pairing reagent, using a water/acetonitrile mobile phase. Using this mobile phase the dyes and pholcodine could not be resolved without producing an unacceptably long retention time for methyl paraben. For example with a 20% acetonitrile content the dyes and pholcodine coeluted at 1.6 minutes while the retention time for methyl paraben was 11 minutes.

Addition of an ion pairing reagent to the mobile phase increased the retention of pholcodine relative to the dyes, allowing a higher concentration of organic solvent to be used giving decreased retention times for all compounds without compromising the resolution of pholcodine from the other components. Methanol was used instead of acetonitrile as the organic solvent when the ion pairing reagent was employed, as methanol has superior solubilisation characteristics for ion pairing reagents (17). The resolution ($R_s = 3.31$) between pholcodine and the closest eluting peak (methyl paraben) indicates that if necessary the analysis time could be reduced even further. However, in order to give the method the robustness required for quality control this was not pursued.

Both standard and cough syrup solutions were diluted in the mobile phase to avoid the phenomenon of peak splitting, which can be particularly pronounced when using ion pairing reagents (18). In addition diluting the cough syrup samples in mobile phase prevented blockage in the microlitre syringe of the autosampler due to the high sugar content of the syrup.



Column: Phenomenex Bondclone 10, C18, 150 x 3.9 mm, 10 um

Mobile Phase: 45:55 Methanol/Water (adjusted to pH 3.3 with Acetic Acid), containing 6 mM Sodium Hexane Sulphonic Acid as ion pairing reagent

Flow Rate: 1.0 mL/min

Detector: UV, 284 nm

Injection Volume: 20 µL

Sensitivity: 0.1 AUFS

Sample: 6.4 g Pholcodine linctus per 50 mL mobile phase

Figure 2. *Chromatogram and conditions for the analysis of pholcodine in cough syrup.*

Caution should be exercised when analysing basic drugs such as pholcodine on silica supported C18 stationary phases as peak tailing is often a problem, due to the interaction between the basic sample and residual silanol groups on the silica support. The problem varies considerably between different columns, and is minimised in columns that have a high degree of endcapping and which are produced from silica with low "acidity" (19). The low tailing factor for the pholcodine peak ($T_s = 1.30$) observed in the present study indicates that peak tailing is not a significant problem for pholcodine on the stationary phase used, and indeed the addition of triethylamine to the mobile phase did not suppress the peak tailing further.

Chromatography of a cough syrup sample containing all the standard components except pholcodine indicated that no interferents were present that had the same retention time as pholcodine. The pholcodine calibration curve was linear in the concentration range 0.010-0.030 %w/v which spans the quality control limits of the diluted cough syrup.

Validation of HPLC Method Versus British Pharmacopoeia Method

Figure 3 shows the correlation between the standard British Pharmacopoeia Method utilising chloroform extraction/

non-aqueous titration versus the HPLC method. Each data point is the mean of four analyses by both methods. There was a strong correlation between the two methods ($R^2 = 0.997$). A t-test comparing the means of each of the points indicated that there was a small but significant ($p<0.05$) difference between the two methods, with the BP method giving a 0.9% lower result than the HPLC method.

Figure 3. Correlation between %w/v Pholocodine for BP and HPLC Methods.

The lower assay results from the BP method may be due to incomplete extraction or loss of analyte during extraction. The BP method also suffers from the use of a relatively dilute titrant (0.02 M $HClO_4$) which affects the sharpness of the endpoint. In practical terms a relative difference of less than 1% between the two methods does not affect the accuracy of the quality control process.

Conclusion

The HPLC method reported here is a rapid, simple, automated alternative to the standard British Pharmacopoeia non-aqueous titration method which has significant benefits in terms of operator and environmental safety by the elimination of the chloroform extraction step. The main disadvantage is the cost of the HPLC system itself compared to the rudimentary equipment required for the BP analysis.

References

1. Findlay, J W (1988) Pholcodine. *J. Clin. Pharm. Ther.* **13(1)**:5-17.

2. Krogh, M; Christopherson, A S and Rasmussen, K E (1993) Automated sample preparation by on-line dialysis and trace enrichment. Analysis of morphine, 6-monomethylmorphine, codeine, ethylmorphine and pholcodine in plasma and whole blood by capillary gas chromatography and capillary gas-chromatography-mass spectrometry. *J. Chromatogr.* **621(1)**:41-48.

3. Johansen, M; Rasmussen, K E and Christopherson, A S (1990) Determination of pholcodine and its metabolites in urine by capillary gas chromatography. *J. Chromatogr.* **532(2)**:277-284.

4. Johansen, M; Rasmussen, K E; Christopherson, A S and Skuterud, B (1991) Metabolic study of pholcodine in urine using enzyme multiplied immunoassay technique (EMIT) and capillary gas chromatography. *Acta. Pharm. Nord.* **3(2)**:91-94.

5. Sautou, V; Constant, H; Bonnefous, J L; Chopineau, J and Aulagner, G (1994) Analysis of opiates in the urine of children with gas chromatography coupled to mass spectrometry. *J. Pharm. Belg.* **49(5)**:383-389.

6. Low, A S and Taylor, R B (1995) Analysis of common opiates and heroin metabolites in urine by high performance liquid chromatography. *J. Chromatogr. B* **663(2)**:225-233.

7. Andresen, A T; Krogh, M and Rasmussen, K E (1992) On-line dialysis and weak cation exchange enrichment of dialysate. Automated HPLC of pholcodine in human blood and plasma. *J. Chromatogr.* **582(1-2)**:123.

8. Johansen, M; Tonnessen, F and Rasmussen, K E (1992) Column switching HPLC detection of pholcodine and its metabolites in urine with fluorescence and electrochemical detection. *J. Chromatogr.* **573(2)**:283-288.

9. Chen, Z R; Siebert, D M; Somogyi, A A and Bochner, F (1988) Determination of pholcodine in biological fluids by HPLC with fluorescence detection. *J. Chromatogr.* **424(1)**:170-176.

10. Taylor, R B; Low, A S and Reid, R G (1996) Determination of opiates in urine by capillary electrophoresis. *J. Chromatogr. B* **675(2)**:213-223.

11. Trenerry, V C; Wells, R J and Robertson, J (1995) Determination of morphine and related alkaloids in crude morphine, poppy straw and opium preparations by micellar electrokinetic capillary chromatography. *J. Chromatogr. A* **718(1)**:217-225.

12. Butz, R F; Jones, E C; Welch, R M and Findlay, J W (1983) Pharmacokinetics and O-dealkylation of morphine-3-alkyl ethers in the rat. A radioimmunoassay study. *Drug Metab. Dispos.* **11(5)**:481-488.

13. *British Pharmacopoeia* (1993) HMSO, London, p1058.

14. Shohet, J S (1975) Analysis of pholcodine in cough preparations. *J. Pharm. Sci.* **64(6)**:1011-1013.

15. Lau, O W; Chan, K; Lau, Y K and Wong, W C (1989) The simultaneous determination of active ingredients in cough-cold mixtures by isocratic reversed-phase ion-pair HPLC. *J. Pharm. Biomed. Anal.* **7(6)**:725-736.

16. Carnevale, L (1983) Simultaneous determination of acetaminophen, guaifenesin, pseudoephedrine, pholcodine, and paraben preservatives in cough mixture by HPLC. *J. Pharm. Sci.* **72(2)**:196-198.

17. Dolan, J W (1996) Improving an Ion-Pairing Method. *LC-GC* **14(9)**:768-775.

18. Dolan, J W (1992) Ion-Pairing Problems. *LC-GC* **10(10)**:745-746.

19. Stadalius, M (1988) Reversed-phase HPLC of basic samples. *LC-GC* **6(6)**:494-500.

HPLC, IC, LC-MS - Quick Reference Buyer's Guide

ANALYSER, AMINO ACID

ALPHATECH SYSTEMS LTD
WATERS, HITACHI
GBC-AEC
GBC
JOHN MORRIS SCIENTIFIC LTD
GILSON
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PERKIN-ELMER PTY LTD
PE APPLIED BIOSYSTEMS, APPLIED BIOSYSTEMS
SCI TECH
PHARMACIA BIOTECH
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU, PICKERING LABORATORIES

AUTOSAMPLER, CHROMATOGRAPHY, LIQUID

A.I. SCIENTIFIC (NZ) LTD
VARIAN, RAININ, DIONEX
ALLTECH ASSOCIATES
ALLTECH, PERKIN ELMER
ALPHATECH SYSTEMS LTD
WATERS
GBC-AEC
GBC, ALCOTT
JOHN MORRIS SCIENTIFIC LTD
GILSON
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
SCI TECH
THERMO SEPARATION PRODUCTS, JASCO
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU
SIGMA ALDRICH PTY LTD
SUPELCO

CHEMICALS, CHROMATOGRAPHIC

ALLTECH ASSOCIATES
ALLTECH
ALPHATECH SYSTEMS LTD
WATERS
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
BDH CHEMICALS NEW ZEALAND LTD
BDH CHEMICALS, MERCK
BIOLAB SCIENTIFIC LTD
ALDRICH, BDH CHEMICALS, MERCK, MALLINCKRODT
GBC-AEC
KEYSTONE SCIENTIFIC, SGE, SMT
LABSUPPLY PIERCE (NZ) LTD
JT BAKER
MEDIC WATSON VICTOR
SHANDON
SCIENTIFIC SUPPLIES LTD
ACROS, ALDRICH, LANCASTER
SIGMA ALDRICH PTY LTD
RIEDEL-DE HAEN, SIGMA, ALDRICH, FLUKA, SUPELCO

CHROMATOGRAPHY, ABSORBENTS

ALLTECH ASSOCIATES
ALLTECH
ALPHATECH SYSTEMS LTD
BIOSEPRA
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
BDH CHEMICALS NEW ZEALAND LTD
BDH CHEMICALS, MERCK
BIOLAB SCIENTIFIC LTD
MERCK, BDH CHEMICALS, MACHERY NAGEL, WHATMAN
GBC-AEC
SGE
LABSUPPLY PIERCE (NZ) LTD
JT BAKER, MERCK, WHATMAN
LIFE TECHNOLOGIES LTD
SPECTRUM
MEDIC WATSON VICTOR
SHANDON
PERKIN-ELMER PTY LTD
PERKIN ELMER, PERSEPTIVE BIOSYSTEMS
SCIENTIFIC SUPPLIES LTD
HICHROM, SERVA/BI BIOPRODUCTS
SIGMA ALDRICH PTY LTD
SUPELCO

CHROMATOGRAPHY, COLUMN PACKING

ALLTECH ASSOCIATES
ALLTECH
ALPHATECH SYSTEMS LTD
WATERS
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
BIOLAB SCIENTIFIC LTD
WHATMAN, PROLABO, MERCK
BOEHRINGER MANNHEIM (NZ) LTD
POROS
GBC-AEC
GBC, KEYSTONE SCIENTIFIC, SGE
LIFE TECHNOLOGIES LTD
SPECTRUM
MEDIC WATSON VICTOR
SHANDON
PERKIN-ELMER PTY LTD
PERKIN ELMER, PERSEPTIVE BIOSYSTEMS, POROS
PHENOMENEX (NZ) LTD
PHENOMENEX, HYPERSIL, KROMASIL, HAMILTON, MERCK, MACHERY NAGEL, WHATMAN
SCIENTIFIC SUPPLIES LTD
HICHROM
SIGMA ALDRICH PTY LTD
RIEDEL-DE HAËN, SIGMA, ALDRICH, SUPELCO

CHROMATOGRAPHY, COLUMNS AND ACCESSORIES

ALLTECH ASSOCIATES
ALLTECH
ALPHATECH SYSTEMS LTD
WATERS, JOUR RESEARCH, BECKMAN, DAICEL, HPLC, TECHNOLOGY, BROWNLEE, HIGGINS ANALYTICAL, HICHROM, CE INSTRUMENTS, SHODEX
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
BDH CHEMICALS NEW ZEALAND LTD
MERCK
BIOLAB SCIENTIFIC LTD
KONTES, QIAGEN, KIMBLE, WHATMAN, MERCK
BOEHRINGER MANNHEIM (NZ) LTD
POROS
GBC-AEC
SGE, GBC, UPCHURCH, KEYSTONE SCIENTIFIC, SMT
LABSUPPLY PIERCE (NZ) LTD
JT BAKER, WHATMAN, PIERCE, MERCK
LIFE TECHNOLOGIES LTD
SPECTRUM
MEDIC WATSON VICTOR
SHANDON

MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PERKIN-ELMER PTY LTD
PERKIN ELMER, PERSEPTIVE BIOSYSTEMS, POROS
PHENOMENEX (NZ) LTD
PHENOMENEX, BECKMAN, COSMOSIL, DEVELOSIL, HAMILTON, HYPERSIL, INTERACTION, POLYMER LABORATORIES, SHODEX, TSK, VYDAC, WHATMAN, CAPCELL
SCI TECH
VSPP, OPTIMIZE TECHNOLOGIES, METACHEM
SCIENTIFIC SUPPLIES LTD
HICHROM
SHIMADZU SCIENTIFIC INSTRUMENTS
J & W SCIENTIFIC

CHROMATOGRAPHY, DATA SYSTEM/INTEGRATOR

A.I. SCIENTIFIC (NZ) LTD
VARIAN, DIONEX
ALLTECH ASSOCIATES
ALLTECH, PERKIN ELMER, PE NELSON, NELSON ANALYTICAL
ALPHATECH SYSTEMS LTD
CE INSTRUMENTS, WATERS, HITACHI
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
BIOLAB SCIENTIFIC LTD
UNICAM
GBC-AEC
GBC, WINCHROM, SCIENTIFIC SOFTWARE INC
JOHN MORRIS SCIENTIFIC LTD
GILSON
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PERKIN-ELMER PTY LTD
PERKIN ELMER, PE NELSON, NELSON ANALYTICAL
SCI TECH
DIGITAL SOLUTIONS, THERMO SEPARATION PRODUCTS
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU, SCIENTIFIC SOFTWARE INC, EZCHROM
SIGMA ALDRICH PTY LTD
SUPELCO

CHROMATOGRAPHY, DETECTOR, CHEMILUMINESCENT

SCI TECH
JASCO
SHIMADZU SCIENTIFIC INSTRUMENTS
ANTEK

CHROMATOGRAPHY, DETECTOR, CONDUCTIVITY

A.I. SCIENTIFIC (NZ) LTD
DIONEX
ALLTECH ASSOCIATES
ALLTECH
ALPHATECH SYSTEMS LTD
BECKMAN
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
GBC-AEC
LAB ALLIANCE
JOHN MORRIS SCIENTIFIC LTD
METROHM
SCI TECH
TOA
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU

CHROMATOGRAPHY, DETECTOR, DIODE ARRAY

A.I. SCIENTIFIC (NZ) LTD
VARIAN
ALLTECH ASSOCIATES
PERKIN ELMER
ALPHATECH SYSTEMS LTD
WATERS
GBC-AEC
GBC
JOHN MORRIS SCIENTIFIC LTD
GILSON
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PERKIN-ELMER PTY LTD
PERKIN ELMER
SCI TECH
THERMO SEPARATION PRODUCTS
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU

CHROMATOGRAPHY, DETECTOR, ELECTROCHEMICAL

A.I. SCIENTIFIC (NZ) LTD
DIONEX
ALPHATECH SYSTEMS LTD
WATERS
GBC-AEC
GBC
JOHN MORRIS SCIENTIFIC LTD
GILSON
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
SCI TECH
ESA
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU

CHROMATOGRAPHY, DETECTOR, EVAPORATIVE LIGHT SCATTERING

ALPHATECH SYSTEMS LTD
POLYMER LABORATORIES
GBC-AEC
SGE
MEDTEC PRODUCTS LTD
POLYMER LABORATORIES
SHIMADZU SCIENTIFIC INSTRUMENTS
SEDERE

CHROMATOGRAPHY, DETECTOR, FLUORESCENCE

A.I. SCIENTIFIC (NZ) LTD
VARIAN
ALLTECH ASSOCIATES
ALLTECH, PERKIN ELMER
ALPHATECH SYSTEMS LTD
WATERS, HITACHI
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
GBC-AEC
GBC
JOHN MORRIS SCIENTIFIC LTD
GILSON
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PERKIN-ELMER PTY LTD
PERKIN ELMER
SCI TECH
JASCO, THERMO SEPARATION PRODUCTS

SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU

CHROMATOGRAPHY, DETECTOR, LIQUID SCINTILLATION

ALPHATECH SYSTEMS LTD
BECKMAN, BERTHOLD, RAYTEST, BICRON, IN/US
SHIMADZU SCIENTIFIC INSTRUMENTS
RAYTEST

CHROMATOGRAPHY, DETECTOR, LOW-ANGLE LASER LIGHT SCATTERING

ALPHATECH SYSTEMS LTD
WYATT TECHNOLOGIES

CHROMATOGRAPHY, DETECTOR, MASS

ALPHATECH SYSTEMS LTD
POLYMER LABORATORIES
LECO AUSTRALIA PTY LTD
LECO CORPORATION
SHIMADZU SCIENTIFIC INSTRUMENTS
SEDERE

CHROMATOGRAPHY, DETECTOR, RADIOACTIVITY

SHIMADZU SCIENTIFIC INSTRUMENTS
RAYTEST

CHROMATOGRAPHY, DETECTOR, REFRACTIVE INDEX

A.I. SCIENTIFIC (NZ) LTD
VARIAN
ALLTECH ASSOCIATES
ALLTECH, PERKIN ELMER
ALPHATECH SYSTEMS LTD
WATERS
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
GBC-AEC
GBC
JOHN MORRIS SCIENTIFIC LTD
GILSON
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PERKIN-ELMER PTY LTD
PERKIN ELMER
SCI TECH
JASCO, THERMO SEPARATION PRODUCTS
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU

CHROMATOGRAPHY, DETECTOR, ULTRAVIOLET/VISIBLE

A.I. SCIENTIFIC (NZ) LTD
VARIAN, RAININ
ALLTECH ASSOCIATES
ALLTECH, PERKIN ELMER
ALPHATECH SYSTEMS LTD
WATERS
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
GBC-AEC
GBC
JOHN MORRIS SCIENTIFIC LTD
GILSON
LIFE TECHNOLOGIES LTD
SPECTRUM
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PERKIN-ELMER PTY LTD
PERKIN ELMER
SCI TECH
THERMO SEPARATION PRODUCTS
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU

CHROMATOGRAPHY, GASES, HIGH PURITY

BOC GASES NZ LTD
BOC GASES NZ LTD

CHROMATOGRAPHY, HPLC COLUMNS & ACCESSORIES

A.I. SCIENTIFIC (NZ) LTD
VARIAN, DIONEX
ALLTECH ASSOCIATES
ALLTECH, BROWNLEE, HAMILTON
ALPHATECH SYSTEMS LTD
WATERS, BROWNLEE, BECKMAN, JOUR RESEARCH, HPLC TECHNOLOGY, RESTEK, HICHROM, HIGGINS ANALYTICAL, RHEODYNE, SHODEX, DAICEL CHEMICAL
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
BDH CHEMICALS NEW ZEALAND LTD
MERCK
BIOLAB SCIENTIFIC LTD
BDH CHEMICALS, MERCK, KONTES, KIMBLE
GBC-AEC
KEYSTONE, SMT
LABSUPPLY PIERCE (NZ) LTD
WHATMAN
MEDIC WATSON VICTOR
SHANDON
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PERKIN-ELMER PTY LTD
PERKIN ELMER, PERSEPTIVE BIOSYSTEMS
PHENOMENEX (NZ) LTD
PHENOMENEX, BECKMAN, COSMOSIL, DEVELOSIL, HAMILTON, HYPERSIL, INTERACTION, POLYMER LABORATORIES, SHODEX, SYNCHROM, TSK, VYDAC, WHATMAN, CAPCELL, BOND ELUT, SGE, RHEODYNE
SCI TECH
JASCO, METACHEM, THERMO SEPARATION PRODUCTS
SHIMADZU SCIENTIFIC INSTRUMENTS
JONES CHROMATOGRAPHY
SIGMA ALDRICH PTY LTD
SUPELCO, SIGMA, ALDRICH

CHROMATOGRAPHY, HPLC INSTRUMENTS/SYSTEM

A.I. SCIENTIFIC (NZ) LTD
VARIAN, RAININ
ALLTECH ASSOCIATES
ALLTECH, PERKIN ELMER
ALPHATECH SYSTEMS LTD
WATERS, HITACHI
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
BDH CHEMICALS NEW ZEALAND LTD
BDH CHEMICALS, MERCK
BIOLAB SCIENTIFIC LTD
MALLINCKRODT
GBC-AEC
GBC SCIENTIFIC, LAB ALLIANCE
JOHN MORRIS SCIENTIFIC LTD
GILSON

MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PERKIN-ELMER PTY LTD
PERKIN ELMER, PERSEPTIVE BIOSYSTEMS
SCI TECH
JASCO, THERMO SEPARATION PRODUCTS
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU
SIGMA ALDRICH PTY LTD
SUPELCO, SIGMA, ALDRICH

CHROMATOGRAPHY, HPLC, PREPARATIVE

A.I. SCIENTIFIC (NZ) LTD
VARIAN, RAININ
ALLTECH ASSOCIATES
ALLTECH, PERKIN ELMER
ALPHATECH SYSTEMS LTD
WATERS
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
BDH CHEMICALS NEW ZEALAND LTD
MERCK
GBC-AEC
GBC SCIENTIFIC
JOHN MORRIS SCIENTIFIC LTD
GILSON
PERKIN-ELMER PTY LTD
PERKIN ELMER, PERSEPTIVE BIOSYSTEMS
PHENOMENEX (NZ) LTD
PHENOMENEX
SCI TECH
SEPRAGEN
SCIENTIFIC SUPPLIES LTD
HICHROM, SCHLEICHER & SCHUELL
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU

