The 2009

Farrer Memorial
ORATION

THE GOOD OIL

Dr Rodney J. Mailer
Industry & Investment NSW

The Good Oil

Dr R.J. Mailer
Industry & Investment NSW

Introduction

Thank you for this prestigious award. This is not the first William Farrer Award ceremony that I have attended but I never expected that I would by the recipient. Although it was an exceptional surprise when I learnt about this award, I have been pleased with my input into the oils and fats industry. Hopefully the outcomes of my work have contributed in some way to Australian agriculture and the industry. My employment with the Department over 30 years has allowed me to work independently with both the agricultural community, and with industry, to cover a wide range of topics and interests. This has been an ideal environment to carry out such work.

Plant Breeding

William Farrer was well known to Australians and possibly Australia's most recognised agricultural scientist. He was a wheat breeder who worked to overcome rust in wheat and develop drought tolerance. He is accredited with establishing the Australian wheat industry. These are exceptionally accolades considering the value of wheat to the Australian economy.

Despite Farrer's achievements, his work continues as current breeders are confronted with new strains of rust and continuing problems with the harsh Australian environment. This research, from the time of Farrer, has been supported by the Australian Federal and State Governments through Departments of Agriculture and the plant breeding programs.

Although I have had little to do with wheat, I have been closely associated with the Department's canola breeding program and with the Breeder, Mr Neil Wratten, have seen the release of 22 cultivars of canola which have contributed significantly to the Australian crop. As an agricultural chemist I was initially analysing around 1,000 samples per year but as the demands increased and the technology improved, the laboratory has screened over 30,000 samples per year to permit selection for new breeding lines. The methods and scientific equipment are far more advanced (Mailer 2004) and Farrer would have been envious of the new technology.

History

I have titled this oration "The Good Oil", which in Australian slang refers to "useful or accurate information, or, the truth". I hope you agree.

The history of fats and oils spans thousands of years although in Australia the history is relatively short. Bryce Bell's book, "1908 – 2008, 100 Years of Oilseeds in Australia" describes in detail the development of the industry. In the beginning available oil types included naturally occurring fats such as whale oil and palm oil, together with imported linseed oil. Henry Meggitt produced the first oil crushing plant for linseed oil as recently as 1908. Other oil crops included cottonseed, peanuts and maize, the growing of which occurred in 1946, only 63 years ago. The main oil, linseed was used for everything from margarine to floor coverings and paint. Rapeseed was introduced in 1966. Olive trees were planted in Australia as early as 1800 although little use of olive oil is reported until much later.

Rapeseed/Canola

Rapeseed was introduced into Australia in 1966. The crop produced around 40% oil which had applications from everything from food to industrial uses. Early cultivars were poor yielding and had no resistance to fungal diseases. From 1969 to 1974, State Governments established plant breeding programs in Victoria, South Australia and New South Wales.

Rapeseed became Australia's biggest oilseed crop with the bright yellow flowers obvious in the spring throughout the agricultural regions. However the crop had restricted use due to the negative health effects reported for the long chain fatty acid, erucic acid present in the oil. The meal, a high protein source for the animal feed industry also contained antinutritional compounds called glucosinolates (Mailer *et al* 2008). Breeders in Canada released the first lines with low erucic acid and low glucosinolate levels in 1980 and they called this new type of rapeseed CANOLA.

The new canola lines were introduced into Australia to replace rapeseed. Breeding in Australia focused on disease resistance and improved quality. In this part, the Wagga Agricultural Research Institute, WARI, played a leading role in assisting all of the Australian breeding programs screening lines for low erucic acid and glucosinolate quality as well as

improved protein and oil concentration. (Mailer 1999; Potter *et al* 1999). Two of the first canola cultivars Maluka and Shiralee were released from the WARI, combining quality, disease resistance and yield. These lines were selected by the canola breeder, Mr Neil Wratten.

Canola production showed considerable fluctuation since its first introduction due mostly to adverse environmental conditions (Aksouh *et al* 2006; Si *et al* 2003). Although the majority of Australia's production initially came from NSW, today Western Australia (WA) produces as much as all of the other states combined. The quality of WA canola has also been superior with oil contents as high as 50% (Seberry *et al* 2008).
The Eastern States production has been erratic with seasonal conditions producing lower oil contents and variable yields.

Canola today is a well known household product in cooking oils and spreads. However, *Brassica napus* lines with variations to the fatty acid profile have been utilised in many applications including lubricants, paint, pharmaceuticals, polymers and cosmetics. The meal, that fraction remaining after the oil is removed, is well suited to the pork and poultry industries due to the high protein content and desirable amino acid content (Spragg and Mailer 2009).

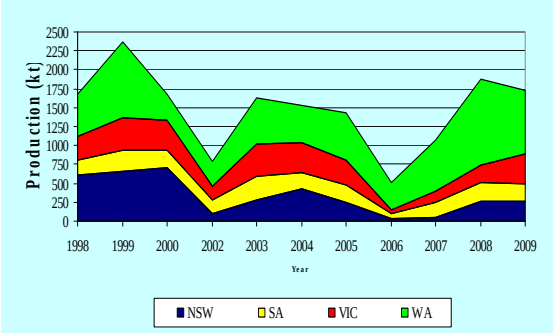

Fig. 1. Australian canola production

Olive Oil
Olive oil has been produced in Mediterranean countries for thousands of years. Olive trees were planted in Parramatta in 1800, sent as part of a consignment by Sir Joseph Banks, and this would make them the first commercial oil crop in Australia (Spennermann 2000). Trees planted by John Macarthur at Elizabeth Farm in Parramatta in 1805 are reported to still be in existence. In 1891, the Department of Agriculture established four experimental farms, one of which was at Wagga Wagga. In 1894 the Department established several groves at the experimental farms. These groves included over 55 cultivars and have been the source of many of the Australian orchards stock today.

Despite the early plantings, olives showed little development until, in 1996, there was resurgence. At that time, a workshop was held in Wagga Wagga which saw the initiation of the Australian Olive Association and my introduction to olive oil.

Oil characteristics
Despite the similarities between edible oils, including canola and olive oil, there are some important differences. The basic components of oil are triacylglycerols illustrated in Figure 2. The molecule contains a glycerol moiety to which is attached three fatty acids. These fatty acids are long chain molecules in which the carbon units are attached to each other by single or double bonds. The three fatty acids shown in Figure 2 in order from the top are referred to as a saturated, monounsaturated and polyunsaturated depending on the number of double bonds.

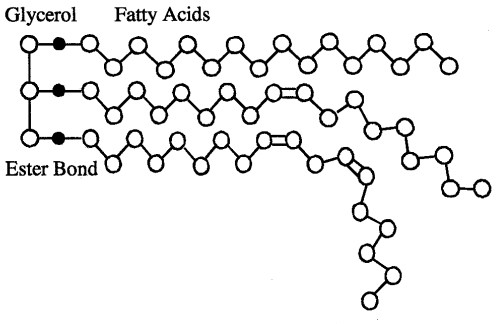

Figure 2. Triacylglycerol molecule with saturated, mono and polyunsaturated fatty acids.

Vegetable oils are composed triacylglycerols shown in Fig 2 with a mixture of fatty acids. These make up around 97% of the oil but the remainder is a complex mixture of minor components, waxes, sterols, phenolic compounds and others. In refining these minor compounds are mostly removed. For virgin oil, unrefined, the minor compounds are retained and contribute to the nutritional benefits, antioxidants and flavour.

Olive oil can be classified under many categories but the most important is virgin oil, oil which has been extracted by only mechanical means and with no chemicals or

solvents. The best olive oil quality is referred to as Extra Virgin Olive Oil (EVOO) and this is the main product targeted by Australian producers. Pomace oil is extracted with solvents from the waste material after virgin oil is removed and is generally used for soap or industrial uses.