CHROMATOGRAPHY, HPLC, PUMP SPARES

ALLTECH ASSOCIATES
ALLTECH
GBC-AEC
UPCHURCH
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU, ISCO

CHROMATOGRAPHY, HPLC, SAMPLE PREPARATION

ALPHATECH SYSTEMS LTD
WATERS, ZYMARK
BDH CHEMICALS NEW ZEALAND LTD
MERCK
BIOLAB SCIENTIFIC LTD
MILLIPORE, WHATMAN
JOHN MORRIS SCIENTIFIC LTD
GILSON
LABSUPPLY PIERCE (NZ) LTD
WHATMAN
MEDIC CORPORATION LTD
SARTORIUS
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PHENOMENEX (NZ) LTD
PHENOMENEX, VARIAN, RHEODYNE
SCIENTIFIC SUPPLIES LTD
SCHLEICHER & SCHUELL, RIEDEL-DE HAEN
SHIMADZU SCIENTIFIC INSTRUMENTS
OI CORPORATION, ISCO, J & W SCIENTIFIC

CHROMATOGRAPHY, HPLC, SOLVENT RECYCLING

ALLTECH ASSOCIATES
ALLTECH
ALPHATECH SYSTEMS LTD
JOUR RESEARCH
GBC-AEC
METACHEM
MEDIC WATSON VICTOR
BUCHI
PHENOMENEX (NZ) LTD
PHENOMENEX

CHROMATOGRAPHY, ION CHROMATOGRAPH

A.I. SCIENTIFIC (NZ) LTD
DIONEX
ALLTECH ASSOCIATES
ALLTECH
ALPHATECH SYSTEMS LTD
WATERS
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
GBC-AEC
LACHAT, LAB ALLIANCE
JOHN MORRIS SCIENTIFIC LTD
METROHM
SCI TECH
TOA
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU
SIGMA ALDRICH PTY LTD
SUPELCO

CHROMATOGRAPHY, LIQUID, FITTINGS

ALLTECH ASSOCIATES
ALLTECH, VALCO, RHEODYNE
BDH CHEMICALS NEW ZEALAND LTD
MERCK
GBC-AEC
UPCHURCH
MEDTEC PRODUCTS LTD
SUN, HEWLETT PACKARD
SCI TECH
OPTIMIZE TECHNOLOGIES
SIGMA ALDRICH PTY LTD
VALCO, UPCHURCH, SSI, SUPELCO

CHROMATOGRAPHY, LIQUID, LOW/MEDIUM PRESSURE

ALLTECH ASSOCIATES
ALLTECH
ALPHATECH SYSTEMS LTD
WATERS, ATTO, HITACHI
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
BDH CHEMICALS NEW ZEALAND LTD
BDH CHEMICALS, MERCK
GBC-AEC
GBC, LAB ALLIANCE
JOHN MORRIS SCIENTIFIC LTD
GILSON
MEDIC WATSON VICTOR
BUCHI
PERKIN-ELMER PTY LTD
PERKIN ELMER, PERSEPTIVE BIOSYSTEMS
PHENOMENEX (NZ) LTD
PHENOMENEX

SCIENTIFIC SUPPLIES LTD
HICHROM
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU, ISCO
SIGMA ALDRICH PTY LTD
RIEDEL-DE HAEN, SUPELCO

CHROMATOGRAPHY, LIQUID, PREPARATIVE

ALLTECH ASSOCIATES
ALLTECH, PERKIN ELMER
ALPHATECH SYSTEMS LTD
WATERS, ATTO, ELDEX, HITACHI
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
BDH CHEMICALS NEW ZEALAND LTD
BDH CHEMICALS, MERCK
BIOLAB SCIENTIFIC LTD
MERCK, KONTES
GBC-AEC
GBC
JOHN MORRIS SCIENTIFIC LTD
GILSON
LIFE TECHNOLOGIES LTD
SPECTRUM
PERKIN-ELMER PTY LTD
PERKIN ELMER, PERSEPTIVE BIOSYSTEMS
PHENOMENEX (NZ) LTD
PHENOMENEX
SCIENTIFIC SUPPLIES LTD
HICHROM
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU, ISCO
SIGMA ALDRICH PTY LTD
SUPELCO

CHROMATOGRAPHY, LIQUID/MASS SPECTROMETER (LC-MS)

ALPHATECH SYSTEMS LTD
FINNIGAN
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PERKIN-ELMER PTY LTD
PERKIN ELMER, SCIEX, PE SCIEX, PERKIN ELMER SCIEX
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU

CHROMATOGRAPHY, POLYMER

GBC-AEC
POLYMER LABORATORIES
SHIMADZU SCIENTIFIC INSTRUMENTS
OI CORPORATION

CHROMATOGRAPHY, SOFTWARE, TRAINING

GBC-AEC
COGNITIVE SOLUTIONS
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU

DEGASSER, ON-LINE, HPLC

ALLTECH ASSOCIATES
ALLTECH, PERKIN ELMER
ALPHATECH SYSTEMS LTD
JOUR RESEARCH
MEDTEC PRODUCTS LTD
HEWLETT PACKARD
PHENOMENEX (NZ) LTD
PHENOMENEX
SCI TECH
UNIFLOWS
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU
SIGMA ALDRICH PTY LTD
SUPELCO

INJECTION SYSTEM

ALPHATECH SYSTEMS LTD
VALCO, RHEODYNE, WATERS
GBC-AEC
SGE, SRI
JOHN MORRIS SCIENTIFIC LTD
GILSON
PHENOMENEX (NZ) LTD
RHEODYNE
SCI TECH
RHEODYNE
SHIMADZU SCIENTIFIC INSTRUMENTS
RHEODYNE, VALCO, SHIMADZU
SIGMA ALDRICH PTY LTD
SUPELCO

SAMPLER, CHROMATOGRAPHY, LIQUID

ALLTECH ASSOCIATES
ALLTECH, PERKIN ELMER
GBC-AEC
GBC, ALCOTT
SHIMADZU SCIENTIFIC INSTRUMENTS
SHIMADZU, OI CORPORATION

SEPARATION & PURIFICATION EQUIPMENT

A.I. SCIENTIFIC (NZ) LTD
VARIAN, RAININ, DIONEX
ALLTECH ASSOCIATES
ALLTECH, PERKIN ELMER
ALPHATECH SYSTEMS LTD
WATERS, BIOSEPRA
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
JOHN MORRIS SCIENTIFIC LTD
GILSON
MEDIC WATSON VICTOR
BUCHI
PERKIN-ELMER PTY LTD
PERKIN ELMER, PERSEPTIVE BIOSYSTEMS
SCI TECH
JASCO, THERMO SEPARATION PRODUCTS
SHIMADZU SCIENTIFIC INSTRUMENTS
OI ANALYTICAL
SIGMA ALDRICH PTY LTD
SUPELCO

STANDARDS, CALIBRATION, CHROMATOGRAPHY

ALLTECH ASSOCIATES
ALLTECH
ALPHATECH SYSTEMS LTD
RESTEK
BDH CHEMICALS NEW ZEALAND LTD
BDH CHEMICALS
GBC-AEC
POLYMER LABORATORIES
PHENOMENEX (NZ) LTD
PHENOMENEX

SCIENTIFIC SUPPLIES LTD
CHEMSERVICE
SHIMADZU SCIENTIFIC INSTRUMENTS
J & W SCIENTIFIC
SIGMA ALDRICH PTY LTD
RIEDEL-DE HAEN, SUPELCO

SYRINGES, MICRO, CHROMATOGRAPHY

ALLTECH ASSOCIATES
SGE, RHEODYNE
BIOLAB SCIENTIFIC LTD
COLE PARMER
GBC-AEC
SGE
SIGMA ALDRICH PTY LTD
ALDRICH, SIGMA, SUPELCO

TUBING, CHROMATOGRAPHY, PLASTIC

A.I. SCIENTIFIC (NZ) LTD
ALLTECH ASSOCIATES
ALLTECH
ALPHATECH SYSTEMS LTD
JOUR RESEARCH
BDH CHEMICALS NEW ZEALAND LTD
MERCK
GBC-AEC
SGE, UPCHURCH
PHENOMENEX (NZ) LTD
PHENOMENEX
SIGMA ALDRICH PTY LTD
SUPELCO

TUBING, STAINLESS STEEL

ALPHATECH SYSTEMS LTD
WATERS
BDH CHEMICALS NEW ZEALAND LTD
MERCK
GBC-AEC
SGE
PHENOMENEX (NZ) LTD
PHENOMENEX
SIGMA ALDRICH PTY LTD
SUPELCO

VALVES, CORROSION RESISTANT

ALLTECH ASSOCIATES
VALCO, RHEODYNE, SGE
ALPHATECH SYSTEMS LTD
VALCO
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
GBC-AEC
SGE, VALCO
PHENOMENEX (NZ) LTD
RHEODYNE
SIGMA ALDRICH PTY LTD
SUPELCO

VALVES, HIGH PRESSURE

ALLTECH ASSOCIATES
SGE, RHEODYNE, VALCO
ALPHATECH SYSTEMS LTD
VALCO
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
GBC-AEC
SGE, VALCO
PHENOMENEX (NZ) LTD
RHEODYNE
SIGMA ALDRICH PTY LTD
ALDRICH

VALVES, NEEDLE

ALLTECH ASSOCIATES
SGE, RHEODYNE, VALCO
GBC-AEC
SGE, VALCO, UPCHURCH
PHENOMENEX (NZ) LTD
RHEODYNE
SHIMADZU SCIENTIFIC INSTRUMENTS
RHEODYNE, J & W SCIENTIFIC
SIGMA ALDRICH PTY LTD
SUPELCO

VALVES, PLASTIC

ALLTECH ASSOCIATES
SGE, RHEODYNE, VALCO
ALPHATECH SYSTEMS LTD
VALCO
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
SIGMA ALDRICH PTY LTD
SUPELCO

VALVES, STAINLESS STEEL

ALLTECH ASSOCIATES
SGE, RHEODYNE, VALCO
ALPHATECH SYSTEMS LTD
VALCO
AMRAD PHARMACIA BIOTECH LTD
PHARMACIA BIOTECH AB
GBC-AEC
SGE, VALCO
MEDIC CORPORATION LTD
SARTORIUS, SANITECH
MEDTEC PRODUCTS LTD
VALCO
PHENOMENEX (NZ) LTD
RHEODYNE
SIGMA ALDRICH PTY LTD
SUPELCO

VIALS, CHROMATOGRAPHY, AUTOSAMPLER

ALLTECH ASSOCIATES
CHROMPACK
ALPHATECH SYSTEMS LTD
HPLC TECHNOLOGY
CROWN SCIENTIFIC LTD
PHARMAGLASS AUSTRALIA
GBC-AEC
NATIONAL SCIENTIFIC
MEDTEC PRODUCTS LTD
HEWLETT PACKARD, SUN BROKERS
PHENOMENEX (NZ) LTD
PHENOMENEX
SCIENTIFIC SUPPLIES LTD
VWR
SIGMA ALDRICH PTY LTD
SUPELCO

Company Contact Details

A.i. SCIENTIFIC (NZ) LTD
P O Box 35579, Browns Bay, Auckland
Phone: (09) 4781351, Fax: (09) 4781360

ALLTECH ASSOCIATES
P O Box 100-352, North Shore Mail Centre, Auckland
Phone: 0800 255832, Fax: (09) 4442399

ALPHATECH SYSTEMS LTD
P O Box 37-583, Parnell, Auckland
Phone: (09) 3770392, Fax: (09) 3098514

AMRAD PHARMACIA BIOTECH LTD
P O Box 56-364, Auckland
Phone: 0800 733893, Fax: (09) 6387098

BDH CHEMICALS NEW ZEALAND LTD
P O Box 1246, Palmerston North
Phone: 0800 426252, Fax: (06) 3567311

BIOLAB SCIENTIFIC LTD
Private Bag 36900, Northcote, Auckland
Phone: 0800 807809, Fax: (09) 4803430

BOC GASES NZ LTD
P O Box 3337, Wellington
Phone: 0800 100949, Fax: 0800 275275

BOEHRINGER MANNHEIM
P O Box 62-089, Auckland
Phone: 0800 652634, Fax: (09) 2768917

CROWN SCIENTIFIC LTD
P O Box 101-119, North Shore Mail Centre, Auckland
Phone: (09) 4154119, Fax: (09) 4154120

GBC-AEC NZ
P O Box 68-330, Newton, Auckland
Phone: 0800 428428, Fax: (09) 3600683

JOHN MORRIS SCIENTIFIC LTD
P O Box 6348, Wellesley Street, Auckland
Phone: 0800 651700, Fax: (09) 3663060

LABSUPPLY PIERCE (NZ) LTD
P O Box 34-234, Birkenhead, Auckland
Phone: 0800 734100, Fax: (09) 4447314

LECO AUSTRALIA PTY LTD
P O Box 334, Cambridge, New Zealand
Phone: (07) 8231122, Fax: (07) 8231177

LIFE TECHNOLOGIES LTD
P O Box 12-502, Penrose, Auckland
Phone: 0800 600200, Fax: (09) 5793119

MEDIC CORPORATION LTD
Medic Watson Victor
Private Bag, Lower Hutt, Wellington
Phone: 0800 508070, Fax: 0800 807777

MEDTEC PRODUCTS LTD
P O Box 38-543, Petone, Wellington
Phone: (04) 5670011, Fax: (04) 5672821

PERKIN-ELMER PTY LTD
P O Box 38-833, Wellington
Phone: 0800 776767, Fax: 0800 776000

PHENOMENEX (NZ) LTD
P O Box 31-601, Milford, Auckland
Phone: (09) 4780951, Fax: (09) 4780952

SCIENTIFIC SUPPLIES LTD
P O Box 14-454, Panmure, Auckland
Phone: (09) 2747579, Fax: (09) 2740267

SCI TECH (NZ) LTD
P O Box 663, Dunedin
Phone: (03) 4777860, Fax: (03) 4777870

SHIMADZU SCIENTIFIC INSTRUMENTS
P O Box 45-077, Auckland
Phone: 0800 735725, Fax: (09) 8367757

SIGMA ALDRICH PTY LTD
P O BOX 12423, Penrose, Auckland
Phone: 0800 936666, Fax: 0800 937777

The above information was summarised and reproduced with permission from recent editions of *LABSPEC*.

LABSPEC

Your comprehensive guide to laboratory products and services available in New Zealand. Available Free Now!

circle number 60 on the reader reply card

varian

Rainin Microsorb MV HPLC columns are now just

$250.00 +GST

These 4.6mm ID columns are available in a selection of lengths and a variety of packings with a 100 Å pore size. To order call **(09) 478 1351.**

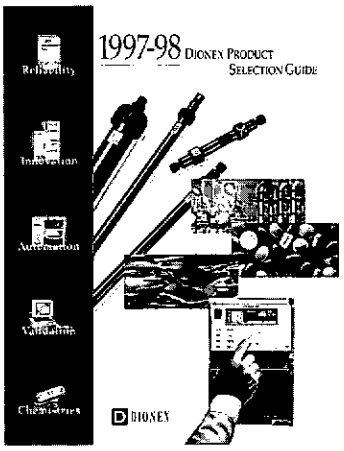
A.i. Scientific
Spectroscopy, Separation & Sample Preparation

PO Box 35579, Browns Bay, Auckland
Phone: (09) 478 1351 Fax: (09) 478 1360

circle number 6 on the reader reply card

HPLC, IC, LC-MS
Focus Feature

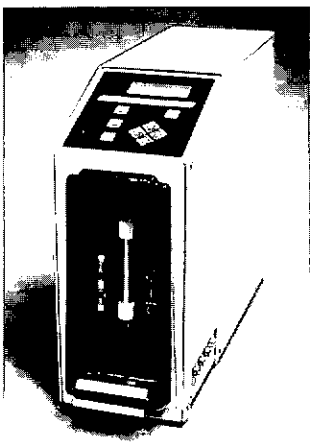
NEW DIONEX PRODUCT SELECTION GUIDE



A.i. Scientific announces the release of the new selection guide describing the full Dionex product line of accessories for ion chromatography, HPLC capillary electrophoresis, supercritical fluid extraction/ chromatography, accelerated solvent extraction and laboratory automation. Unique decision trees for selecting ideal separation mechanisms, columns and detectors for each application are included, as well as a detailed description of Dionex technical literature and publications.

For further details,
Contact: Mark Albertson, A.i. Scientific (NZ) Ltd
P O Box 35579, Browns Bay, Auckland
Phone: (09) 4781351, Fax: (09) 4781360
circle number 35 on the reader reply card

CONCENTRATE AND NEUTRALISE SAMPLES ON-LINE



The SCAN 1000 Sample Processor simplifies Sample Concentration And Neutralisation in ion chromatography. The SCAN 1000's patent-pending system concentrates and/or neutralises samples much more effectively and conveniently than conventional techniques. Ultra-trace level samples are concentrated for ppb and ppt anion and cation detections without the need for a secondary pump. Acidic or basic samples are neutralised on-line as they are analysed, eliminating labour-intensive manual off-line pretreatment techniques. The SCAN 1000 is easily automated for continuous unattended operation.

Contact: Alltech Associates, Inc.
Freephone: 0800 ALLTECH (0800 255832)
Fax: (09) 4442399, Email: alltech@alltech.co.nz
circle number 36 on the reader reply card

ONE STOP SHOPPING FOR HPLC WITH VARIAN

You have a stronger partner in HPLC due to Varian's recent acquisition of the Rainin HPLC product line.

With the most comprehensive offering of HPLC products, from micro LC to high-volume preparative systems, Varian gives you more choices, more pumps, more detectors, more automation choices and more columns to meet all your application needs. Whether you need state-of-the-art analytical HPLC or high performance preparative systems, Varian is your one-stop shop. More choices mean more flexibility, such as our SD-1 pump-based systems that can be scaled up from analytical to preparative as your needs change. Ask one of our LC sales specialists to help you make the right decisions for your laboratory's particular requirements.

For more information or a free copy of the newly released catalogue,
Contact: Mark Albertson or Kevin Moloney
A.i. Scientific (NZ) Ltd
P O Box 35579, Browns Bay, Auckland
Phone: (09) 4781351, Fax: (09) 4781360
circle number 37 on the reader reply card

SEPARATE INORGANIC AND ORGANIC ANIONS

Alltech introduces the Allsep A-2 Anion Column for simultaneous separation of weakly retained organic and strongly retained inorganic anions. The A-2 column separates organic anions such as acetate and formate away from eluting inorganic anions without the need for a gradient technique. This hydrophilic-based column provides symmetrical peaks for all anions.

Contact: Alltech Associates, Inc.
Freephone: 0800 ALLTECH (0800 255832)
Fax: (09) 4442399, Email: alltech@alltech.co.nz
circle number 38 on the reader reply card

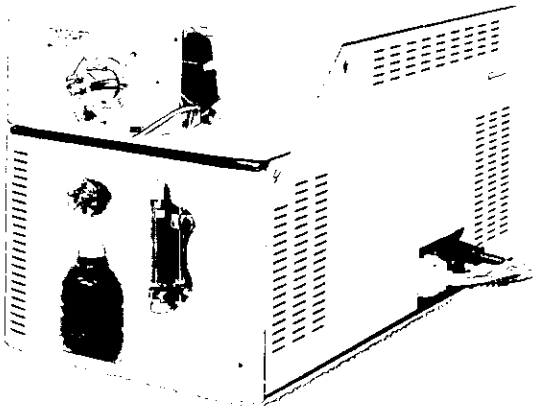
NEW DX-500 ION CHROMATOGRAPHY SYSTEM EXPANDS CAPABILITIES WITH NEW OVEN MODULE

A.i. Scientific introduces the newest addition to the Dionex DX500 IC family, the LC25 Chromatography Oven. The compact PEEK-based LC25 provides convection heating with a temperature range of 30-40 °C, in a single channel configuration. Features include an electric Rheodyne valve, a built-in conductivity cell and an integrated eluant organiser. The DX500 IC System offers the highest performance available in an IC system. Quaternary gradient or isocratic pumps deliver precise, accurate flow and suppressed conductivity detection with autosuppression provided by the CD20 detector. Full PC-based system control is possible via the PeakNet Chromatography Workstation.

For further details,
Contact: Mark Albertson, A.i. Scientific (NZ) Ltd
P O Box 35579, Browns Bay, Auckland
Phone: (09) 4781351, Fax: (09) 4781360
circle number 39 on the reader reply card

SHIMADZU QP-8000 LC-MS SYSTEM VALIDATION, PRODUCTIVITY AND MASS DETECTION

The new Shimadzu LC-MS detector, the QP-8000, is a valuable addition to the new LC-10A*vp* HPLC systems. The QP-8000 has been designed to be a routine LC detector. It brings the simplicity, ease-of-use, ruggedness, compactness and affordability of a typical LC detector to quadrupole LC-MS.



Shimadzu's LC-MS design incorporates quadrupole mass spectrometer technology developed through decades of GC-MS production.

In spite of its small size, the design has kept operation and maintenance in mind. The front entry interface chamber enables the user to access the ion source for column connection or maintenance.

Both Electrospray and APCI atmospheric pressure interfaces are standard and user selectable. Switching between the two interfaces is easily performed, in less than five minutes, without breaking the vacuum.

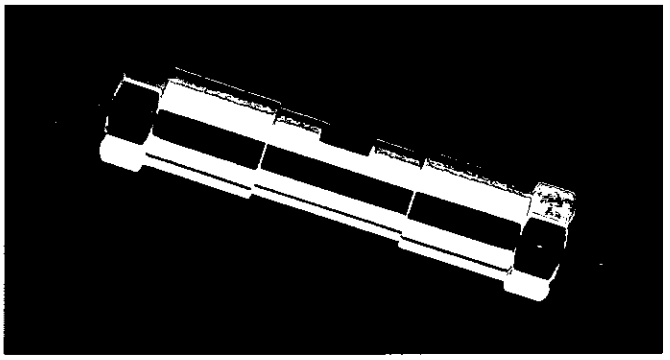
The CLASS-8000 32-bit software package is completely compliant with Windows 95 and controls the entire LC-MS system including pumps, ovens switching valves, autosamplers and detectors.