Grades of Olive Oil

1. **Extra virgin olive oil**
   free acidity < 0.8%
2. **Virgin olive oil**
   ree acidity < 2%.
3. **Ordinary virgin olive oil**
   free acidity < 3.3%
4. **Lampante virgin olive oil**
   free acidity > 3.3%

5. **Refined olive oil**
   from virgin olive oil
6. **Pure Olive oil**

blend of refined and virgin oil

7. **Olive-pomace oil**
   from olive pomace with solvents
8. **Crude olive-pomace oil**
   olive-pomace oil
9. **Refined olive-pomace oil**
   refined from crude pomace oil
10. **Olive-pomace oil**
    blend refined pomace and virgin

Australian olive oil production is concentrated in the south eastern and south western grain belt and since 2000 has shown a dramatic increase to around 12, 000 tonnes in 2008. Although Australia produces very small quantities in world terms, it produces virtually 100% EVOO unlike European countries where refining is more common.

Early studies at the AORL in Wagga Wagga focussed on identifying and authenticating olive trees to ensure they were true to type (Mailer and May 2002).

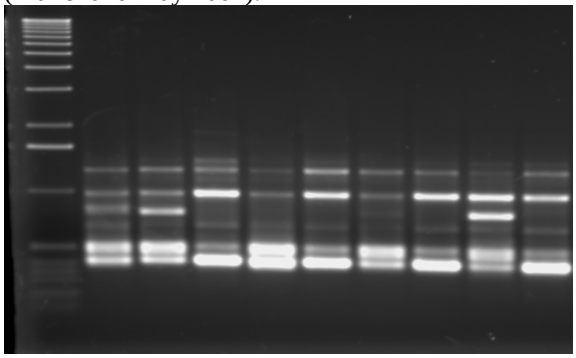

Fig 3. Comparison of DNA from nine olive cultivars

The different cultivars were evaluated to determine which types performed best under Australian growing conditions (Mailer *et al* 2002). Research at Wagga's AORL then concentrated on oil quality and helping producers meet the stringent requirements of international standards. In particular, harvest timing has been shown to be one of the most critical factors with early harvest producing pungent green oil with high antioxidant content and good shelf life. Later harvest producers more mellow oil but with reduced oxidative stability
(Mailer and Ayton 2009a).
Additionally, the time between harvesting and extraction, damage to the fruit and fruit storage has been shown to have negative effects on olive oil.

Processing is also important to oil quality with the operations of grinding, malaxing and centrifuging and controlled conditions, particularly temperature playing an role.

Current research is focussing on storage conditions for olive oil (Mailer and Ayton 2009b). Oil, unlike wine, does not improve with storage but deteriorates and should be considered as a fruit juice. Our studies have been able to identify oil which has good oxidative stability over those with low stability and therefore allow us to make decisions about the shelf life of particular oils. Studies on storage at high and low temperatures, exposed to light or dark and open or closed to oxygen is helping us provide directions to oil producers and consumers about how to manage their oil (Mailer and Ayton 2009c).

More recently, my work has focussed on authenticity in olive oil and attempts to overcome adulteration or marketing of products which do not meet the description on the product label. Screening of oils from supermarkets has revealed fraudulent practices of blending seed oil with olive oil for increased profit. Refined oil and pomace oil have also been found in bottles marketed as extra virgin olive oil. A new code of practice, introduced by the Australian Olive Association is designed to overcome this and the Wagga AORL will play a strong role in enforcing the code.

Perhaps the final hurdle for the Australian olive industry is to confront international standard which fail to recognise the natural variability which exists in olive oil, or other products grown in diverse environments such as Australia (Mailer 2007; Mailer and Ayton

2007). Australian oil has been rejected from Europe as it does not meet standards established based on oil grown in traditional countries. The variability accounts for excellent quality and diversity in Australian product and my efforts have focussed on having international standards such as Codex Alimentarius modified to accept that diversity.

In recent years, scientists have studied fats in human health with not always producing clear outcomes. Debate about the benefits or harmful effects of oil products, particularly saturated fat, monounsaturates, trans fatty acids and cholesterol are not always conclusive. Consumers are confused about what products are best and which ones to avoid. It is the continuing role of scientists to determine benefits and harmful effects of these products and to educate the public. Understanding of the products will ensure they are used accordingly to improve the problems of obesity, diabetes, heart disease and other issues.