The validation and productivity features of the new LC-10A*vp* HPLC series software and hardware provide valuable security, audit and self-diagnostic tools required for GLP/GMP/ISO compliance.

For more information,
Contact: Clare Hodgson, Shimadzu New Zealand
Phone: 0800 735725, Fax: (09) 8367757
Email: clareh@shimadzu.co.nz
circle number 40 on the reader reply card

HIGH SPEED ANALYSIS WITH ALLTECH ROCKET HPLC COLUMNS

Alltech Rocket HPLC columns combine small-particle, high resolution, porous media with a hardware format (33 x 7 mm) that is built for speed. Packed with 1.5 µm or 3 µm platinum base-deactivated media, Rocket columns generate high efficiency with excellent peak shape while offering unique surface chemistries to solve almost any separation problem. Many analysis normally performed on conventional 150 x 4.6 mm columns can be run on Rocket columns with a 70-90% reduction in analysis time. Imagine the advantages of increasing your sample throughput by 3-10 times!



Contact: Alltech Associates, Inc.
Freephone: 0800 ALLTECH (0800 255832)
Fax: (09) 4442399, Email: alltech@alltech.co.nz
circle number 41 on the reader reply card

NEW CD-ROM FROM HEWLETT PACKARD PROVIDES ON-LINE MULTIMEDIA TRAINING FOR LIQUID CHROMATOGRAPHY/MASS SPECTROMETRY (LC/MS)

Hewlett Packard (HP) Company has introduced the HP 1100 Series LC/MSD reference collection on CD-ROM. It provides liquid chromatographers with on-line, at-the-computer, multimedia training and documentation describing how to run the HP LC/MSD system. Multimedia presentations feature more than 170 minutes of video instruction narrated by HP application chemists and by Robert Voyksner, director of the MS facility at Research Triangle Institute, Research Triangle Park, NC Solution-chemistry and sample-preparation questions are answered using specific samples as examples.

The reference collection includes the following training modules:

- Getting Started with your LC/MSD System;
- Solution Chemistry for LC/MS Applications;
- Sample Preparation for LC/MS Applications;
- MS Fundamentals for LC Chromatographers; and
- MS Hypertext Glossary.

The reference collection is designed to speed learning so chromatographers can begin generating useful analytical results soon after HP installs the LC/MSD. Training can begin immediately; chromatographers do not have to leave the laboratory or wait to attend off-site training courses. Because the reference collection is self-paced and provides multiple levels of instruction, it accommodates wide differences in LC/MS experience.

The HP 1100 Series LC/MSD reference collection is included with every HP 1100 Series HP LC/MSD system.

Information about HP chemical analysis products and services can be found on the World Wide Web at http://www.hp.com/go/chem

Contact: Medtec Products Ltd
P O Box 34-241, Auckland
Phone: (09) 4791068, Fax: (09) 4791450
circle number 42 on the reader reply card

SYKAM ION CHROMATOGRAPHY S 135, MOST SENSITIVE DETERMINATION OF IONS BECOMES SIMPLE

The Sykam IC S 135 is a compact system with modular setup. Even the basic system is designed for most sensitive anion analysis employing suppression of eluent conductivity.

The column oven integrated into the system holds the measuring cell, pre-column, separation column and suppression columns, and thus guarantees accurate retention times and quantitation with superior reproducibility.

The conductivity detector's outstanding features are high background suppression, baseline stability and signal linearity over a range of several decades. These characteristics become especially important when single column techniques are employed, e.g. for the determination of alkaline ions and alkaline earths.

The chemically inert pump with its pump head made of PEEK meets all the requirements of ion chromatography. It has two serial pistons thus delivering with extremely low pulsation. This pump can even be used for HPLC and by just adding a gradient module the system can be easily upgraded for any HPLC application.

System control and data handling are performed by software running under Windows. Results can be output fully automatically with templates defined and created by the user. With automatic injection, analysis of more than one hundred samples of drinking water can be done in one sequence.

Depending on applicational needs or analytical problems, the Sykam Ion Chromatograph can be easily modified by integrating additional Sykam system components. For example there are:

- switching valves to select columns or eluents for rapid method change.
- the UV/Visible detector with variable wavelength for high sensitivity determination of nitrite, organic acids, or transition metals after PAR post-column reaction.
- the electrochemical detector for detection of sulfide/cyanide or carbohydrates.
- automatic concentration units for trace analysis.

Contact: Sci Tech (NZ) Ltd
P O Box 663, Dunedin
Phone: (03) 477860, Fax: (03) 477870
Email: grayston@scitech.co.nz
circle number 43 on the reader reply card

SEPARATE AND QUANTIFY MYCOTOXINS BY HPLC

Monitoring grain and dairy foods for the presence of aflatoxins is important to ensuring consumer safety. HPLC is the method of choice for separating these potentially carcinogenic substances. Detection normally is performed by fluorescence spectroscopic methods on TFA derivatives of aflatoxins.

Mycotoxins, secondary metabolites produced by fungi, are important contaminants in foods. Many of these compounds, such as aflatoxins are toxic or carcinogenic, while others, such as some trichothecenes, are antitumour agents or their precursors. Detecting mycotoxins is relatively simple and can be done by TLC. Identifying and quantifying these compounds, however, has been difficult. Several categories of mycotoxins can be separated reliably for identification and quantification by using Supelcosil HPLC columns. For more details request Bulletin 800.

Contact: Patrick Wesley, Supelco
Sigma-Aldrich Pty Ltd
P O Box 12423, Penrose, Auckland
Phone: 0800 936666, Fax: 0800 937777
Email: sigmaa@ibm.net
circle number 44 on the reader reply card

WATERS 2700 SAMPLE MANAGER

Alphatech is pleased to introduce Waters' new, high-performance XYZ sample processing workstation for laboratories supporting high-volume chemical synthesis techniques such as combinatorial chemistry.

The Waters 2700 Sample Manager can pretreat samples, transfer and inject variable sample volumes into high performance liquid chromatography (HPLC), liquid chromatography-mass spectrometry (LC-MS), and flow injection analysis-mass spectrometry (FIA-MS) instrumentation.

The software-controlled, robot-like arm of the 2700 Sample Manager moves along three axes. It travels along a programmed path to automatically pretreat, transfer, and inject newly-synthesised compounds occupying individual test tubes, HPLC autosampler vials, or wells in microtitre plates. The samples are injected directly into a HPLC or FIA instrument for further chemical analysis. The 2700 is compatible with standard 96-well and high-density 384-well microtitre plates, test tubes and conventional 2 mL autosampler vials.

Contact: Alphatech Systems
P O Box 37583, Auckland
Phone: (09) 3770392, Fax: (09) 3098514
Email: sales@alphatech.co.nz
circle number 45 on the reader reply card

THE MICROMASS PLATFORM LC, THE MS DETECTOR FOR HPLC DESIGNED WITH THE CHROMATOGRAPHER IN MIND

Waters, the world leader in HPLC technology, and Micromass, the market leader in benchtop LC/MS since 1992, have redefined and simplified the Platform LC. The result is the Waters Alliance LC/MS system featuring the Micromass Platform LC detector. It is an easy to use, powerful tool for mass spectrometric detection of chromatographic peaks.

FOR A QUICK, NO-FUSS REPLY . . .
REQUEST FURTHER INFORMATION,
PRICING DETAILS ETC.,
USING THE FREEPOST READER REPLY CARD

Mass spectrometric detection adds a new dimension to your liquid chromatograph enabling identification and quantitation of compounds that are not suited to GC/MS or conventional HPLC. The Micromass Platform LC detector is designed for the chromatographer, method development chemist and QA/QC analyst featuring easy to use instrument setup, calibration, maintenance and data handling.

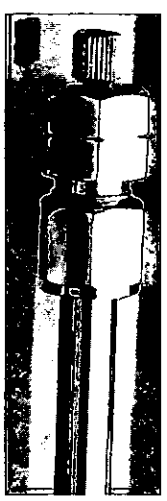
The Platform LC detector features proven Atmospheric Pressure Ionisation (API) techniques such as Electrospray (ESI) and Atmospheric Pressure Chemical Ionisation (APCI), and Micromass' optional CrossFlow technology. The latter enables easy LC/MS analysis even with complex matrices and involatile mobile phase modifiers. Even phosphate buffers and ion pairing reagents can be transiently accommodated. CrossFlow can save the user days, and thousands of dollars in method redevelopment time.

ESI and APCI will each generate pseudomoleular ions from which the molecular weight of target compounds can be deduced. The MS information is handled in much the same way as data obtained from PDA detection. Both channels of information can be obtained on a single injection.

Spectra can be combined and background subtracted from every chromatographic peak. API spectra in particular reveal a fundamental physico-chemical property for each analyte - its molecular weight. Additionally, secondary fragmentation can be induced by "In-Source" Collisionally Induced Dissociation (CID) for some structural disclosure.

Contact: Alphatech Systems
P O Box 37583, Auckland
Phone: (09) 3770392, Fax: (09) 3098514
Email: sales@alphatech.co.nz
circle number 47 on the reader reply card

NEW DISCOVERY HPLC COLUMN FOR PHARMACEUTICAL METHOD DEVELOPMENT



At Supelco, a part of the Sigma-Aldrich family, we are committed to providing chromatography solutions that work. In response to the specialised demands of the drug discovery and pharmaceutical industries, we have developed the next generation of HPLC columns.

Our new Discovery columns are designed to provide exceptional reproducibility, longer column lifetime, better polar compound retention, improved resolution and unique selectivity. Each Discovery column is backed by comprehensive QC testing and certificates of analysis. Plus, you get the benefit of Supelco's unmatched technical service, support and delivery.

Contact: Patrick Wesley, Supelco
Sigma-Aldrich Pty Ltd
P O Box 12423, Penrose, Auckland
Phone: 0800 936666, Fax: 0800 937777
Email: sigmaa@ibm.net
circle number 48 on the reader reply card

NEW ALLTIMA 3 µM HPLC PHASES

Alltima's exceptional base-deactivated phases for acids, bases, and neutrals are now available in 3 µm particles. Developed by and available only at Alltech, Alltima 3 µm phases offer a significant increase in resolution and efficiency while producing the same capacity and selectivity as Alltima 5 µm and 10 µm phases. Alltima is available in a wide range of bonded phases, particle sizes, and columns formats.

Contact: Alltech Associates, Inc.
Freephone: 0800 ALLTECH (0800 255832)
Fax: (09) 4442399, Email: alltech@alltech.co.nz
circle number 49 on the reader reply card

ALPHATECH SYSTEMS LTD IN CONJUNCTION WITH THERMOQUEST CORPORATION ANNOUNCE THE ARRIVAL OF THE ALL NEW NAVIGATOR LC-MS WITH aQa

Finnigan introduces aQa, a paradigm shifting Atmospheric Pressure Ionisation (API) source on the all new Navigator. Self-cleaning aQa enables analyses to be performed non-stop over days, even with samples containing salts, ion pairing agents or plasma extracts.

aQa incorporates flow focusing which eliminates source tuning while maintaining optimum performance at LC flow rates up to 2mL/min for APCI and ESI without splitting. With built-in fast calibration and infusion, aQa makes Navigator a truly automated "connect and use" LC-MS system.

Why aQa has been developed.
Historically the methods for connecting the output from an LC to a mass detector were extremely complicated and in the main, unreliable. The problem of integrating the high flow rates from an LC column to a low pressure mass detector was largely overcome with the introduction of API techniques.

API allowed samples to be analysed routinely but involatile buffers could not be used as blockages occurred very quickly. The frequent cleaning of the system or the need to redevelop LC methods was costly and time consuming. It was clear that the next development in API technology had to be a system capable of tolerating non-volatile buffers for a minimum period of an overnight assay but preferably for very much longer. With the development of aQa this is now a reality.

Without self-cleaning, blockages occur quickly (hours compared to days) and the sensitivity of the system will be continually falling during this period. The quantitation precision of the system can be extremely unpredictable and therefore limits the methods and buffers that can be used for any assay work. For these types of analyses, the Limit of Quantitation (LOQ) has to be set at a far higher value than is possible for a single sample run on a clean system. With aQa, the LOQ can be confidently achieved throughout an assay with no compromise in existing LC methods.

To see schematics of aQa along with performance information visit the web site address at http://www.finnigan.co.uk

Contact: Stuart Tyler, Alphatech Systems Ltd
Phone: (09) 3770392, Fax: (09) 3098514
Email: sales@alphatech.co.nz
circle number 50 on the reader reply card

An Improved Method For HPLC Determination Of Acidic Herbicides In Aqueous Samples

Michael S Young, Waters Corporation

Introduction

The phenoxyacetic acid and other acidic herbicides are among the most widely used agrochemicals. Most of these compounds are typically determined in water samples following liquid-liquid extraction procedures or by reverse-phase solid-phase extraction (SPE). The Environmental Protection Agency (EPA) in the United States currently offers two SPE procedures for the analysis of drinking water for these compounds. One of these, Method 555 (1), is an on-line SPE procedure followed by HPLC analysis. The sample is first adjusted to pH 12 to hydrolyse esterified analytes, then it is acidified to pH 1 and a 20 mL aliquot is pumped through a reverse-phase concentrator column. By use of a switching valve, the concentrator column is then plumbed in line with the analytical column and the sample constituents are then passed to the analytical column for separation and detection.

While this method gives acceptable performance, there are some important limitations which are dealt with in this study. Although an on-line procedure is convenient for some analysts, many prefer the off-line approach which gives a convenient extract in an organic solvent suitable for multiple analyses. Moreover, such an extract is generally much more stable than the aqueous sample form which it was derived, and is therefore more suitable for long-term storage. Also, the off-line approach allows the processing of many samples at one time, an approach which is generally more productive in laboratories that are not fully automated.

Recently, a new type of reverse-phase analytical HPLC column was introduced (2). The packing in this column is SymmetryShield™ RP8 5 µm, prepared from Symmetry® silica by bonding to it an alkyl chain containing an imbedded polar carbamate functionality. This results in a packing material on which polar functionalities on the silica surface are effectively shielded from interactions with polar analytes. Outstanding peak symmetry and unique selectivity are therefore shown for many types of analytes which often tail or may show insufficient resolution on traditional reverse-phase columns. Among the classes of compounds for which SymmetryShield™ RP8 is particularly useful is the acidic herbicides. This new HPLC column allows the separation of these analytes in one analytical run where previously recommended columns required two runs.

Another new product is the Oasis™ HLB sample extraction cartridge for reverse-phase solid-phase extraction (SPE). These cartridges contain a water-wettable, moderately polar polymeric resin of high sorbent capacity. The high capacity allows the analysis of samples as large as 250 mL using a cartridge containing 60 mg of resin.

Consequently, when the cartridge is eluted with 1 mL of solvent, considerable sample enrichment is achieved in a 15 minute procedure. Also, because the adsorbed sample is eluted with relatively small solvent volumes of about 1 mL, subsequent exchange to HPLC mobile phase is rapid and straightforward. Because the polymer is water wettable, the analyst need not worry if the cartridge bed runs dry during the analysis or during any of the conditioning steps. This cartridge has recently been demonstrated to be highly effective for the extraction of a wide variety of polar herbicides and metabolites from drinking water samples (3).

The first goal of this work was to develop an improved acidic herbicides sample preparation procedure that would be compatible with either GC or LC. The other goal was to develop an improved HPLC analysis. We investigated an alternative EPA protocol for acidic herbicides as the basis of an improved method that would meet both objectives. The alternative EPA method for determination of acidic herbicides is method 515.2 which utilises off-line SPE followed by derivatisation and GC analysis (4). With some modifications, a sample preparation procedure similar to that used in the EPA GC method was successfully applied to the development of a new HPLC based method. This new HPLC method incorporates the Oasis™ HLB cartridge for sample preparation and the SymmetryShield™ RP8 column for the subsequent HPLC analysis.

Experimental

Instrumentation and Materials

HPLC System. The Waters liquid chromatography system used for this study was comprised of a 616 Solvent Delivery System, a 996 Photodiode Array Detector (PDA), and a 712 Autosampler. Data processing and instrument control were accomplished using the Millennium® Chromatography Manager. Temperature was ambient. The primary column used for these experiments was a SymmetryShield™ RP8 5 µm, 3.9 mm ID x 150 mm.

Reagents. Reagents and solvents for preparation of mobile phases were obtained from Baker (Phillipsburg, NJ). HPLC grade water was obtained in-house using a Milli-Q™ system (Millipore, Bedford, MA).

Standard Chemicals. Chemical standards for calibration and for spiking experiments were obtained from Accustandard (New Haven, CT). Structure for the herbicides included in this study are presented in Figure 1.

Water Samples. Two types of water were used for spiking experiments. Municipal finished drinking water (tap water) was

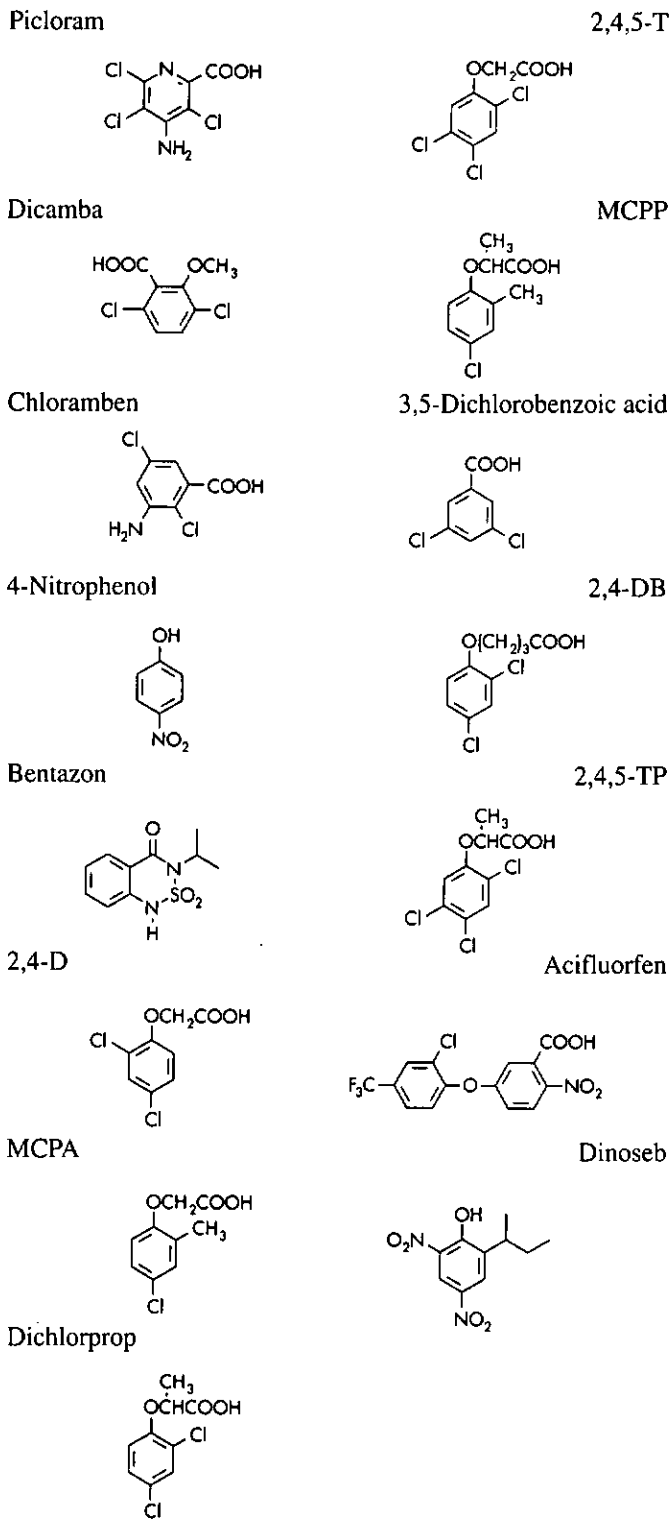


Figure 1. *Structures of herbicides included in this study.*

obtained from the laboratory faucet at Waters Corporation in Milford, MA. Groundwater was obtained from a well at the home of the author in Stow, MA.

Solid-Phase Extraction. All SPE analysis was performed using Waters Oasis™ HLB extraction cartridges (3 cc/60 mg sorbent).

Procedure

Sample Preparation. The samples (75 mL) were first spiked with the appropriate amount of the analytes and were then adjusted to pH 12 with NaOH. After 1 hour, the samples were adjusted to pH 2 with phosphoric acid. A vacuum manifold was fitted with 60 mL reservoirs (75 mL total capacity) atop Oasis™ HLB 3 cc cartridges. An aspirator was used to provide a vacuum of 30 to 50 kPA below atmospheric pressure to yield a flow of about 5 mL/minute through the cartridges for conditioning and sample loading steps. Before the samples were loaded, the cartridges were conditioned with 3 mL of 10% methanol (MeOH) in methyl t-butyl ether (MTBE), then 3 mL of methanol, and finally 2 mL of pH 2 reagent water. After sample loading was complete, the cartridges were washed with 1 mL of reagent water and then eluted with 2 mL of 10% methanol in MTBE. Elution was accompanied at a very low vacuum level to give a flow of about 2 mL/minute. The eluted samples were then evaporated under a gentle stream of nitrogen (37 °C) to approximately 100 µL and then adjusted to exactly 500 µL with water.

No stopcocks were employed in manipulation of flow rate during cartridge conditioning steps or in sample loading. No effort was made to prevent the sorbent bed from drying.

HPLC Analysis. The following conditions were used for the separation with the SymmetryShield™ PR8 column. The aqueous portion of the mobile phase (mobile phase A) was 13 mM sodium phosphate buffer at pH 3.4. The organic portion of the mobile phase was acetonitrile. A multi-step gradient was employed to separate all analytes included in this study. The gradient was 85% A initial with a linear gradient to 70% A in 8 minutes, held at 70% A until 15 minutes, then linear to 40% A in 30 minutes, and then to 10% A in 35 minutes. The flow rate was 1.0 mL/min and the injection volume was 75 µL.

Results

The solvent chosen for the elution of the Oasis™ HLB cartridges was 10% methanol in methyl t-butyl ether (10% MeOH/MTBE), the solvent specified for the EPA 515.2 GC analysis method. This solvent is used for the GC method because it gives good recovery and is compatible with the diazo-methane derivatisation required for the analysis. In this study, this mixed solvent was shown to have some important attributes useful for an HPLC procedure. A significant interference is usually present in many drinking water samples extracted by reverse-phase (SPE) solid-phase extraction at acidic pH. This interference is caused by the presence of humic or other natural organic matter (NOM). This interference is most pronounced when high polarity solvents, such as methanol or tetrahydrofuran (THF) are used for SPE elution; this interference is minimised if relatively non-polar solvents are employed. Dichloromethane and MTBE were both investigated as potential elution solvents, but recoveries were generally unacceptably low. However, 10% MeOH/MTBE gave recovery in the same range as THF and was sufficiently non-polar to minimise the interference of natural organic matter. Care was taken to remove the MTBE from the eluent prior to HPLC analysis; this was effectively accomplished by evaporation of the eluent to 100 µL and subsequent dilution with water.

The results from the spiked water experiments are presented in Table 1. They compare favourably to those reported in both EPA methods, with the exception of dinoseb. In Table 1, results for the first three experiments were obtained by evaporating the eluent to dryness before reconstituting in 15% methanol/water. It was observed that dinoseb was not consistently recovered using that procedure. The high and consistent recovery seen in the last experiment was obtained by evaporative concentration of the eluent to 100 µL and dilution to 500 µL with water.

The HPLC analysis is shown in Figure 2. This chromatogram was obtained from the 400 ng/L spiked tap water experiment and shows the excellent performance obtained for this separation using the SymmetryShield™ RP8 column. Although other

Table 1. Results of acidic herbicides recovery experiments, % recovery (RSD).

Compound	Tap Water 2.0 µg/L 5 replicates	Tap Water 400 ng/L 5 replicates	Well Water 2.0 µ/L 5 replicates	Well Water 400 ng/L 5 replicates
picloram	90.9 (7.0)	126 (5.3)	97.5 (3.8)	106 (2.3)
dicamba	85.1 (7.2)	115 (4.4)	98.5 (3.8)	96.3 (8.3)
chloramben	86.7 (7.3)	99.2 (6.9)	95.1 (10)	90.6 (5.6)
4-nitrophenol	83.3 (6.1)	113 (6.0)	90.4 (1.7)	112 (13)
bentazon	89.3 (6.0)	114 (5.6)	91.2 (3.0)	104 (8.8)
2,4-D	92.3 (7.1)	107 (3.1)	86.5 (1.8)	122 (12)
MCPA	97.6 (8.2)	104 (4.5)	80.8 (3.6)	96.7 (5.5)
dichlorprop	96.4 (11)	107 (9.0)	87.4 (3.0)	103 (6.0)
2,4,5-T	106 (6.2)	116 (8.8)	95.1 (5.0)	96.6 (12)
MCPP	100 (7.7)	116 (6.6)	93.8 (3.0)	94.7 (2.9)
3,5-dichlorobenzoic acid	93.3 (6.3)	119 (9.7)	84.3 (2.7)	96.9 (5.9)
2,4-DB	95.4 (5.1)	110 (8.4)	83.7 (5.6)	83.3 (5.2)
2,4,5-TP	89.3 (7.9)	92.5 (6.7)	87.7 (5.3)	82.7 (10)
acifluorfen	94.8 (8.3)	102 (8.5)	70.0 (17)	81.3 (8.2)
dinoseb	71.7 (7.1)	73.8 (6.8)	54.7 (5.2)	88.1 (1.9)

Column:	SymmetryShield™ RP8, 5 µm, 3.9 mm x 150 mm
Mobile Phase:	A: pH 3.4 phosphate buffer (13 mM) B: Acetonitrile
Gradient:	85% A linear to 70% A in 8 min, hold until 15 min, then linear to 40% A in 30 min, then linear to 10% A in 35 min
Flow Rate:	1.0 mL/min
Detection:	UV at 230 nm (0.015 AUFS)
Injection:	75 µL

1. picloram
2. dicamba
3. chloramben
4. 4-nitrophenol
5. bentazon
6. 2,4-D
7. MCPA
8. dichlorprop
9. 2,4,5-T
10. MCPP
11. 3,5-dichlorobenzoic acid
12. 2,4-DB
13. 2,4,5-TP
14. acifluorfen
15. dinoseb

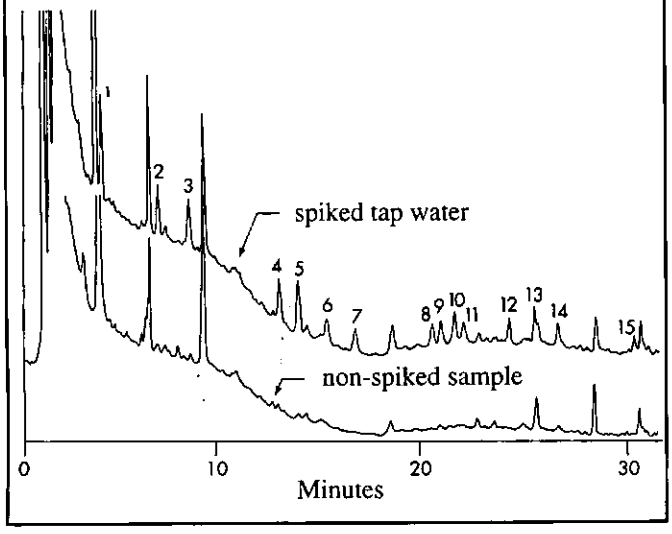


Figure 2: HPLC analysis of 400 ng/L spiked water sample on a SymmetryShield™ RP8 column.

HPLC columns are routinely used for this analysis, it is difficult to obtain the separation of all 15 of these compounds on other phases in a single run.

Conclusions

A convenient, sensitive, off-line SPE-based method has been developed for the determination of acidic herbicides in aqueous samples. This method is compatible with either HPLC or GC analysis. Of critical importance to the HPLC analysis procedure is the outstanding performance of the Waters SymmetryShield™ PR_8 column for the separation of the acid herbicides. Using Oasis™ HLB cartridges and the improved HPLC analysis developed in this study, analysis time is significantly reduced compared with the derivatisation GC method. Unlike the on-line SPE/HPLC method, the new procedure discussed in this study yields a convenient extract which can be analysed by multiple, confirmatory procedures, saved for later re-analysis, or held for long term storage.

References

1. Methods for the Determination of Organic Compounds in Finished Drinking water, Supplement 2 (1992), EPA/600/R-92129, p 237.

2. O'Gara, J E; Alden, B A; Walter, T H; Peterson, J S; Niederlander, C L and Neue, U D (1995) *Anal. Chem.* 67:3809.

3. Young, M S (1997) HPLC '97, paper 177, June, Birmingham, England.

4. Methods for the Determination of Organic Compounds in Finished Drinking Water, Supplement 2 (1992), EPA/600/R-92129, p 51.

For more information on Waters products and instruments
Contact: Alphatech Systems
P O Box 37-583, Auckland
Tel: (09) 3770392, Fax: (09) 3098514
Email: sales@alphatech.co.nz
circle number 54 on the reader reply card

HPLC Troubleshooting Tips

How To Identify And Isolate The Most Common HPLC Problems

Patrick Wesley, Supelco Technical Specialist

Isolating HPLC Problems

In an HPLC system problems can arise from many sources. First define the problem and then isolate the source. A process of elimination will usually enable you to pinpoint the specific cause and correct the problem.

How to Prevent Mobile Phase Problems

Low sensitivity and rising baselines, noises or spikes on the chromatogram can often be attributed to the mobile phase. Contaminants in the mobile phase are especially troublesome in gradient elution. The baseline may rise and spurious peaks can appear as the level of the contaminated component increases. Water is the most common source of contamination in reverse phase analysis. High purity distilled or deionised water should be used when formulating mobile phases.

Only HPLC grade solvents, salts, ion pair reagents, and base and acid modifiers should be used. Cleaning with lower quality solvents is time consuming and trace levels of contaminants often remain.

Many aqueous buffers promote the growth of algae or bacteria, cloudy buffers should be discarded and fresh buffers prepared. Prevent micro-organism growth by adding approximately 100 ppm of sodium azide to aqueous buffers.

To prevent bubbles in the system, degas the mobile phase prior to use. Filtering the mobile phase through a 0.2 or 0.45 µm filter using a vacuum filtration apparatus eliminates dissolved gas. This will also remove particles that could produce noisy baselines or plug the column.

Isolating Pump Problems

Pumping system problems are usually easy to spot and correct. Some of the more common symptoms are erratic retention times, noisy baselines or spikes in the chromatogram. Leaks at pump fittings or seals will result in poor chromatography. Buffer salts should be flushed from the system daily with fresh deionised water. Regular maintenance should be performed rather than waiting for a problem to occur.

Column Protection

Filters and guard columns prevent particles and strongly retained compounds from accumulating on the analytical column. Silica particles in a saturator column dissolve in high pH mobile phases, protecting the silica-based packing in the analytical column.

The useful life of these disposable products depends on mobile phase composition, sample purity, pH, etc. As these devices become contaminated or plugged with particles, pressure increases and peaks broaden or split. As an example, Figure 1 presents a clear case for the use of guard columns.

Keeping Accurate Records

Most problems do not occur overnight, but gradually develop. Accurate record keeping is vital to detect and solve many problems.

Column:	SUPELCOSIL LC-PCN, 25 cm x 4.6 mm ID, 5 µm particles (with Supelguard LC-PCN guard column)
Mobile Phase:	0.01 M potassium phosphate (pH to 7 with 85% phosphoric acid) : acetronitrile : methanol, 25:60:15
Flow Rate:	2 mL/min
Temperature:	30 °C
Detection:	UV, 215 nm
Injection:	100 µL reconstituted SPE eluent (20 ng/mL each analyte and internal standard in serum)

1. Trimipramine (internal standard)
2. Doxepin
3. Amitriptyline
4. Imipramine
5. Desmethyldoxepin
6. Nortriptyline
7. Desipramine
8. Protriptyline (internal standard)

Analytical column plus Supelguard column after 100 serum extract injections.

Same analytical column after replacing Supelguard column.

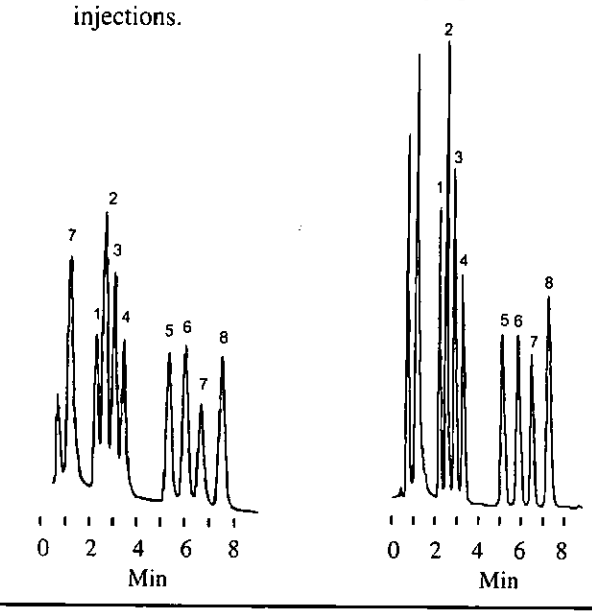


Figure 1. *Supelguard columns prolong lifespan of your analytical columns.*

Evaluate every column you receive, when you receive it and at regular intervals thereafter. By keeping a written history of column inefficiency, mobile phases used, lamp current, pump performance, etc., you can monitor your system's performance.

For more information about protecting your HPLC system, request Bulletin 826B and 781.

Contact: Patrick Wesley, Supelco
Sigma Aldrich Pty Ltd
Phone: 0800 936666, Fax: 0800 937777
Email: sigmaa@ibm.net

circle number 55 on the reader reply card

Patent Proze

by Jane Calvert and Greg Lynch

TRANS-TASMAN MUTUAL RECOGNITION AND INTELLECTUAL PROPERTY PROTECTION IN NEW ZEALAND AND AUSTRALIA

In New Zealand the Trans-Tasman Mutual Recognition Act has recently come into force. The Australian Trans-Tasman Mutual Recognition Act is expected to come into force in June or July this year.

In 1983 New Zealand and Australia signed the Closer Economic Relationship (CER) Agreement with the intention of enhancing trade between the two countries.

Since 1983 trade between the countries has increased by approximately 400% so as to be now more than NZ$ 8.5 billion. Each country represents the biggest export market for the other's manufactured goods.

The passing of the Trans-Tasman Mutual Recognition Acts will enable the qualifications of persons, and the acceptability of goods, in one country to be recognised in the other, and so thereby enhancing the free flow of services and goods between New Zealand and Australia.

The inevitable result of these Acts is that cooperation and relations between Australia and New Zealand will develop further. It will also mean that many of the laws may be amended to obtain better consistency in approaches on either side of the Tasman. This is a stated intention of CER, but has not yet been achieved.

It is anticipated that because of present differences between Australian and New Zealand intellectual property legislation and related matters, difficulties will continue to arise in obtaining consistent protection between the two countries.

Because of the large volume of trade which has developed between the countries many products are now manufactured in one country for sale in the other. Alternatively, many products are partially manufactured in one country for manufacture to be completed in the other.

Unless a technology or product has the necessary intellectual property protection in both countries an opportunity for exploitation by competitors may arise.

Other difficulties may be encountered through lack of intellectual property protection in New Zealand or Australia, such as an inability of the patent owner, licensor or licensee to make use of the payment of royalties under a patent licence agreement.

It follows that if any new technology is to be protected by way of a patent or otherwise in New Zealand or Australia, careful consideration should be given to securing protection in the other country.

Further developments or impacts arising from the Trans-Tasman Mutual Recognition Acts on intellectual property related matters will be discussed in future issues of *Patent Proze* as the effects of the legislation become apparent.

Finally, we wish to inform readers of the joining of forces of Baldwin Son and Carey with the Sydney-based firm, Shelston Waters. The new firm, to be known as Baldwin Shelston Waters, will come into effect as of 1 April 1998.

Baldwin Shelston Waters, the first trans-Tasman specialist intellectual property firm, is poised to take advantage of the Trans-Tasman Mutual Recognition legislation and to simplify procedures in obtaining intellectual property protection for many clients in both countries.

Please forward any queries to:
Patent Proze, Baldwin Shelston Waters
P O Box 852, Wellington
Email: email@bswip.co.nz
Internet: www.bswip.co.nz

Jane Calvert

Jane Calvert and Greg Lynch are both employed in the patent department of Baldwin Shelston Waters, Patent and Trademark Attorneys and Solicitors, where they specialise in chemistry patents. Jane joined the firm after completing a PhD in chemistry at the University of Canterbury in 1994. Greg also joined the firm in 1994 after three years research at Industrial Research Limited in Wellington. Following completion of a PhD in chemistry at the University of Otago in 1989, he spent a two year period as a post-doctoral researcher at Oxford in the United Kingdom.

Greg Lynch

CONFERENCES & SEMINARS

15-18 April 1998

Third International Meeting on Esterases Reacting with Organophosphorus Compounds

Venue: Dubrovnik, Croatia

Contact: Dr Elsa Reiner, "Esterase Meeting"
Institute for Medical Research and Occupational Health
P O Box 291, Ksaverska cesta 2
HR-10001 Zagreb, Croatia
Fax: (+385-1)-274572

19-22 April 1998

International Symposium on Stability and Stabilisation of Biocatalysts

Venue: Cordoba, Spain

Contact: Dr F J Plou
Department of Biocatalysis, CSIC
Campus Univ Autonoma
28049 Madrid, Spain
Fax: (+34-1)-5854760

21-24 April 1998

Preparative High Performance Liquid Chromatography Training Course

Venue: Champigneulles, France

Contact: PROCHROM S.A., Training Courses
BP. 9, F-54250 Champigneulles, France
Tel: (+33-0)-383312244
Fax: (+33-0)-383312051
Email: prochrom@millipore.com

2-8 May 1998

22nd International Symposium on High Performance Liquid Phase Separations and Related Techniques

Venue: Regal Riverfront Hotel, St Louis, Missouri, USA

Contact: Ms Janet Cunningham, HPLC '98
Symposium and Exhibit Manager
Barr Enterprises
P O Box 279, Walkersville, MD 21793, USA
Tel: (+1-301)-8983772
Fax: (+1-301)-8985596
Email: Janetbarr@aol.com

Web Site: http://www.stlcdg.org/hplc98

26-29 May 1998

VIIIth International Symposium on Luminescence Spectrometry in Biomedical and Environmental Analysis

Venue: Las Palmas de Gran Canaria, Canary Islands

Contact: J J Santana Rodrigues
University of Las Palmas de GC
35017, Las Palmas de GC
Canary Islands, Spain
Fax: (+34-9)-28452922

16-19 June 1998

VIII International Starch Convention

Venue: Cracow, Poland

Contact: Dr Malgorzata Baczkowicz
Secretary, VIII International Starch Convention
Department of Chemistry
University of Agriculture
Mickiewicz Ave, 21, 31-120, Cracow, Poland

24-26 June 1998

Asia-Pacific Society for Neurochemistry: Biennial Conference

Venue: Seoul, Korea

Contact: Peter Dodd, Email: peterD@qimr.edu.au
or full details from:
Professor Yoo-Hun Suh
c/o Organising Secretariat of 4th APSN Meeting
Department of Pharmacology
Seoul National University College of Medicine
28 Yongon-dong, Chongno-gu
Seoul 110-799, Korea

26 June - 2 July 1998

9th Congress of the International Society for Biomedical Research on Alcoholism (ISBRA)

Venue: Copenhagen, Denmark

Contact: Professor Christer Alling
Department of Medical Neurochemistry
Institute of Laboratory Medicine
University Hospital, S-221 85 Lund, Sweden
Fax: (+46-46)-175376

8-10 July 1998

Annual Conference of the New Zealand Biotechnology Association

Venue: Conference Centre, University of Waikato
Hamilton, New Zealand

The theme of the conference will be *Breakthroughs and Technology Transfer*, and the intention is to publicise current research activities in New Zealand.

Contact: Associate Professor Ian Maddox
Institute of Technology and Engineering
Massey University, Palmerston North
Tel: (+64-6)-3505548
Fax: (+64-6)-3505654
Email: I.S.Maddox@massey.ac.nz

13-17 July 1998

MACRO 98 AUSTRALIA

37th IUPAC International Symposium on Macromolecules

Venue: Gold Coast, Queensland, Australia

This forefront conference will bring together polymer-oriented scientists, technologists, educators and students from all areas of the scientific community: academia, industry and government. It will provide an international forum for the communication and discussion of general and specific contemporary topics of interest to the polymer community.

The conference will embrace both the fundamental and applied aspects of polymer chemistry, polymer physics, materials technology and engineering. The program will focus on a number of broad themes which will incorporate a range of symposia, involving plenary and invited lectures, and contributed verbal and poster presentations. Plenary speakers will be Professor J Economy (USA), Professor J Feast (UK), Professor A Khokhlov (Russia) and Professor Y Tabata (Japan). A special International Symposium will be held in honour of the late Professor Jim O'Donnell.