Australia produces several oil crops in addition to canola and olives discussed here, including sunflower, safflower, soy and cottonseed oil (Mailer 2005). Public breeding programs have been crucial to the development of these crops through support from State and Federal funding and infrastructure. Private breeding programs are now carrying on that selection, continuing to improve resistance and improve drought tolerance as did William Farrer. There are some concerns that private breeding may reduce selection pressure for minor desirable traits in favour of more lucrative ones with the goal of marketing cultivars. This was less apparent in Government funded programs where financial returns on intellectual property was not so critical.

Government must maintain support for impartial and broad character selection in breeding lines, divorced from immediate financial gain. Public breeding, which includes the work of breeders, pathologists, chemists, agronomists and others is as important today as it was when William Farrer devoted his life to the development of wheat.

References

Ayton, J., R. J. Mailer, A. Haigh, D. Tronson, D. Conlan. 2007. Quality and oxidative stability of Australian olive oil according to harvest date and irrigation. *Journal of Food Lipids* 14:138-156.

Mailer R.J., Ayton, J. and Conlan D. 2007. Influence of harvest timing on Olive (Olea europaea) oil accumulation and fruit characteristics under Australian conditions. *J. Fd Agric. & Environ.* Vol 5. (3 & 4): 58-63.

Mailer R. 2007 Setting Quality Standards for Australasian Olive Oils. *In* "A Handbook of Australasian Edible Oils". Chapter 4. (Ed. O'Connor, Lal and Eyres). Oliver Young Publishing, Auckland. ISBN 978-0-473-12283-6.

Mailer R. 1999. Product Quality. *In* Canola in Australia - the first thirty years. Salisbury, Potter, McDonald and Green. *ISBN* 0-646-38131-8.

Mailer R.J. 2005. Oilseeds Overview, *In* "Encyclopaedia of Grain Science" (Ed. Wrigley, Corke and Walker). Vol 2. Elsevier Academic Press, Amsterdam. pp 380-386

Mailer, R.J. 2004. Rapid evaluation of olive oil by NIR reflectance spectroscopy. JAOCS. **81**(9):823-827

Mailer, R.J. and Ayton, J. 2008. Compliance of Australian olive oil to international standards. RIRDC Final Report

Mailer, R.J. and Ayton, J. 2009a. Optimal harvest, irrigation and storage conditions for olive oil. RIRDC Final Report. In preparation.

Mailer, R.J. and Ayton, J. 2009c. Shelf life and oxidative stability in olive oil. RIRDC Final Report. In preparation.

Mailer, R.J. and Ayton, J. 2009b. The effect of storage in flexible plastic bags on olive oil quality. RIRDC Final Report. In preparation.

Mailer, R.J. and May, C.E. 2002. Variability and interrelationships of olive trees and cultivars using RAPD analysis. *Advances in Horticultural Sciences*. (16)3-4: 192-197.

Mailer, R.J. Ayton, J. and Conlan, D. 2002. Comparison and evaluation of the quality of thirty eight commercial Australian and New Zealand olive oils. *Advances in Horticultural Sciences.* (16)3-4: 259-256.

Mailer, R.J.,McFadden, A. and Ayton J. 2008 Anti-nutritional components, fibre, sinapine and glucosinolate content, in Australian canola (Brassica napus L) meal. JAOCS

Aksouh, N. M. Campbell, L.C. and Mailer, R.J. 2006. Canola response to high and moderate temperature stresses. *Canadian Journal of Plant Science*. Volume 86, Number 4, October 2006

Potter, T., Mailer, R., Wratten, N. and Salisbury. 1999. Variety Testing. *In* Canola in Australia - the first thirty years. ed. Salisbury, Potter, McDonald and Green. *ISBN* 0-646-38131-8.

Seberry, D., Mailer, R.J., and Parker, P. 2008. *Quality of Australian canola*. Australian Oilseed Federation publication ISSN 1322-9397.

Si, P., Mailer, R., Galwey, N. W. and Turner, D. W. 2003. Influence of genotype and location on oil and protein concentrations of canola (*Brassica napus* L.) grown across southern Australia. *Australian Journal of Agricultural Research*. **54**:397-407.

Spennemann, D. R. 2000. Centenary of olive processing at Charles Sturt University. Charles Sturt University Publication. Wagga Wagga. ISBN 1 86467 070 3

Spragg, J. & Mailer, R.J. 2009. Effects of Processing on canola meal. Part II AOF Report.