Contact: MACRO 98 Secretariat
Chemistry Department, University of Queensland

CONFERENCES & SEMINARS

Brisbane, Queensland 4072, Australia
Tel: (+61-7)-33653955
Fax: (+61-7)-33654299
Email: macro98@chem.chemistry.uq.edu.au
Web Site: http://www.uq.edu.au/~cmawhitt/macro98.html

22-24 July 1998
Chemistry for Industrial, Agricultural Development and Environmental Protection
Venue: HoChiMimh City, Vietnam
Contact: The NZIC Secretariat
P O Box 38-546, Howick
Auckland, New Zealand
Tel: (+64-9)-5356495
Fax: (+64-9)-5353476
Email: NZICOffice@NZIC.org.nz

23-26 July 1998
18th International Machinery and Materials Exhibition for Asia - Mex 98
Venue: Hong Kong International Trade and Exhibition Centre, Hong Kong
Contact: Business and Industrial Trade Fairs Limited
Unit 1223, 12/F
Hong Kong International Trade and Exhibition Centre
1 Trademart Drive, Kowloon Bay, Hong Kong
Tel: (+852)-28652633
Fax: (+852)-28661770 or (+852)-28662076

2-7 August 1998
The 9th International Symposium on Novel Aromatic Compounds (ISNA-9)
Venue: The Hong Kong Convention and Exhibition Centre, Hong Kong
Contact: Professor B Halton
Department of Chemistry, Victoria University
P O Box 600, Wellington, New Zealand
Fax: (+64-4)-4955241
Email: brian.halton@vuw.ac.nz

24-28 August 1998
17th International Cancer Congress
Venue: Rio de Janeiro, Brazil
Contact: Congrex do Brazil
Ruad do Ouvidor, 60 gr 413
20040-030 Rio de Janeiro RG, Brazil
Fax: (+55-21)-2231492

30 August - 4 September 1998
7th European Symposium on Thermal Analysis and Calorimetry
Venue: Balatonfüred, Hungary
Contact: Professor György Liptay
Hungarian Chemical Society
Tel/Fax: (+36-1)-2018056
Email: estac7@ch.bme.hu

1-4 September 1998
19th International Conference on Polyphenols
Venue: Lille, France
Contact: Scientific Secretariat
Dr Christian Rolando
Université des Sciences et Technologies de Lille
UFR de Chimie, Bâtiment C3
59655 Villeneuve d'Ascq Cedex, France
Fax: (+33-1)-43370051
Email: polyphen@univ-lille1.fr

14-18 September 1998
XXth Congress of the International Federation of the Societies of Cosmetic Chemists
Venue: Cannes, France
Contact: CONVEREGENCES-IFSCC'98
Fax: (+33-1)-40310165
Email: converge@iway.fr
Web Site: www.convergences.fr

16-19 September 1998
First International Conference on Inorganic Materials
Venue: Palais des Congres de Versailles, France
Contact: 4 Manor Farm Barns, Church Lane
Charlton-on-Otmoor, Kidlington
Oxford OX5 2UA, United Kingdom
Tel: (+44-1865)-331040
Fax: (+44-1865)-331125
Email: 101515.2472@compuserve.com
Web Site: http://www.elsevier.nl/locate/materials98

23-25 September 1998
International Symposium on Preparative and Industrial Chromatography and Allied Techniques - SPICA 98
The subject of SPICA 98 will focus on isolation, purification and fractionation of value-added products, e.g. fine chemicals, natural products, pharmaceuticals, biotechnical products, agrochemicals, aroma and food additives, applying chromatographic techniques, membrane technology and electrophoresis. In conjunction with the Symposium, an exhibition of instruments will be held, giving participants the opportunity to meet most of the world's leading suppliers of preparative and industrial separation products and technologies.
Venue: Strasbourg, France
Contact: Secretariat SPICA 98
ENSIC, 1, rue Grandville - B.P. 451
F-54001 Nancy Cedex, France
Tel: (+33-383)-175003
Fax: (+33-383)-350811
Email: brionne@ensic.u-nancy.fr

17-20 September 1998
Polyurethanes Expo 98
Venue: Wyndham Anatole Hotel, Dallas, Texas, USA
Contact: Polyurethane Division
Tel: (+1-212)-3515425
Fax: (+1-202)-2966877

4-9 October 1998
3rd Australian Peptide Conference
Venue: Laguna Quays, the Whitsundays
Queensland, Australia
Contact: Dr A I Smith, Conference Secretary
Baker Medical Research Institute
P O Box 348, Prahran, Victoria, Australia
Tel: (+61-3)-95224333
Fax: (+61-3)-95211362

CONFERENCES & SEMINARS

13-16 October 1998

Preparative High Performance Liquid Chromatography Training Course

Venue: Champigneulles, France

Contact: PROCHROM S.A.
Training Courses
BP. 9, F-54250 Champigneulles, France
Tel: (+33-0)-383312244
Fax: (+33-0)-383312051
Email: prochrom@millipore.com

18-22 October 1998

14th International Clean Air and Environment Conference

Venue: Melbourne Hilton on the Park
Melbourne, Australia

Contact: PR Conference Consultants Pty Ltd
Tel: (+61-3)-98169111
Fax: (+61-3)-98169287
Email: prcc@labyrinth.net.au

Web Site: http://www.labyrinth.net.au/~prcc

7-9 December 1998

First Singapore Chemical Conference

Venue: Singapore

This conference will be a major event hosted by the National University of Singapore and will provide a broad forum for researchers to share experiences and exchange ideas in fundamental and industrial chemical research. Emphasis will be made to link chemical research to industrial applications. Another key objective of the conference is to foster better interactions and dialogue among researchers in chemistry or related areas in this region.

Contact: The NZIC Secretariat
P O Box 38-546, Howick
Auckland, New Zealand
Tel: (+64-9)-5356495
Fax: (+64-9)-5353476
Email: NZICOffice@NZIC.org.nz

Web Site: http://www.science.nus.sg/~chem/scc.htm

24-28 January 1999

Organometallic Chemistry in the South Pacific - A Celebration

This conference is being organised to honour Professor Warren Roper of the University of Auckland on the occasion of his 60th birthday. The scope of the conference will include organometallic and coordination chemistry. The meeting will have a strong international flavour with approximately 35 high profile, invited speakers from around the world. Poster presentations contributed by attendees will be welcomed.

Venue: University of Auckland Conference Centre
Auckland, New Zealand

Contact: Dr P J Brothers or Dr L J Wright
Department of Chemistry
University of Auckland
Private Bag 92019, Auckland, New Zealand
Tel: (+64-9)-3737599
Fax: (+64-9)-3737422
Email: P.Brothers@auckland.ac.nz
or LJ.Wright@auckland.ac.nz

Web Site: http://www.che.auckland.ac.nz/conf.htm

3-7 July 1999

IV Liquid Matter Conference

Venue: University of Granada, Spain

The Conference is sponsored by the European Physical Society and the University of Granada. The scope of the IV Liquid Matter Conference is rather broad and the program is based on the following twelve Symposia, entitled: simple liquids and solutions, classical and quantum; molecular liquids and reaction dynamics; ionic liquids and liquid metals; liquid crystals; polymers, polyelectrolytes and gels; colloids, surfactants, eulsions and foams; membranes and biological liquids; fluids in confined geometries, films and interfacial phenomena; supercooled liquids and glasses; phase transitions and nucleation phenomena; rheological properties of liquids; and powder and other granular matter.

Contact: Professor Dr Roque Hidalgo-Álvarez
Departamento de Física Aplicada
Universidad de Granada, Campus de Fuentenueva
E-18071 Granada, Spain
Tel: (+34-58)-243213
Fax: (+34-58)-243214
Email: liquid99@ugr.es

Web Site: http://www.ugr.es/~liquid99

December 1999

23rd Australian Polymer Symposium

Venue: Geelong, Victoria, Australia

Contact: Dr W D Cook
Department of Materials Engineering
Monash University
Clayton, VIC 3168, Australia
Tel: (+61-3)-99054926
Fax: (+61-3)-99054940
Email: WDCOOK@eng2.monash.edu.au

6-11 February 2000

RACI 11th National Convention

Venue: Canberra, ACT, Australia

Contact: Dr W D Cook
Department of Materials Engineering
Monash University
Clayton, VIC 3168, Australia
Tel: (+61-3)-99054926
Fax: (+61-3)-99054940
Email: WDCOOK@eng2.eng.monash.edu.au

14-18 August 2000

12th International Conference on Thermal Analysis and Calorimetry

Venue: Copenhagen, Denmark

Contact: Dr O Toft Sorensen, Risoe National Laboratory
Fax: (+45-46)-351173

14-19 December 2000

Pacifichem 2000

Venue: Waikiki, Honolulu, Hawaii

Contact: Professor B Halton
Department of Chemistry
Victoria University
P O Box 600, Wellington, New Zealand
Fax: (+64-4)-4955241
Email: brian.halton@vuw.ac.nz

METHOD FOR THE BUCHI FAT DETERMINATION SYSTEM B-815/820/821 APPROVED BY THE AOAC

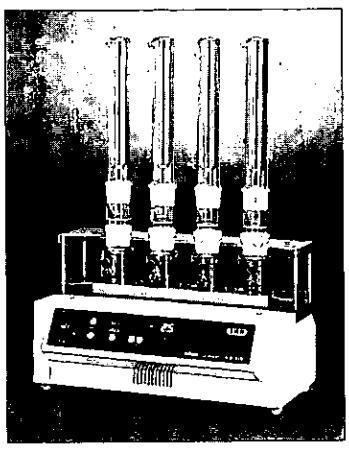
- AOAC Peer-Verified Method No. : PVM 4:1997
- Title : "Total Fat Determinination According to the Caviezel Method Based on a GC Technique for Food and Feed Stuff".

The method will be published in an upcoming issue of the *Journal of AOAC International*, which will be available shortly.

Fat Determination

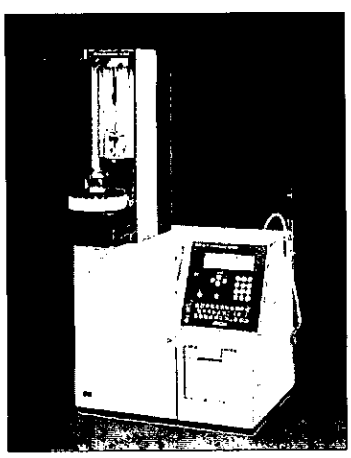
Extraction Unit B-815

- 4 glass ceramic heaters with combined stirring function.



Fat Determination Unit B-820/B821

- Gas chromatographic technology.
- Fixed temperature and evaluation programmed.
- Very short time analysis.



For more details,
Contact: Mike Fisher, Product Manager
Medic Corporation Ltd
Free Phone: 0800 508070
circle number 21 on the reader reply card

NEW LABORATORY INSTRUMENT MEASURES VISCOSITY OF FORMULATIONS DURING SMALL BATCH PROCESSING

The job of controlling and monitoring the preparation of small batches of formulations from paint to foods in the laboratory is made easier with a new stirrer weigher from Sheen Instruments, Kingston, United Kingdom.

The instrument gives a direct indication of the weight of each component as it is added and monitors the changes in viscosity of the batch as the process progresses.

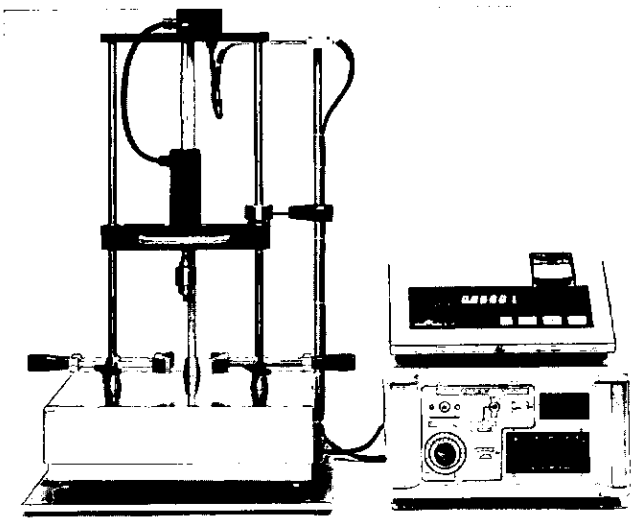
The information can be used to help in the design of full scale production processes.

The monitoring of viscosity is important because rapid increases can be accompanied be excessive heating of the batch and a reduction in product quality.

If the viscosity is too low at certain times during the process, dispersion or mixing processes may be inefficient, leading to long mixing or variable product quality.

The stirrer weigher consists of an IP65 rated 15 kilogram balance with a resolution of 0.01 gram and variable speed stirrer with mixing vessel. As the components are added to the mixing vessel, the weight is displayed by the balance, thus avoiding errors caused by 'weighing by difference' or over addition of a component.

At the beginning of each batch the stirrer is set to a fixed speed between 50 and 1200 revolutions per minute. As the viscosity of the batch changes during processing, the torque on the stirrer varies and this is detected and shown on a liquid crystal display.



Contact: Alan Routs, Sheen Instruments Ltd
Unit 4, St Georges Industrial Estate, Richmond Road
Kingston-upon-Thames, Surrey KT2 5BQ, United Kingdom
Tel: (+44-181)-5414333, Fax: (+44-181)-5493374
circle number 22 on the reader reply card

VARIAN AA SAMPLE INTRODUCTION PUMP SYSTEM (SIPS)

SIPS is an innovative sample introduction and dilution system for Varian flame AA systems. SIPS is available in two versions, the single pump SIPS 10 and the dual pump SIPS 20. The SIPS 10 or 20 can be used on all PC-controlled SpectrAA instruments in the current range. The SpectrAA 50 and 55 without PC can be fitted with the SIPS 10 only.

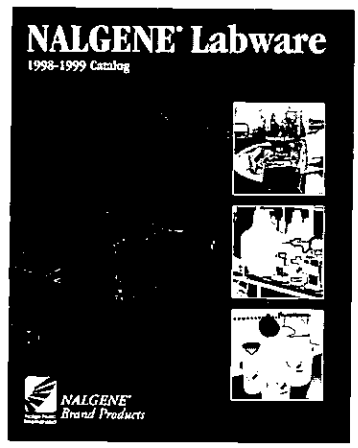
It makes up standards for you:
SIPS will calibrate your instrument on-line by diluting aliquots from a single bulk standard. You simply enter the concentration of the bulk standard, the number of standards you require and the top standard concentration. Get a cup of coffee and watch while SIPS does the work. This eliminates the need for the manual preparation for multiple standards.

It dilutes over-range samples during analysis:
SIPS will automatically dilute and reanalyse over-range samples. If any sample is over-range, SIPS automatically reruns that sample, using a dilution factor calculated to bring the sample within the calibration range. This eliminates the need for both predilution before analysis and manual dilution during analysis. Imagine the productivity gains this will bring you! You no longer have to stop the run, dilute the sample and restart the run. SIPS is at least twice as fast as diluting manually and more accurate, with less than 2% error. SIPS also minimises other sources of error, such as loss of analyte and contamination.

Standard additions and modifiers are handled as well:
The dual pump SIPS 20 can automatically prepare a standard additions calibration using a single standard. It can also add modifiers or perform on-line analytical spiking of samples.

For more information,
Contact: Kevin Moloney, A.i. Scientific (NZ) Ltd
P O Box 35579, Browns Bay, Auckland
Phone: (09) 4781351, Fax: (09) 4781360
circle number 23 on the reader reply card

FINDING THE RIGHT NALGENE PRODUCT IS FAST AND EASY WITH THE 1998 NALGENE LABWARE CATALOGUE



The new 208 page 1998 Nalgene Labware Catalogue is designed to make specifying and ordering Nalgene brand products fast and easy. Numerous indexes, charts, guides and clear graphic icons help readers quickly locate appropriate products for their application needs.

New products in the 1998 Nalgene Labware Catalogue include PES membrane filtration products, safety waste systems, Top Works aseptic liquid transfer systems, laboratory organisers, biologically-pure tubing, platinum-cured silicone tubing, and sanitary conical-bottom processing tanks. The catalogue offers a selection of more than 4500 Nalgene products.

Catalogue searching guides include indexes, compatibility charts for more than 250 chemicals, specification guides for bottles/ carboys, ordering guides for BioProcess products, filtration application guides, and centrifugeware rotor matching guides. Graphic icons make it easy to locate specific product attributes, such as autoclavable, new, Nalgene certified, sterile, moulded of Teflon or equivalent, meets USP Class VI, complies with UN4G, for biohazard use, radiation safety products, and CFC-free.

The 1998 Nalgene Labware Catalogue is available free from Nalge Nunc International.

For more information,
Contact: NNI Documentation Centre
Sevenoaks, Kent TN14 5XA, United Kingdom
Fax: (+44-1732)-453166
circle number 24 on the reader reply card

HOARE RESEARCH SOFTWARE ANNOUNCES allCLEAR 4.0 FOR WINDOWS "STELLAR" FLOWCHARTING PACKAGE AVAILABLE IN NEW ZEALAND

Hoare Research Software (HRS) are pleased to announce that they are now selling and supporting the new version of allCLEAR, the Smarter Flowcharter, in New Zealand. allCLEAR is an award-winning flowcharting package from SPSS Inc. that enables users to quickly and easily create different types of flowcharts, organisation charts, and decision trees just by typing in the words.

The trick with allCLEAR is that you do not have to draw the chart - you can type in a text outline, and it creates the chart for you. When you change your wording, the diagram is changed automatically. This makes it quick and easy to create and revise even the most complex charts. If you prefer using the mouse, you can shift boxes that way, or drag-and-drop clusters of shapes.

United States Windows Sources magazine was so impressed by allCLEAR 4.0 they gave it their "Stellar" award, which represents "the cream of the crop". They said "It did not take us long to get used to this approach; we completed our chart within minutes. If you usually brainstorm just by typing in notes,and especially if you do not have the time or patience to draw charts well, allCLEAR is worth a close look".

"allCLEAR is so easy to use, you can have the perfect chart ready in minutes, no more fussing about dropping things in the right place," says Ray Hoare, Manager of Hoare Research Software. "Two out of three allCLEAR customers tried another product and then switched to allCLEAR for one reason, ease of use. There is nothing else like it".

"allCLEAR is a must-buy."
- US Computer Shopper
"Easily creates flowcharts... (a) time-saving godsend."
- US PC World
"Using allCLEAR was like driving a Porsche 911 on the Autobahn. We now recommend allCLEAR at all our sites."
- Bob Daniell, Siemens USA

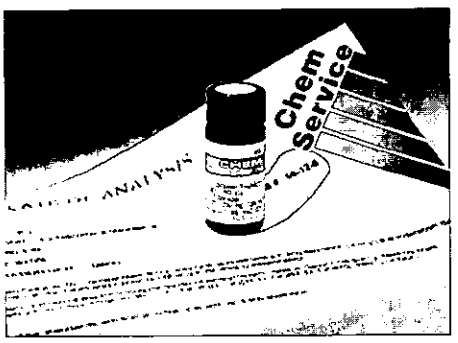
allCLEAR can import text and Visio files, and is OLE-compliant. You can export data to a picture or Excel worksheet. It has a spell checker and find-and-replace feature, with eight diagram types and 300 shapes.

For further information, visit the HRS web site: www.hrs.co.nz or the SPSS web site: www.spss.com/software/allclear/ Screen shots are available, as are full copies of allCLEAR for review from HRS.

Contact: Rory Fitzpatrick, Marketing Manager
Hoare Research Software
P O Box 4153, Hamilton East
Freephone: 0800 477776, Fax: (07) 8399103
Email: rory@hrs.co.nz
circle number 25 on the reader reply card

SUPELCO NOW DISTRIBUTES CHEM SERVICE PRODUCTS

Chem Servcie, Inc. is recognised across the world as a producer of high-quality pesticide and pesticide metabolite standards. Now, a broad range of these products are available through Supelco, in neat and solution form. Each standard is carefully quality-controlled by Chem Service and includes a Chem Service Certificate of Analysis describing it's purity, identity and stability.



For more information, request our Chemical Standards Catalogue Update.

Contact: Patrick Wesley, Supelco
Sigma-Aldrich Pty Ltd
P O Box 12423, Penrose, Auckland
Phone: 0800 936666, Fax: 0800 937777
Email: sigmaa@ibm.net
circle number 26 on the reader reply card

HEWLETT PACKARD ADDS HIGH-SENSITIVITY FLUORESCENCE DETECTOR TO HP 1100 SERIES MODULES AND SYSTEMS FOR HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

Hewlett Packard (HP) Company has announced the HP 1100 Series fluorescence detector, which provides chemical and pharmaceutical analysts with easy-to-use, high-sensitivity fluorescence detection of high-performance liquid-chromatography analyses including simultaneous measurement of multiple signals and on-line spectra acquisition at an affordable price.

The HP 1100 Series fluorescence detector allows a wide range of excitation and emission wavelengths and the new optical design provides superior sensitivity for trace-level quantification using any combination of these. The sensitivity of the detector in terms of the signal-to-noise ratio for the Raman line of water, is greater than 200:1, and the limit of detection (LOD) is 10 fg anthracene.

Simultaneous detection of multiple signals improves selectivity as well as sensitivity. One keystroke is enough to obtain complete fluorescence scans comprising excitation and emission spectra for the compounds of interest. The detector's ability to acquire spectra on-line and on the fly enables the use of spectral libraries and peak-purity analysis to verify separation quality in routine analysis. In addition, storage of spectra is virtually unlimited.

This addition to the HP 1100 Series of liquid chromatography (LC) modules can be controlled by an HP ChemStation for LC or by the handheld HP 1100 Series control module. The fluorescence detector fits neatly in an HP 1100 Series tower and includes such standard HP 1100 Series features as early maintenance feedback and diagnostics tools. Further, it uses the same leak-handling channel for ease of use and complete system safety.

Information about HP chemical analysis products and services can be found on the World Wide Web at http://www.hp.com/go/chem

Contact: Medtec Products Ltd
P O Box 34-241, Auckland
Phone: (09) 4791068, Fax: (09) 4791450
circle number 27 on the reader reply card

THE PERFECT EXAMPLE OF AN OPTIMISED PRODUCT - VINOSART 2.

Combined cold sterilisation and bottling of wine has generally been adopted in many wine-growing regions during the past two decades. One of the major reasons is that the reliability of the membrane filter cartridges can be tested before the bottling operation. Membrane filter cartridges maintain the quality of wine during bottling, without altering its taste or colour.

During the past ten years, the Sartorius Vinosart has made a name in the global wine marketplace, becoming one of the most successful products of the Sartorius Separation Technology Division.

Success breeds success

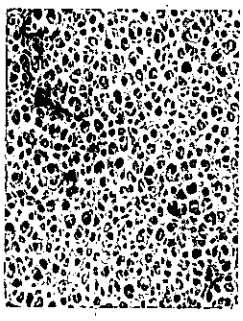
In further optimising our successful Vinosart cartridge we thoroughly took the requirements of the market into consideration, and continued to use the advantages of cellulose acetate. Vinosart 2 is the result.

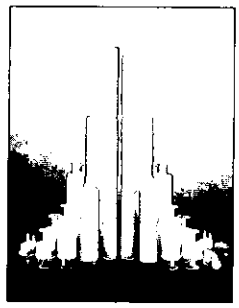
The essential advantages of cellulose acetate in Vinosart 2 are:
- Low non-specific adsorption; this means the wine largely retains its constituents and colour after filtration.
- Effective cleaning of the filter cartridges using hot water, allowing wineries to dispense with the use of chemical cleaning agents.
- No loss of hydrophilicity during sterilisation, because cellulose acetate is hydrophilic by nature, unlike PVDF or PSU.

Outstanding Vinosart 2 features

Its gauze-reinforced, asymmetrical single membrane enables:
- Maximum process reliability
- Excellent mechanical stability
- High flow rates
- Outstanding throughputs
- Effective cleaning
- Steam sterilisation without any effects on the cartridge properties
- Integrity testing for microbiological security.

Cost-effective use of membrane filter systems means that numerous factors must be considered. Pressing the grapes, fermentation, fining, clarification, prefiltration, flow rates and cleaning all add up in determining the efficiency of a cold-sterilising membrane filter.





Contact: Ian Goode, Medic Corporation Ltd
Private Bag, Lower Hutt
Free Phone: 0800 508070, Free Fax: 0800 807777
or: Sartorius AG, Germany, Phone: (+49-0)-5513080
circle number 28 on the reader reply card

VARIAN OFFERS HIGH PERFORMANCE WINDOWS SOFTWARE UPGRADES FOR CARY 1/3/4/5 SPECTROPHOTOMETERS

Varian Associates, Inc., continues its traditional upgrade path for Cary UV-Vis-NIR spectrophotometers with the availability of Cary Win UV software that gives full 32-bit Windows functionality to Cary 1/3/4/5 instruments.

"Thousands of these instruments dating from 1989 can approach the performance of the recently introduced Cary 100/300/400/500 spectrophotometers with a simple and economical software upgrade," said Alan Marks, UV-Vis-NIR marketing manager for Varian Optical Spectroscopy Instruments, Melbourne, Australia.

Cary Win UV software has a modular design so the customer buys only the needed functionality, and further upgrades are simple. Using the advantages of Windows' 32-bit capabilities such as multitasking and file association, the operator can drag and drop a data file onto a Cary application and it will be loaded immediately.

Transferring existing data to the new Cary Win UV software is easy and straightforward. Users simply open the File Open dialog box and then select either Cary DOS or Cary OS/2 data files. The files can then be opened and viewed directly in the Cary Win software interface. These files can then be saved in the Windows format.

The Cary software is Good Laboratory Practice (GLP) compliant. The Win UV software offers a range of functions for making GLP compliance easier; the most important of which is the complete file security system. Every application in the new Cary Win UV software can be password protected by the laboratory administrator or supervisor. Users can be assigned passwords with privileges according to whether they can open applications and modify methods and data.

Other important features in the Windows software include a desktop shortcut that can be set up to start up an application and load a particular method. This means that if the laboratory routinely runs three different quantitative analyses, three icons can be setup on the desktop, one for each analysis. The operator then just clicks on the appropriate icon.

For additional information or literature,
Contact: Kevin Moloney or Mark Albertson
A.i. Scientific (NZ) Ltd
P O Box 35579, Browns Bay, Auckland
Phone: (09) 4781351, Fax: (09)4781360
circle number 29 on the reader reply card

LATEST MOISTURE BALANCE FROM A&D

A&D have released a new moisture balance model, the AD4715. It provides fast and accurate moisture determination for a wide range of samples.

It features a moisture predict mode to greatly reduce determination time and has a clear, large multi information display i.e. moisture content, elapsed time, temperature etc.

Heating is via an infrared light source for even heat distribution and drying temperature range is from 50 to 200 °C, and is controlled via PID.

Full RS232 Interface is standard, capacity is 1 to 300 g in 0.001 g.

Contact: Labsupply Pierce (NZ) Ltd
P O Box 34-234, Birkenhead, Auckland
Free Phone: 0800 734100, Fax: (09) 4447314
circle number 30 on the reader reply card

GRADUATED VIALS

The Graduated Vial combines volume graduations with a colour-coded marking spot to help fill autosampler vials to consistent levels and easily determine sample volumes. The graduations are available on all types of 12 x 32 mm (2 mL) and 15 x 45 mm (4 mL) clear and amber glass vials for fast and easy sample identification.

Contact: Alltech Associates, Inc.
Freephone: 0800 ALLTECH (0800 255832)
Fax: (09) 4442399, Email: alltech@alltech.co.nz
circle number 31 on the reader reply card

Determining Volatiles In Beer With Automated SPME And GC/MS/ECD

Zelda Penton, Varian Chromatography Systems

Volatile compounds are monitored in beer to detect components causing "off' flavours as well as to assure uniformity of product. Compounds of particular interest are 2,3 butanedione (diacetyl), 2,3-pentanedione, trans-2-nonenal, trans,trans-2,4-decadienal, and ethyl esters (Figure 1). Solid phase microextraction (SPME) was evaluated for determining these volatiles. Several different SPME fibres were compared for relative efficiency in extracting the analytes of interest; then linearity and precision were studied. A comparison was made with conventional static headspace (SHS) for this application.

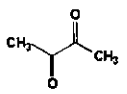
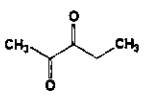
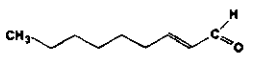
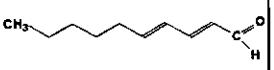
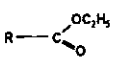
ECD Detection	**MW**	
2,3-butanedione (diacetal)	86.09	
2,3-pentanedione	100.12	
MS Detection		
trans-2-nonenal	140.2	
trans,trans-2,4-decadienal	152.2	
ethyl esters		

Figure 1. *Structures of compounds monitored in beer.*

Instrumentation and Conditions

While the aldehydes are easily detected at very low levels with the ion trap detector, the diones fragment into small ions (butanedione: mass 43 and pentanedione: masses 43 and 57). Since the background contains numerous interfering ions with the same masses, sensitivity is poor. For the same reason, sensitivity is not improved in the chemical ionisation mode (CH_4).

However, the diones give a strong signal with ECD detection, this signal is temperature-dependent with significantly more sensitivity at a detector temperature of 150 °C than at 220 °C (Figure 2). Therefore, the system was configured so that both ECD and ion trap detection could be used.

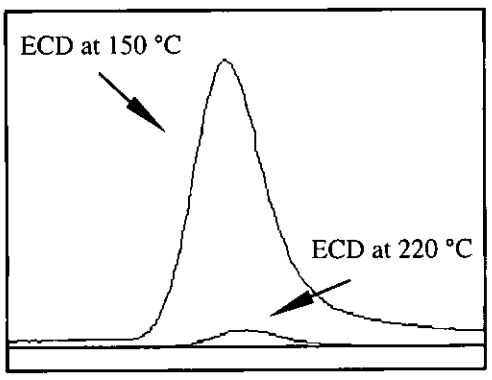


Figure 2. *Response for Butanedione versus ECD Temperature.*

A 4-port switching valve (Figure 3) allowed the effluent from the analytical column to pass through the ECD to detect the early-eluting diones. After eight minutes, the effluent was directed into the ion trap where the later eluting aldehydes as well as various ethyl esters were detected.

Another possible approach for combining ECD and ion trap detection would have been to split the effluent between the ECD and the ion trap. This was rejected for two reasons:

1. It was necessary to keep the ECD at a low temperature to maximise sensitivity. If the effluent were split, high boiling compounds would have entered the cold ECD, causing contamination.

2. Splitting the effluent would have decreased sensitivity for all of the compounds.

Instruments

- Varian Saturn 2000 GC-MS equipped with an ECD and two injectors, a SPI and a 1078.
- A 4-port 1/32 inch high temperature mass spec leak-tested Valco valve was mounted in the column oven.
- Automated SPME III system.
- Varian Genesis static headspace sampler with electroform nickel sample path.

Column

- 30 m x 0.25 mm coated with 0.50 µm Supelco wax 10™, temperature program: 50 °C, 1 minute, 5 °C/min to 200 °C, hold 9 minutes, carrier gas: helium, 41 cm/s at 60 °C.
- Two pieces of 35 cm 0.25 mm deactivated fused silica tubing were used to connect the valve to the ECD and to the ion trap. An auxiliary column (0.25 mm) was also required (see Figure 2).

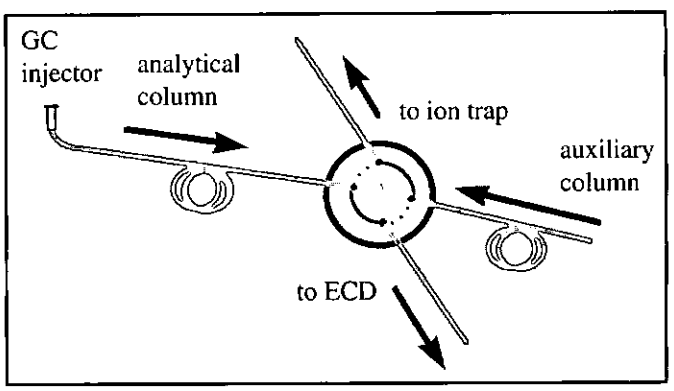


Figure 3. *Schematic of system for beer analysis. The sample is introduced into the GC injector and flows into the ECD where the diones are detected. After eight minutes, the valve is activated and directs the sample into the ion trap to detect the aldehydes and esters.*

Injector

- SPI (isothermal mode) with SPME insert, 210 °C-230 °C with the Carboxen-PDMS fibre.

ECD

- Range 10, temperature 150 °C, sampled first 8 minutes of the run.

Ion Trap

- Electron impact ionisation mode, mass range 45-300 m/z, ion trap temperature 150 °C, transfer line temperature 180 °C, acquisition delay time 8 minutes.

Automated SPME Conditions

- Fibres (Supelco, Inc.) were coated with 100 µm polydimethylsiloxane (PDMS), 85 µm polyacrylate and 65 µm Carboxen-PDMS.
- Headspace sampling over 0.8 mL in 2 mL vials, 38 minutes absorption, 3 minutes desorption, one sampling per vial.

Conventional Static Headspace

- 10 mL samples in 22 mL vials were heated to 70 °C, line and valve temperatures were 90 °C, equilibration time one hour.

Beer Samples

- Michelob Amber Bock, Budweiser Light.

Standards

- Pure standards of the four compounds of interest: 2,3 butanedione, 2,3-pentanedione, trans-2-nonenal and trans,trans-2,4-decadienal were dissolved in purge and trap grade methanol to concentrations of 1 mg/mL each compound and then diluted into the beer samples at the level desired for the particular experiment.

Results and Discussion

Establishment of SPME Sampling Conditions

To optimise SPME sampling, the following parameters were studied: response with various fibres, effect of saturating the beer with salt (Na_2SO_4), liquid versus headspace sampling and agitation. Table 1 shows the results of these investigations. Quantitative data for the aldehydes was obtained using mass 81 for trans-2-nonenal and the sum of masses 81 and 83 for trans,trans-2,4-decadienal.

The data in the table shows a very significant enhancement of response for the diones with the carboxen fibre. Saturating with salt also enhanced the response for these compounds, however it was felt that saturation with salt was too inconvenient for routine monitoring. Figure 4 is a chromatogram of beer spiked with the four compounds of interest.

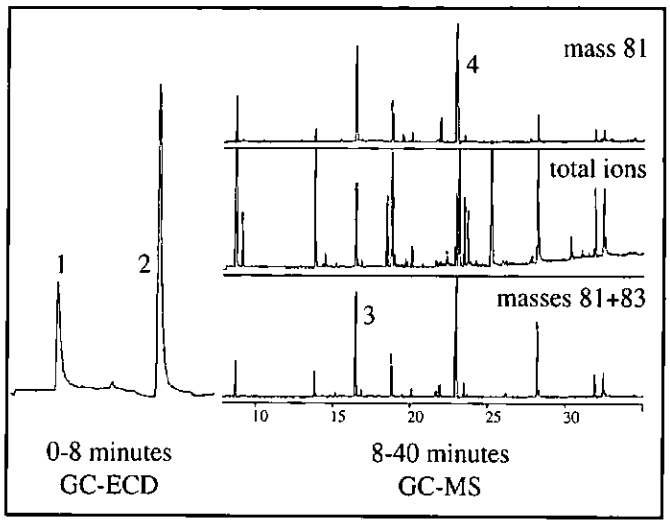


Figure 4. *SPME chromatogram of headspace over beer sampled with a polyacrylate fibre. The beer was spiked with 100 ppb 2,3-butanedione (1), 2,3-pentanedione (2), trans-2-nonenal (3) and trans,trans-2,4-decadienal (4).*

Linearity, Precision and Minimum Detectable Quantities

The Michelob Amber Bock beer samples were spiked with the compounds of interest at levels of 25 ppb to 1 ppm for linearity determinations with the polyacrylate fibre and SHS. For sampling with the Carboxen-PDMS fibre, the spiking level was 10 ppb to 250 ppb. (The ECD was saturated above this level.)

In all cases, the ECD response curves for the diones showed a better fit to a quadratic curve than to a linear curve. For example, when 2,3-butanedione was sampled with the polyacrylate fibre, the correlation coefficient (r^2) to a straight line was 0.9990, r^2 was 0.9997 for a quadratic curve fit. The r^2 values were 0.9988 (linear) and 0.9998 (quadratic) with SHS and 0.9959 (linear) and 0.9987 (quadratic) for SPME sampling with the Carboxen-PDMS fibre.

The unspiked beer samples contained 25-50 ppb 2,3-butanedione and 5-18 ppb 2,3-pentanedione. To establish a blank value, it was necessary to sample bottled drinking water that had been vigorously boiled to remove interfering compounds.

The ion trap responses to the two aldehydes were linear with SPME sampling. The correlation coefficients to straight lines were 1.000 for both compounds when sampled with the polyacrylate fibre. These compounds were not reliably detected with SHS at the levels studied. The unspiked beer samples did not show any trace of these compounds with SPME sampling although the detection limits were less than 1 ppb. Table 2

Table 1. *Effect of varying SPME parameters on area count ratios of the four compounds of interest in spiked beer: 2,3-butanedione (1), 2,3-pentanedione (2), trans-2-nonenal (3), and trans,trans-2,4-decadienal (4).*

Parameter	Area Count Ratio	1	2	3	4
Salt saturation (Na_2SO_4)	Salt/no salt	1.6	2.0	1.0	1.5
Fibre coating	Polyacrylate/100 µm PDMS	2.0	1.5	0.53	0.64
	Carboxen-PDMS/100 µm PDMS	147	24.6	0.35	0.07
Phase sampled	Liquid/headspace	1.2	1.1	1.8	2.2
	Liquid plus agitation/headspace	1.4	1.3	1.6	2.8

gives the precision and minimum detectable values for the compounds.

Table 2. *Precision and minimum detectable quantities for the four compounds of interest in spiked beer: 2,3-butanedione (1), 2,3-pentanedione (2), trans-2-nonenal (3) and trans,trans-2,4-decadienal (4). Compounds 1 and 2 were detected with an ECD, 3 and 4 were detected with the Saturn.*

% rsd	1	2	3	4
Polyacrylate fibre*	3.08	2.14	2.93	3.31
Carboxen-PDMS fibre**	3.56	2.82	5.70	8.59
SHS*	5.20	5.73	n.d.	n.d.
mdq (ppb, s/n = 3)				
Polyacrylate fibre	10	3	0.6	0.2
Carboxen-PDMS fibre	0.2	0.1	1.4	2.1
SHS	4	3	n.d.	n.d.

* 6 samplings at 100 ppb
** 8 samplings at 50 ppb
n.d. none detected

In addition to the four compounds that were spiked into the beer samples for the study, additional compounds were identified in the beer samples. These are shown in the chromatogram (Figure 5).

Conclusions

The data indicated that SPME is a practical technique for detecting diones and aldehydes that are monitored in beer. The

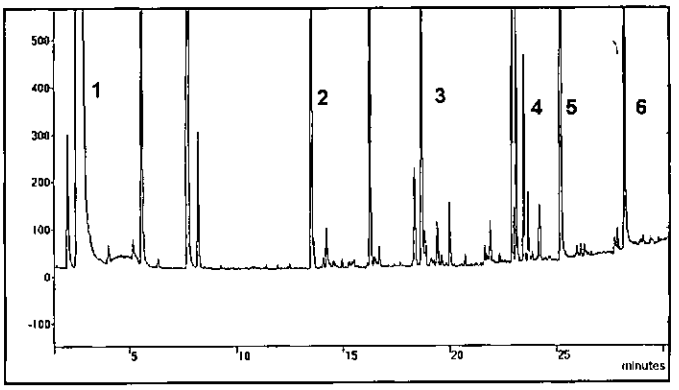


Figure 5. *Total ion chromatogram of beer sampled with the polyacrylate fibre. The compounds were identified as 1. ethanol, 2. ethyl octanoate, 3. ethyl decanoate, 4. ethyl dodecanoate, 5. phenylethanol, and 6. octanoic acid.*

polyacrylate fibre was useful for general screening of all of the compounds in beer including the less volatile ethyl esters. The carboxen fibre would be the natural choice to determine the diones at very low levels although this fibre was less efficient at extracting the less volatile compounds. Both SPME fibres were able to sample a wider range of compounds than the conventional static headspace autosampler.

For more information on Varian SPME and GC/MS/ECD,

Contact: Kevin Moloney, A.i. Scientific (NZ) Ltd
P O Box 35-579, Browns Bay, Auckland
Phone: (09) 4781351, Fax: (09) 4781360
circle number 56 on the reader reply card

GFAA Determination Of Phosphorus In Food Oils

Gregory M Bercowy and Robert Peile

Graphite furnace atomic absorption (GFAA) provides a rapid and relatively sensitive method for the determination of total phosphorus in commercial food oils. Total phosphorus provides a measure of phospholipid content, higher levels of which are known to be a key parameter in premature darkening of the oil with heating, as well as increases in unfavourable flavours.

Sensitivity of inductively coupled plasma-optical emission spectrometry (ICP-OES) is inherently better for non-metals like phosphorus. However, food oils pose sample introduction and matrix-related challenges capable of nullifying this advantage. General consensus of GFAA as a more simplified technique serves to further substantiate it as the method of choice. The basis for the GFAA technique comes from the identification of the 213.5/213.6 non-resonance line, which has sensitivity suitable for phosphorus determinations. Other developmental work demonstrated the presence of multiple gaseous forms of phosphorus that are thermally stable over a wide temperature range, and the need for high atomisation efficiency. Hence, the accurate and precise determination of phosphorus is highly temperature-dependent.

Published techniques show varied approaches in search of the optimum combination of heating and matrix modification to achieve suitable results (1, 2). Chlorinated solvents used for dissolution of the sample matrix have largely fallen from favour due to related health concerns. Heating of samples to improve flow characteristics is useful but cumbersome in automating production laboratory operations. Lanthanum commonly is utilised as a matrix modifier, yet a mixture of palladium and calcium nitrates also shows promise (3).

With commercial food oils, the technique of standard additions is often necessary to address the inconsistencies between sample matrices, as well as difficulties with automated pipetting techniques. Dilution of oils to assist pipetting can readily compromise method sensitivity. These conditions make it difficult to address the needs of today's cost-conscious production laboratories, necessitating more laborious techniques (4).

Many instruments feature high degrees of automation, which can prove to be very useful with a properly developed furnace heating procedure. For example, individual calibration points can be established automatically by mixing varying amounts of the single (most concentrated) standard with a suitable blank, keeping the total volume deposited constant. To this mix, matrix modifier easily can be added, further simplifying run preparation. This article presents a rapid, sensitive technique for the determination of phosphorus in commercial food oils at levels below 0.250 mg/kg. Oils are diluted 1:2 in methyl isobutyl ketone (MIBK) to improve characteristics of flow and deposition into the graphite tube. An added benefit is improved mixing with the matrix modifier lanthanum 2-methoxyethoxide.

Method and Materials

An atomic absorption (AA) spectrometer equipped with ultra-pulse background correction, a superlamp power supply, a longitudinally-heated GF 3000 graphite atomiser and PAL 3000 autosampler were used for atomic absorption measurements (GBC Scientific). Pyrolytically-coated graphite furnace tubes (Part No. 99-0059-00) were used for all determinations. Accuracy and precision were enhanced by a data acquisition rate of 240 data p/s, and a 1 millisecond delay between total and background absorbance measurements. Other instrument conditions and graphite furnace parameters are depicted in Table 1.

Working standards were prepared by serial dilution of a 5000 mg/kg phosphorus metallo-organic standard (Conostan Specialty Products) in MIBK to give a final concentration of 2.5 mg/kg. An intermediate standard of 25 mg/kg was first prepared by gravimetrically transferring 0.5 g of the source standard (5000 mg/kg) to a 125 mL glass container. MIBK solvent was added to achieve a 100 g final weight.

The working standard (2.5 mg/kg) was made by gravimetrically transferring 0.5 g of the 25 mg/kg intermediate standard to a 5 mL glass beaker. MIBK solvent was added to achieve a final weight of 5 g. This beaker was transferred directly to the instrument. A calibration curve of 0, 0.25, 0.5, 1.0 and 2.5 mg/kg is established by the instrument by serial of the single working standard. MIBK was used as a calibration blank and for rinsing of the autosampler tip. Rinsing of the tip was performed automatically during each replicate firing, speeding overall analysis times.

Matrix modification was accomplished through the use of lanthanum 2-methoxyethoxide, 5% weight/volume (w/v) in 2-methoxyethanol (Johnson Matthey), which was found to be superior to a metallo-organic lanthanum standard. This solution was transferred directly to the matrix modifier position on the instrument's autosampler.

Samples were prepared gravimetrically by transferring 0.5 g of each sample to separate 2 mL polypropylene beaker cups (GBC Scientific). Each sample was then diluted 1:2 (1+1) through the gravimetric addition of 0.5 g MIBK and subsequent mixing with a transfer pipette. This dilution assisted sample flow, deposition into the graphite tube, and mixing with the matrix modifier. Sample concentrations are quantitated versus the calibration established and multiplied by a factor of 2 to account for the preparative dilution.

Results

Soybean oil was used extensively in the development of the final furnace program. Optimisation of the procedure involved identification of the most appropriate matrix modification and sample dilution scheme in addition, assurances were needed that the creation of standards in a non-oil matrix would not introduce bias due to sample matrix differences. Figure 1 shows a calibration curve for the toluene-based standards used. Sensitivity of the analysis, defined as the concentration of phosphorus necessary to provide 0.0044 absorbance was 0.100 mg/kg. A method detection limit was calculated to be 0.150 mg/kg based upon three standard deviations of a ten replicates mean value.

Lanthanum has been widely used as a matrix modifier in the determination of phosphorus. Previous work proved successful when a metallo-organic standard of lanthanum was used, although higher sample dilutions were necessary to reliably achieve precision on replicate determinations below a 10% relative standard deviation (RSD). Lanthanum 2-methoxy-ethoxide obtained as a 5% w/v solutions in 2-methoxyethanol was found to be advantageous owing to its lower viscosity. This enabled direct transfer to the instrument and easy pipetting by the autosampler. At the modifier volume added, peak height absorbances were consistent for MIBK-based standards versus earlier attempts with alternate lanthanum preparations (Table 1). Evaluation of the lanthanum 2-methoxyethoxide was performed with varying dilutions of soybean oil in MIBK. Earlier work yielded a lower practical working dilution of 1:5 when using the oil-based lanthanum source. Comparison of peak height ratios and replicate precision was made under identical heating conditions, while varying sample dilutions from 1:2 through 1:5. A 1:2 dilution of soybean oil in MIBK provided a suitable compromise between replicate (n=2), precision (less than 10% RSD) and best detection limits, although a greater dilution of sample may be desirable where ultimate sensitivity of the analysis plays a smaller role.

With a graphite furnace program optimised for gradual heating of the sample for matrix reduction and symmetry of the peak at

Table 1. *Spectrometer conditions and optimised graphite furnace parameters.*

Spectrometer Conditions

Wavelength:	213.6 nm	Lamp Current:	8.0 mA (Boost Current: 6 mA)
Slit Width:	0.5 nm	Slit Height:	Reduced
Sample Volume:	30 mcL	Modifier Volume:	30 mcL
Measurement Mode:	Peak Height	Read Time:	2.5 sec

Optimised Graphite Furnace Parameters

Step	Final Temp (°C)	Ramp Time (sec)	Hold Time (sec)	Gas Type	Read and Signal Graphics
1	80	5.0	5.0	Argon	-
2	170	40.0	5.0	Argon	-
3	500	50.0	10.0	Argon	-
4	1100	20.0	5.0	Argon	-
5	1100	0.5	0.5	None	-
6	2700	0.9	1.6	None	On
7	2850	0.5	2.5	Argon	-

atomisation, well-defined peaks were achieved with very manageable background, as shown in Figure 1. The analysis was then extended to other oils, such as safflower and sunflower, and a comparison of peak height for the three commercial oils and MIBK-based standard versus added concentration was performed. Good linearity is seen for all matrices, as well as an absence of matrix-related bias.

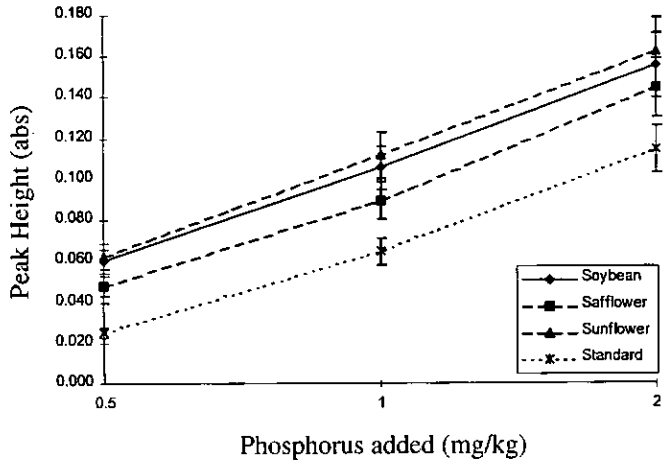


Figure 1. *Comparison of food oil and standard peak height absorbances versus concentration of added phosphorus.*

Conclusion

The method described provides a simple and rapid, yet sensitive, method for the determination of phosphorus in commercial food oils. Run times typically are five minutes per sample when performed in duplicate. In addition, the sensitivity of this method is suitable for current regulations and practices within this industry. Other advantages of this technique include avoidance of matrix-related bias and faster analysis preparation times.

References

1. AOCS (1992) Phosphorus by direct graphite furnace atomic absorption spectrometry. AOCS Official Method Ca. 12b-92.

2. Prevat, A and Cente-Jauniaux, M (1978) Rapid determination of phosphorus in oils by flameless atomic absorption. *Atomic Absorption Newsletter* **17(1)**:1-3.

3. Curtius, A J; Schlemmer, G and Weiz, B (1987) Determination of phosphorus by graphite furnace atomic absorption spectrometry, part 3: Analysis of biological reference materials. *Journal of Analytical Atomic Spectrometry* **(2)**:311-315.

4. IUPAC Method 2.423 (1987) In Standard Methods for the Analysis of Oils, Fats and Derivatives. International Union of Pure and Applied Chemistry, 7th edition Blackwell Scientific Publications.

ABOUT THE AUTHORS

Grecory M Bercowy is technical director for North American operations at GBC Scientific Equipment, Inc. Robert is worldwide product manager for atomic absorption instrumentation at GBC Scientific Pty Limited, Dandenong, Victoria, Australia.

Contact: David Pegman, GBC-AEC NZ
P O Box 68-330, Newton, Auckland
Free Phone/Fax: 0800 428428, Email: dpegman@clear.net.nz

circle number 57 on the reader reply card

NCRL

NATIONAL CHEMICAL RESIDUE LABORATORY

A laboratory with over 25 years experience and expertise in analytical chemistry, particularly residue analysis.
NCRL provides a comprehensive analytical and consultancy service, including:
• Veterinary Drugs • Pesticides • Herbicides
• Environmental Contaminants • Trace Elements
• Field and Animal Trials • Heavy Metals • Vitamins
• Protein & Amino Acids • Fat Fibre and Moisture Content

The laboratory is well equipped with modern instrumentation, including:
• Atomic Absorption • HPLC • GC • GC/LC-MS
Audited by US Department of Agriculture and the European Commission.

For further information
Laboratory Manager - National Chemical Residue Laboratory
Wallaceville Research Centre, P.O. Box 40-063, Upper Hutt
Telephone (04) 528-0718, Fax (04) 528-1375

MAF Quality Management

New Zealand Accredited & GLP Compliant laboratory

circle number 8 on the reader reply card

FOR SALE

Gas Chromatograph Type SRI 8610C with TCD, direct injector, packed column, carrier gas dryer and PeakSimple 4-channel A/D converter and chromatography data system. This equipment is six months old and has had little use. Purchased from Alltech New Zealand, original cost over NZ$10,000.

No reasonable offer refused.

Contact:
Dr John R L Walker
Department of Plant and Microbial Sciences
University of Canterbury
Private Bag 4800, Christchurch
Fax: (03) 3642083
Email: Walker@botn.Canterbury.ac.nz

**FOR A QUICK, NO-FUSS REPLY . . .
REQUEST FURTHER INFORMATION,
PRICING DETAILS ETC.,
USING THE FREEPOST READER REPLY CARD**

Victoria University Graduation Ceremony Speech
10th December 1997
Dr Jeffery Tallon

Your Excellency, Chancellor, Vice-Chancellor, Graduands, Ladies and Gentlemen. Tena koutou, tena koutou, tena koutou katoa.

Over the next few minutes I want to address an issue that seriously impacts on science enrolments, Faculties and careers and carries through inevitably to agriculture and industry. Government is currently considering proposals to reduce spending over the next few years for research, science and technology.

I will look back with some pleasure on 1997 as a year of stimulating international debate in my field, of major research developments, the year in which I was privileged to take up a James Cook Fellowship and in which we at the New Zealand Institute for Industrial Research installed the world's first large-scale fully-operational application of high temperature superconductors (HTS), a switching magnet in the carbon-dating accelerator at the Institute of Geological and Nuclear Sciences. A full ten years had passed since we began this particular journey following the discovery of HTS superconductors. Ten years to fruition - that's a long time by modern business expectations, and there is much yet to be done. A decade or so earlier we too came to receive our degrees: callow, naive, at once both eager and uncertain. Was there a career there? Could we respond to the aggressive demands of internationally competitive research? Could we make our mark? Well, we could and we did, and for two reasons. We were personally committed to competing with the best and we were given the long-term resources to do so. The message is clear: adequately resourced New Zealanders, here in the most remote place on earth, can compete with the very best, worldwide, in any endeavour. But what if, in the science and technology arena, those resources are eroded? Does it matter to New Zealand industry and agriculture if the retrenchment of the 1980s is repeated?

As a scientist, my cultural Whakapapa threads its way back through the generations of scientific luminaries whose lives and discoveries provided the inspiration for my own passion for science. Curiously enough, it is exactly 100 years since J J Thomson's discovery of the electron, 200 years since the discovery of the battery by Volta, 250 years since Franklin discerned the existence of positive and negative electricity and 400 years since the first differentiation between magnetism and electricity. Moreover, this year is possibly the closest estimate to the bicentennial of the birth of Christ which, allowing for the fact that there was no zero AD, probably falls this year rather than when the "Millennium bug" strikes in just over two years' time.

Jesus is quoted as saying "Many Prophets longed to see what you see but they could not, and to hear what you hear but they did not". We live in a remarkable era of unprecedented accomplishment in science, technology and medicine. So persistent and pervasive is the onslaught of invention that we have lost the ability to be astonished. Now as then we perhaps fail to appreciate what the sages of earlier years would have longed to see, the present lavish fruits of the seeds of insight, invention and discovery that they sowed in their time. The list is boundless, but we might include the ability to grow organs through tissue culture, to splice genes across the ancient boundaries of species, to exploit the essentially infinite electrical conductivity of superconductors, the nanoscale-engineering of components atom by atom, and non-invasive laser surgery whether of organs, tumours or satellites! This is not a mere side-show of spectacle, for the fact is that the present prosperity that the Western nations of this world enjoy, prosperity in health, wealth and leisure pursuits, are overwhelmingly derived from the results of science, technology and information, rather than through capital investment in physical infrastructure. Most of this was destroyed in Japan and Germany 50 years ago. Yet within little more than one and a half decades they had completely recovered because their knowledge base and educated human capital were still intact. The converse where the capital infrastructure is retained but the knowledge base destroyed might take millennia to restore.

If wealth creation comes from the application of the scientific and technological knowledge base then competitive edge is derived from the continual upgrading and addition to that knowledge base. There is an ongoing imperative which applies to New Zealand as much as any country. Yet, in spite of all the evidence that science and technology R&D expenditure is a wealth-creating investment it is still widely perceived as a cost! And costs of course should be cut! This is the proposal currently before Government. Never before has the impact of science and technology on society been so visible and all-pervasive yet ironically, literacy, enrolments and career options in the sciences are on the decline. Twenty years ago the average senior high school student in New Zealand studied 1.5 science subjects, now just 0.86. Why is this? Surely partly because, if salaries and career prospects are taken as the measure, our society attaches little status to science as a profession. All analyses indicate a serious shortage of scientists and engineers early in the new Millennium. Another round of reduction in R&D funding, signalling further career and programme uncertainty, will only seriously accelerate the decline. There is a cost to cost-cutting.

He rakau morimori e kore e taea te piki - a tree shorn of its branches can not be climbed.

New Zealand was founded on passion for discovery, innovation and scientific research. The coming of the Maori was an astonishing accomplishment of exploration and discovery across vast tracts of empty ocean. I am privileged to be able to devote all my time over the next two years to research in superconductivity under a James Cook Fellowship. Cook did not come here to have a mountain, a strait, a wine or a cafe named after him, nor even principally to explore and discover, but to carry out a physics experiment - the observation of the transit of Venus across the face of the sun and thereby determine the dimensions of the solar system. The government of the day would provide only one third of the costs, the remainder being met privately by Joseph Banks. For Banks it was to secure the longest-serving Presidency of the Royal Society. Certainly there was personal gain, but for the government the expedition was seen as a cost and not as an investment and therefore funded as such.

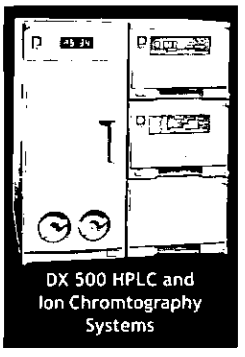
New Zealand has a proud history of dispatching to the world outstanding scientists who have carved out distinguished careers in the institutions and countries they have adopted: Rutherford, Mellor, Ashcroft, Ziman, Heine, Popper, Vaughan-Jones, and Beatrice Tinsley to name a few. While they have brought credit to our nation abroad this has been a waste of some of our best resources - all cost and no return on investment. We desperately need to retain our intellectual resources for the benefit of the nation. Regrettably, the process will continue because the science trend within our universities is contraction and within our Crown Research Institutes is to short term contracts with little career development. Perceptive students seek other careers which offer genuine rewards. It is essential that scientific employment and career opportunities be seriously developed in this country so that we are able to capture and cultivate the best talent. This will never happen within a scenario of arbitrary and unreasoned budget cutting. Long-term reliability of funding, albeit with the appropriate accountability, is vital to this process. In a recent survey of New Zealand scientists conducted for the Royal Society of New Zealand we find the remarkable result that nearly half stated they would not recommend science and engineering careers to students, in spite of a general passion for their subjects. The single most critical issue identified in the survey was interrupted funding.

Moreover, our objective should not merely be to appoint the scientifically trained to positions of academic research, teaching, and high-tech industry but to all sectors of business, industry, and public office. Per capita, Japan has 5 times the number of engineers as New Zealand. We have 25 times the number of accountants. The ratio of accountants to engineers is an astounding 125 times higher in New Zealand than in Japan! Now I am on dangerous ground here with Commerce Faculty and graduands present, but I seriously believe we need a culture shift if we wish to take the path of technical innovation as the key route to prosperity. Cutting back on investment in research, science and technology and thereby indirectly shunting students out of the science education route can only exacerbate the problem. We need technically literate people in positions of power and decision making. Fifteen years ago I first heard from a computer scientist of the potential "Millennium bug" - that computers would not be able to cope with the change of year from 99 to 00 at the turn of the century. The British Government recently assessed the potential cost in the United Kingdom as an astonishing £31 billion! Why was this issue not raised and resolved a decade earlier? Was it cynical exploitation by the manufacturers who stand to benefit from the enforced purchase of new machinery? Or was it the absence of detailed technical literacy in the business world which could have foreseen the problem and insisted on a solution? Probably both. All it required was the idea conceived and placed in the hands of either authority or purchasing power.

What is the cost of an idea? An idea takes a mere moment of conception, often at no marginal cost. What is the value of an idea? Hew iti, hei pounamu: "it is tiny, but it is Greenstone!". Of course the generation and application of science-based ideas requires a research milieu which is costly but the benefits to New Zealand have been enormous: the scientific development of the *Pinus radiata* resource worth tens of billions of dollars, the development of earthquake dampers now installed in 8000 structures worldwide, the development of anti-cancer and anti-leukaemia drugs now in clinical use, the development of technology and process for steel from iron sand, geothermal power development, plant and seed cloning of new crops, genetic improvements to livestock, controlled enzyme production of milk protein, the development of vaccination of ewes against one of their own steroid hormones resulting in a 20% increase in lambing, and the discovery of high temperature superconductors that promise a profound 21st century technology that will ultimately impact widely on the energy, communications, transport and health sectors. The accumulated impact of international competitive advantage made through these developments has been huge, probably in the neighbourhood of $100 billion.

Science and technology R&D is an investment, not a cost! At less than 2% of total government revenue and 0.6% of GDP it is a small fraction, much less than many of our competitors. *Hei iti, hei pounamu.* Despite vigorous promotion by the present and immediate past Ministers of Science we are already moving rapidly away from the 2010 target 0.8% of GDP. I urge the Government to put away the scalpel, to reaffirm research, science and technology as a key route to prosperity in the new Millennium and to adopt bold, new approaches to promoting science and technology throughout our schools, universities, research institutes, and the industrial marketplace. Our international competitors are certainly doing so.

Proven solutions from Dionex


DX 500 HPLC and Ion Chromtography Systems

Compact, interlocking modules, your choice of advanced pumps & detectors and built-in ease of use help you achieve high performance chromatography. Discover just how versatile, sensitive, precise and powerful the DX 500 can be. For your free DX 500 brochure call (09) 478 1351.

A.i. Scientific
Spectroscopy, Separation & Sample Preparation
PO Box 35579, Browns Bay, Auckland
Phone: (09) 478 1351 Fax: (09) 478 1360

DIONEX

circle number 7 on the reader reply card

SGE INTERNATIONAL ACQUIRES ETP ELECTRON MULTIPLIERS

The agreement took effect on January 19, 1998 and covers both Australia and United States electron multiplier operations. ETP will continue operating as a separate company with manufacturing and product development operations in Sydney.

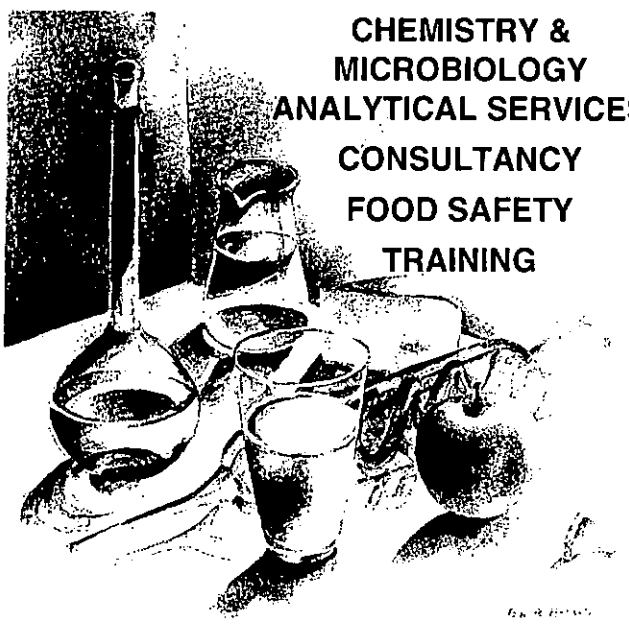
The new relationship will facilitate greater focus on sales and marketing of electron multipliers throughout the world. Peter Dawes, Managing Director, SGE International said, "we are excited about this development. There is clearly excellent potential for ETP Electron Multipliers to continue outstanding growth as part of the SGE organisation. In addition, SGE is in an excellent position to bring greater value to the ETP organisation through our worldwide product support, product development and manufacturing".

SGE manufactures and sells equipment and supplies for chromatography and maintains manufacturing and development facilities in Australia. ETP manufactures and sells state-of-the-art Electron Multipliers for mass spectrometers and other analytical instruments.

Contact: SGE International Pty Ltd
Phone: (+61-3)-98746333, Fax: (+61-3)-98745672
Email: info@sge.com.au, Web Site: http://www.sge.com

LYNFIELD

DAIRY AND FOOD LABORATORY



CHEMISTRY & MICROBIOLOGY ANALYTICAL SERVICES
CONSULTANCY
FOOD SAFETY
TRAINING

Contact: Sheila Fisher
MAF Quality Management
Lynfield, 131 Boundary Road, Blockhouse Bay
P O Box 41, AUCKLAND, NEW ZEALAND

Phone: 0064 9 6266026 • Fax: 0064 9 6279750

MAF
MAF Quality Management

circle number 9 on the reader reply card

CHEMWEB LAUNCHES THE INTERNATIONAL YOUNG CHEMISTRY WRITER OF THE YEAR AWARD

ChemWeb (http://ChemWeb.com) launched the ChemWeb International Young Chemistry Writer of the Year Award in association with the webzine, *The Alchemist*, in London on the 5 March 1998.

For the first time, young chemists from every country in the world are being given the opportunity to have their work published on the Web and become $1000 richer, simply by entering this new international competition.

The winner, chosen by our panel of judges, will be announced at the American Chemical Society fall meeting in Boston. As well as receiving $1000, the entrant's winning article will be published in ChemWeb's webzine, *The Alchemist*, on 28 August 1998.

The competition is open to all chemists aged 16-30 and the closing date is the 30 June 1998. Further details are available at http://chemweb.com/home/events.htm

ChemWeb was developed as a joint venture between MDL Information Systems, Inc. and the Current Science Group. ChemWeb, Inc. produces the on-line "club" for the world's chemistry researchers, ChemWeb, which delivers complete information resources for chemical research and communication via the World Wide Web. It is the first commercial Web communication to combine electronic publishing, databases, journals, and scientific forums, along with informatics technologies for structure-based searching, high-speed text retrieval and manipulation of "live" molecular structures. ChemWeb, Inc. is now a wholly owned subsidiary of Elsevier Science.

The Alchemist is ChemWeb's 'webzine". Updated on a weekly basis, *The Alchemist* reports on the newest developments in chemistry and science and is free of charge to ChemWeb members.

The Alchemist includes features such as:

- News - chemical industry, environmental policy and events
- ChemWeb Picks - *The Alchemist*'s selection from the World Wide Web
- Catalyst - topical issues featuring award winning science writer David Bradley
- Research News - keep in touch with chemistry's cutting edge
- Warr Zone - Wendy Warr's pick of the news
- Filternet - what's hot in discussion lists and newsgroups
- Getting Personal - scientist's profiles and interviews
- Spotlight - a closer look at major chemistry topics
- Book Reviews
- Software reviews.

The International Young Chemistry Writer of the Year and the Young Chemistry Writer of the Year are Trademarks of ChemWeb, Inc.

NEW ZEALAND INSTITUTE OF CHEMISTRY

NEWLY ELECTED FELLOWS

Kerry W Dalzell

Kerry joined DSIR Chemistry Division as a student bursar in 1968. In 1972 he graduated from the University of Canterbury, majoring in Chemistry. He was elected to membership of the NZIC in 1973.

His career since then has focused on corrosion and surface coatings technology: as a scientist with DSIR Chemistry until 1991, then as the Field Engineer for Sigma Coatings through Levene Paint Manufacturing Limited until 1994, and presently as Technical Manager for Surface Technologies Limited, a company dedicated to corrosion engineering and consultancy services. He has recently established the only independent IANZ accredited testing laboratory in New Zealand specialising in surface coatings technology.

Kerry's specialist interests have always been in the protection of on-shore, off-shore, and marine structures, as a coatings consultant, specifier, and inspector. He has published papers and lectured widely on these subjects.

Tim Oughton

Tim Oughton is currently Deputy Rector and Head of Education at St Andrew's College. He was formerly Senior Lecturer in Science Education at the Christchurch College of Education and before that taught chemistry at Rangiora High School, Christchurch Boys' High School and Central Southland College. He was coordinating writer of Chemistry in the New Zealand Curriculum and has carried out considerable pre-service and in-service work in chemistry education throughout New Zealand.

John C Wallaart

John has over 25 years experience in both large and small industries and has tutored part-time in tertiary education institutes. He is formally qualified in chemistry, as well as domestic and international management and has post-graduate qualifications in occupational health and safety. He is currently commencing PhD studies in respiratory protection at the University of Sydney, sitting the American Certified Industrial Hygienists examinations and is half-way through the Master of Business Studies degree in international management at Massey University.

John is a member of the New Zealand Institute of Management, as well as the New Zealand Association of Scientists and is also a member of the American Conference of Governmental Industrial Hygienists and the International Society of Respiratory Protection.

He has travelled extensively, both nationally and internationally, and has given many presentations on occupational health issues from Europe to Australasia, with more planned in 1998. The most recent publications were produced in Europe and in Australia in 1997. Further written publications and presentations in USA, New Zealand and Australia on occupational health issues are due in 1998.

NZIC BRANCH NEWS

OTAGO

Annual General Meeting

At the AGM on 30 October 1997, the following Officers and Committee for 1997/98 were elected by acclaim (all at University of Otago except Mrs Margaret Mills):

Chairman: Dr Wayne Temple, National Toxicology Group
Secretary: Dr Kate McGrath, Department of Chemistry
Treasurer: Dr Kim Currie
National Institute of Water and Atmospheric Research
Branch Delegate:
Professor Keith Hunter, Department of Chemistry
Branch Editor: Dr Paul Fawcett, School of Pharmacy
Student Representative:
Ms Andrea Clarkson, Department of Chemistry

Members:
Dr John Birch, Department of Consumer and Applied Science
Dr Keith Gordon, Department of Chemistry
Dr Jonathan Kim, Department of Chemistry
Mrs Margaret Mills, Queen's High School
Dr Mike Murphy, Department of Biochemistry
Ms Kaye Wilson, Department of Biochemistry

The AGM was followed by a talk on the Chemical Basis of Sensory Perception given by Associate Professor John Prescott of the Sensory Science Research Centre, University of Otago.

Using wine as a vehicle he gave a fascinating insight into the sources of flavour and the importance of odour using α-ionone, 2-isobutyl-3-methoxypyrazine, oil of sandalwood and diacetyl to illustrate fruity, grassy, woody and buttery odours respectively. He also told us about the individual nerves involved in the sensations of sweetness/sourness and astringency, and about the importance of tannins.

Analytical Competition

The 1997 competition was successfully managed by Jonathan Kim aided by Margaret Mills, Kim Currie and Eng Tan. The competition involving the analysis of three carbonate samples based on Oamaru Stone was won by Miss Mrudula Kushnaswarmy, a sixth former at Columba College with second prize going to Miss Yehrun Yoo, a seventh former at Queen's High School. The two prizewinners were treated to a guided tour of the chemistry-oriented University Departments (Chemistry, Biochemistry and Pharmacy) and after being presented with their prizes by Dr Wayne Temple were hosted for lunch at the University Staff Club. Neither was interested in a career in chemistry but were planning to take their analytical skills into medicine and law.

1997 Analytical Competition prizewinners, Miss Yehrun Yoo and Miss Mrudula Kushnaswarmy.

New Programme

The Otago Branch programme for 1998 began on 17 February with a visit to the Maritime Studies Centre and Aquarium at Portobello. The meeting took place on a glorious summer evening and was well attended by some 45 members and their guests. A "touchy-feely" tour of the Aquarium led by Manager Sally Carson was followed by an enjoyable dinner concluding with an address by the retired head of the Centre, Associate Professor John Jillett. From him, we learned all about the viscissitudes of the centre since it first opened as a fish hatchery in 1904 and about some of the colourful personalities who played a significant role over the years. The future programme for the year is looking rich in variety with meetings devoted to toxicology, food science, land care, the pharmaceutical industry and brewing as well as lectures of a more academic nature.

The membership also looks healthy at present with some 118 current members, recently joined by three new members Graham Caygill, Geoff Low and Gareth Thomas and another seven new student members.

University News

Chemistry Department

Professor Keith Hunter, National Second Vice-President of the NZIC was recently elected a fellow of the Royal Society of New Zealand. Well known for his work in marine chemistry, Keith has held a personal chair in chemistry since 1994.

Professor Brian Robinson has stepped down as Head of the Department to be succeeded by Professor Jim Simpson. Brian is taking sabbatical leave in Cambridge, England from April and will return to the Department in 1999.

The recipients of prizes donated by the NZIC were recently announced. The Inglis Memorial Prize for the best BSc student in chemistry was shared by Anthony Butcher and Ruth Hovel. The NZIC prize for the best second year student in chemistry went to Anita Fraser. Congratulations to the three winners. The following postgraduate students have received Student Travel Scholarships donated by the NZIC: Kitty Lee and Andrew Clarkson to attend the 33rd International Conference on Coordination Chemistry in Florence, Italy; Paul Pfliger to attend the RACI Inorganic Chemistry Division Conference in Woollongong, Australia; Michael Elwood to attend the American Society of Limnology and Oceanography Conference in San Diego, USA and Jans Degenhardt (NZIC student poster competition winner in 1997) to attend the 20th Australian Colloid and Surface Chemistry Student Conference in Hahndorf, South Australia.

Biochemistry Department

Professor Diana Hill, Director of the University Agricultural Research Unit has been elected a Fellow of the Royal Society of New Zealand. Diana is well known for her work on genome studies in animals particularly animal models of human disease.

George Petersen, in his position as President of the Academy of the Royal Society of New Zealand has been busy lobbying the Minister for Science and Technology for more money to be put into science. This was highlighted in a recent editorial in *Nature* in which the prospects for New Zealand science funding did not look good. The Department is setting up a new first year biochemistry paper to run for the first time in the second semester. This is a break in the usual tradition of teaching biochemistry to students only after they have had a year of chemistry. The Department is looking forward to the upcoming publication in *Nature* of the research on a Maori family with stomach cancer. This work was by a team in the Cancer Genetics laboratory led by Parry Guilford and Tony Reeve.

Two new lecturers will be joining us later this year; Sigurd Wilbanks whose interests are in protein structural determination and Ericka Hagelberg who uses mitochondrial DNA from human remains to follow human population movements in the Pacific. Ericka has been involved in a number of high profile studies using mitochrondrial DNA to identify unknown human remains, for example in identifying the Romanov remains in Russia.

Pharmacology Department

Professor Dick Laverty has recently retired from his post as Head of the Department of Pharmacology, a position he held from 1980 to 1997. Dick became a member of the NZIC in about 1965, a fellow in 1979 and has served as Chairman of the Otago Branch.

As well as his contributions to teaching and research within the Department, Dick has made outstanding contributions to pharmacology both nationally and internationally. He has served on or chaired (and in many cases continues to serve on) such committees and research bodies as the Health Research Council's Standing Committee on Therapeutic Trials; the New Zealand Neurological Foundation Council and Scientific Assessing Committee and the Toxic Substances Board. He is a member of the Editorial Board of the European Journal of Pharmacology. During his time as Head of Department, he has also advanced New Zealand pharmacology's internationl links through such roles as New Zealand convenor for the Australasian Society of Clinical and Experimental Pharmacologists and Toxicologists (ASCEPT) and as a member of the ASCEPT council.

Outside of Departmental duties, Dick's interests are notable for their variety. He was an active member of the Royal New Zealand Naval Volunteer Reserve retiring in 1983 with the rank of Commander, having served for a time as a Commanding Officer of HMNZS Toroa. His contributions to the Naval Reserve were recognised by the award of the VRD with bar for long service.

Freedom from the administrative load of HOD will give Dick a chance to continue his distinguished academic career and take up the demanding post of technician to Janet Ledingham in the Hypertension Research Unit. Besides his many awards Dick has the rare distinction of being the first member of the NTG Homebrew Club.

Paul Fawcett

MANAWATU

Congratulations to Manawatu Branch Committee member Kath Fletcher, who was among twenty New Zealand science teachers who recently received a National Excellence in Teaching regional award. Kath is Head of Science at Central Hawkes Bay College in Waipukurau, Hawkes Bay. The award winners were selected from more than 300 teachers nominated by parents and secondary school students from throughout New Zealand. The National Excellence in Teaching Awards are made through the Australian Scholarships Group, a non-profit organisation made up of over 45,000 New Zealand and Australian parents saving for their children's tertiary education. The awards aim to identify teachers whose professional contribution merits national recognition, to encourage teaching excellence, and improve public perception of the teaching profession. Kath Fletcher last year initiated and convened a biennial national conference on chemical education "Chem Ed '97" for secondary and tertiary educators, overseas speakers and industry and research organisations.

Also congratulations to Chairman of the Branch Grant Boston, who has been appointed as the new Honorary General Secretary for NZIC.

In the chemistry and biochemistry departments of Massey University, Andrew Baldwin has been awarded the 1997 NZIC Chemistry Prize for 300 level chemistry and Anna Meyer the 1997 NZIC Biochemistry Prize for 300 level biochemistry.

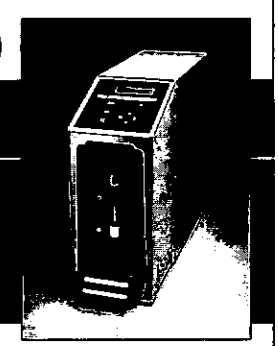
Chemistry at Massey University is now part of the Institute of Fundamental Sciences in the College of Sciences. In a massive restructuring exercise, designed to reposition the University in the rapidly changing tertiary sector, nine faculties have disappeared and have been replaced by four Colleges. Thus the former Faculties of Science, Technology, Veterinary Science, Agricultural and Horticultural Sciences, and Information and Mathematical Sciences, now make up the College of Sciences under the leadership of a Pro Vice-Chancellor. As part of this exercise, 22 departments now form eight institutes each with a strong research focus. It is recognised that the disciplines of chemistry, physics and mathematics have a special role to play in underpinning the other sciences in the College and each will maintain a strong profile within the new Institute. Thus, Andrew Brodie, as the Professor of Chemistry and former Head of the Department of Chemistry, retains an academic leadership role for the discipline of Chemistry. The Head of the Institute of Fundamental Sciences is Professor David Parry.

In February Tony Burrell, Eric Ainscough and Andrew Brodie of the Institute of Fundamental Sciences - Chemistry formed part of the contingent of 32 New Zealanders who attended the IC '98 (Inorganic Chemistry) Conference at Wollongong University in Australia. All presented papers and took special note of everything since IC '99 is to be held in Wellington in February next year. IC '99 will be a joint meeting of the NZIC Inorganic and Organometallic Chemistry Specialist Group and the Inorganic Division of the RACI and is being organised by a committee from Massey University, Victoria University and IRL Limited under the co-chairmanship of Andrew Brodie

Alltech's SCAN™ 1000

Two Instruments in One!

Automated Sample Preconcentration and/or Neutralization



Sample Concentration

- Preconcentrates Anions and Cations for Ultra-Trace Level (ppb & ppt) Detection
- Processes Large-Volume Samples without Secondary Pumps
- Automates Preconcentration for Multi-Sample, Unattended Operation

Sample Neutralization

- On-Line Acidic or Basic Sample Neutralization Improves Productivity and Reproducibility
- Electrochemical Neutralization Eliminates Labor-Intensive Manual Pre-Treatment Techniques
- Modular System is Compatible with Any Ion Chromatograph

Call us toll free at 0800 255 832

Alltech

Alltech Associates, Inc.
P.O. Box 100352 NSMC, Auckland
Phone: 09 444 3230 • Fax: 09 444 2399
Email: alltech@alltech.co.nz • Website: http://www.alltechweb.com

circle number 10 on the reader reply card

and John Spencer. At Wollongong, Andrew Brodie was re-elected for another term to represent New Zealand on the RACI Inorganic Division Committee.

Simon Burton, Research Officer since 1988 with the Centre for Separation Science, Institute of Fundamental Sciences - Chemistry, has taken up a three year post in the School of Chemical Engineering, University of Birmingham, United Kingdom. It is hoped he will be able to further expand the applications for the technology he developed at Massey in collaboration with Massey's partners in the USA. He will be working on the isolation and purification of plasmids not proteins in this case.

At the New Zealand Dairy Research Institute (NZDRI), Dr Allan Anderson took up the post of Chief Executive on February 1st after the retirement of Dr Kevin Marshall. Allan is a graduate of Massey University with a BTech (Food) and a PhD. After graduation he worked for Healtheries, developing New Zealand's first soymilk. He then returned to Massey to study for his PhD, and financed by NZDRI, he looked at the modelling of food products for development of the Thai and South-East Asian markets. His next work was for Salmond Industries and then more recently he worked as a product development consultant for six years. His present role developed from a project in which he was asked to examine the role of sensory science in the New Zealand dairy industry. The result was a recommendation to merge the Flavour and Sensory Evaluation Sections of NZDRI and he was asked to establish a new Sensory Science Section. At the end of 1996, this Section and the Food Systems Section were merged to form the Consumer and Application Science Section of which Allan was Manager, prior to his new appointment.

Harry Percival

Book Review

HEAT TRANSFER
(OXFORD CHEMISTRY PRIMERS NO. 50)
By R H S Winterton
Oxford University Press, Oxford, United Kingdom, 1997
ISBN 0 19 856297 7

One of the few definitions that my wife recalls from her high school science education of 30 years ago is that of radiation, the transfer of heat from one body to another without involving the intervening medium. She came across this in physics rather than chemistry, of course, in the days when we all studied physical sciences from several points of view. In both the United Kingdom and New Zealand, these days are no more, with the result that today's chemistry students often have only the most superficial grasp of the physical and mathematical principles that underpin much of chemistry. This point came home to me with some force as I read this little volume. This short text (85 pages) is one of the extensive series of Oxford Chemistry Primers, now numbering 52. This series is intended to provide accessible (in terms of both price and content) accounts of essential topics for students of chemistry and more recently, chemical engineering. This volume represents a first step into the latter field.

After a brief introduction, the book's four main chapters address the topics of conduction, forced and natural convection, and radiation. An appendix contains a limited range of experimental and mathematical data. The approach throughout is very much that of the engineer: starting with the mathematical statement of a phenomenological relationship (Fourier's law for conduction or Newton's law of cooling for convection, for example), the author works through the consequences in a range of more or less practical applications. One can find connections with chemistry (the effectiveness of a standard reflux condensor is a problem of conduction and forced convection, for example), but chemical engineers will find much more of value and interest. Each chapter features a list of further readings, worked examples and problems. For me, the most interesting section was an estimate of the magnitude of the greenhouse effect in the chapter on radiation. However, chemists like to think at a molecular level and for us there is not a great deal in the way of interpretation or justification; Planck's law for black-body radiation, for example, merits a brief "the start of what later became known as quantum theory".

Presumably for reasons of economy, the layout of the book lacks the visual appeal of many modern texts - no colour, no plates and little historical context. There are also more irritating typographical errors than one might expect. A 10 minute scan turned up missing parentheses, powers of 10 not superscripted, mathematical quantities not italicised, and "Botzmann" for Boltzmann". Finally, one must also wonder about the market for volumes like this. Even at a very modest $18.95, the material covered must represent such a limited fraction of a standard chemical engineering course that a comprehensive set would far exceed the typical $100 for a general text. In conclusion, there is something of interest for the chemical engineering student and teacher in this book, but I suspect that it will find its way onto the shelves of few chemists.

Douglas Russell
Department of Chemistry, University of Auckland

ADVERTISERS INDEX

A.i. SCIENTIFIC (NZ) LTD	24, 47
ALLTECH ASSOCIATES	51
JOHN MORRIS SCIENTIFIC LTD	Inside Front Cover
LABSPEC	24
LABSUPPLY PIERCE	Inside Back Cover
MAF QUALITY MANAGEMENT	
- Lynfield Food and Dairy Laboratory	48
MAF QUALITY MANAGEMENT	
- National Chemical Residue Laboratory	45
SCI TECH	Inside Front Cover
SHIMADZU NEW ZEALAND	Back Cover
SIGMA ALDRICH PTY LTD	Front Cover

A&D Balances

The complete range for every application

A&D Balances are highly accurate, highly reliable and easy to use instruments, designed to meet the needs of almost every weighing application

Analytical Series

- 4 balances
- 60 to 310 gm
- 0.1 & 0.01 mg resolution
- multiple weighing units
- multiple calibration modes

Multifunction Lab Series

- 13 balances
- 210 to 8100 gm
- counting and percent functions
- rugged design and tough aluminium alloy housing
- optional RS232 and battery packs

Compact Lab/Portable Series

- 11 balances
- 60 to 1200 gm
- percent and counting functions
- multiple weighing units
- comparator function
- optional RS232 and battery packs

Labsupply Pierce (NZ) Limited

Labsupply PIERCE

AUCKLAND
OFFICE & WAREHOUSE
127 Sunnybrae Road, Glenfield
P O Box 34-234 Birkenhead
Tel: (09) 443 5867
Fax: (09) 444 7314

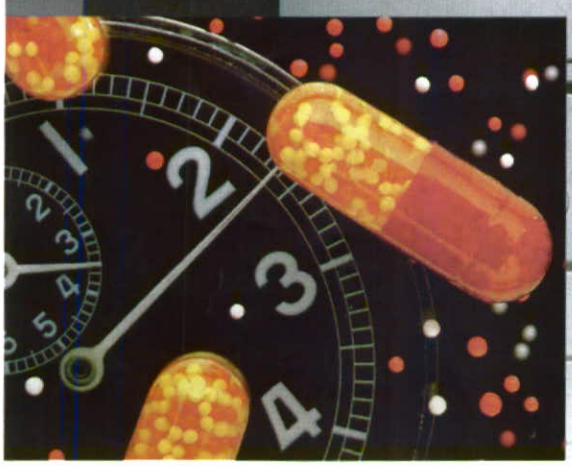
CHRISTCHURCH
OFFICE & WAREHOUSE
11B Sheffield Crescent
P O Box 20-035 Bishopdale
Tel: (03) 358 7410
Fax: (03) 358 9598

Toll Free: 0800 734100
Email: labsupply@labsupply.co.nz

circle number 5 on the reader reply card

SHIMADZU

VP Series HPLC
Smart Enough to Look After Itself



Self-Controlling

Self-Monitoring

Self-Validating

... and Intelligent Enough to Get You There Quicker

- High sample throughput with automated sample pretreatment including dilution, derivatisation, mixing and spiking
- System suitability 'Go-No-Go' feature of Class-VP™ software ensures analysis criteria are met everytime
- Error and maintenance logs built into each VP Series module monitors system components and enables customised maintenance schedules
- System controller with intuitive graphic displays enables you to tailor the screens to meet your needs

The VP Series HPLC is the smart solution for high volume pharmaceutical QC and R&D laboratories. Intelligent automation features enable high sample throughput with complete control from sample pretreatment through analysis and detection. System reliability is enhanced by greater durability of pump seals and pistons, longer lasting lamps as well as constant self-monitoring of system components.

SHIMADZU

Solutions for Science

since 1875

ISO9001 Registered

For more information call us at 0800 735 725 today

circle number 2 on the reader reply card

BUSINESS REPLY POST
Authority No. 90144

Postage Paid if
posted in NZ

ANCAT HOLDINGS LTD
P O BOX 38546
HOWICK
AUCKLAND 1730

1. SURNAME: INITIALS: TITLE:

INSTITUTION OR COMPANY:
DEPARTMENT:
ADDRESS:
TEL: FAX:
EMAIL:

2. YOUR FUNCTION (please tick)

- MANAGEMENT ☐
- RESEARCH/ DEVELOPMENTPRODUCTION ☐
- QA/QC ☐
- TEACHING ☐
- PURCHASING ☐
- CONSULTING/ADVISORY ☐
- OTHER (please specify) ☐

3. WHAT EQUIPMENT/TECHNIQUES DO YOU USE? (please tick)

GC/GC-MS	☐	HPLC/LC	☐
UV/VISIBLE SPECTROSCOPY	☐	FLUORESCENCE SPECTROSCOPY	☐
AA SPECTROSCOPY	☐	ICP, ICP-MS	☐
NMR	☐	POLYMERASE CHAIN REACTION	☐
THERMAL ANALYSIS	☐	FTIR/IR SPECTROSCOPY	☐
MICROSCOPY	☐	ELEMENTAL ANALYSIS	☐
pH/ELECTROCHEMISTRY	☐	PARTICLE SIZE ANALYSIS	☐
CENTRIFUGES	☐	MASS SPECTROSCOPY	☐
XRF or XRD	☐	OTHER (please specify)	☐

4. I WOULD LIKE TO KNOW MORE ABOUT BECOMING A MEMBER OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY. PLEASE SEND ME DETAILS.

Please tick ☐

5. I AM INTERESTED IN FURTHER INFORMATION ON THE FOLLOWING NUMBERED PRODUCTS.
(CIRCLE THE CORRESPONDING NUMBER FROM THE BASE OF THE ADVERTISEMENT OR ARTICLE)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

Chemistry in New Zealand March 1998

Find it in ...

LABSPEC

Your comprehensive guide to where to source everything for the laboratory

Available free from

Ancat Holdings Ltd
P O Box 38-546
Howick, Auckland
Ph: (09) 535-3475
Fax: (09) 535-3476
Email: info@labspec.co.nz
Website: http://www.labspec.co.nz

READER REPLY
PRODUCT INFORMATION
REQUEST CARD

Dear Reader

This postage paid card is provided so that you can request further information on the products and services featured in this publication.

Please answer all questions on the card. Alternatively you may wish to contact the supplier(s) directly.

Please tell your supplier you saw their product in *Chemistry in New Zealand.*