9th Wartburg Symposia on Flavour Chemistry and Biology 13th - 16th April 2010, Eisenach, Germany

FINAL REPORT to

GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: **GWT 09/11**

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1 Abstract:

The 9th Wartburg Symposia on Flavour Chemistry and Biology was held in Eisenach, Germany from April 13th to 16th 2010 and attracted more than 150 delegates from 18 different countries. The conference discussed flavour compounds from a chemical and biological view and how they interact with the olfactory system, with an emphasis on the following themes:

- Biochemistry and neurophysiology in olfaction and taste
- Multifunctionality of flavour compounds
- Chemistry and analysis of aroma and taste molecules
- In vivo measurement of flavour perception
- Chemometrics and metabolomics in flavour research
- Flavour biotechnology and genomics

This travel grant enabled participation in the conference via a poster presentation titled: “Identification of Smoke Derived Volatiles in Grapes and Wine by Gas-Chromatography-Olfactometry”.

2 Executive Summary:

The travel funding allowed me to attend and participate (with presentation of a poster) at the 9th Wartburg Symposium on Flavour Chemistry and Biology held in Eisenach, Germany in April 2010. The Wartburg Symposium was founded in 1978 by Dr. M. Rothe and has convened every three years. This symposium is internationally recognised as one of the top symposia on flavour chemistry and biology. Over the four days the program contained ten plenary lectures, 32 short talks and 55 posters. Around 140 people attended the conference and the symposium was divided into six main subject areas concerning diverse topics such as; biochemistry and neurophysiology in olfaction and taste; multifunctionality of flavour compounds; chemistry and analysis of aroma and taste molecules; in vivo measurement of flavour perception; chemometrics and metabolomics in flavour research; and flavour biotechnology and genomics

The presentations were diverse and given by top researchers from around the world in areas of wine chemistry, flavour and fragrance development and some interesting sensory studies on investigating olfactory system functions and new technologies for various research applications. There were also talks from early career researchers and PhD students showcasing projects involving 2D NMR, FAST-GC-MS and even construction of an artificial crushing finger to identify volatiles of medieval plants that could be used as new flavourings in the food industry.

The lunch breaks, poster sessions and symposium dinner provided opportunities to meet with other conference delegates to discuss research interests, directions and the potential for collaboration. It is anticipated that knowledge and introductions gained through the conference will be applied to ongoing research activities, as well as to the current project, potentially with the involvement of international collaborators.

Outcomes accomplished with this project include:

- Dissemination of knowledge via a poster presentation: *Identification of smoke derived volatiles in grapes and wine by gas-chromatography-olfactometry*.
- Gaining new knowledge and ideas in wine science and analytical chemistry.
- Establishing collaborative links with researchers sharing similar research interests.

3 Background:

'Smoke taint' is an emerging field of chemistry, and is therefore of significant international interest to both the scientific community and broader wine industry. The Wartburg Symposium attracted some of the world's leading flavour chemists and biologists, providing a forum to discuss and present the latest developments in flavour research; as such, it represented an excellent opportunity to disseminate my PhD research findings, to learn about new analytical techniques and to establish international collaborations. This project sought funding to assist with travel costs associated with attending the 9th Wartburg Symposia in Eisenach, Germany.

4 Project Aims and Performance Targets:

The aim of this project was to attend and participate in the 9th Wartburg Symposium on Flavour Chemistry and Biology (http://wartburg.congress-services.com), held in Eisenach, Germany from April 13th to April 16th 2010. The specific objectives accomplished included:

- Dissemination of knowledge via a poster presentation of my PhD research titled: *Identification of smoke derived volatiles in grapes and wine by gas-chromatography-olfactometry*. (See Appendix 5).
- Gaining new knowledge and ideas to address the issue of smoke taint; for example new analytical methods for the identification of volatile smoke components in grapes and wine.
- Establishing collaborative links with researchers sharing similar research interests.

The importance of this travel to my research was two-fold: (i) to be able to present my topical research to the wider scientific community and to obtain input into my work; and (ii) to build important contacts with these people who will help me to gain the knowledge for my PhD, as well as for future career goals and opportunities.

5 Method:

Dissemination of knowledge was achieved formally via a poster presentation during the conference and informally via discussions with other conference attendees. The posters were grouped under themes of:

- Biochemistry and neurophysiology of taste and olfaction
- Oral physiology and flavour perception
- Structure/activity in odour and taste perception
- Key food odorants and beyond

- Analysis and chemistry of aroma and taste compounds
- Formation of flavours from precursors
- Flavour biotechnology and metabolism

The poster sessions were held over two days of the conference and were of a very high standard. There was considerable interest by all who attended and delegates were keen to discuss their work and obtain handouts or leave business cards with people interested in their work. The best poster prize was awarded to Natoiya Lloyd from Adelaide University for her work on “The role of yeast in the generation of the odourant damascenone in wine”. Natoiya’s project concerns the potent odourant damascenone which has the fruity odour of ‘stewed apples’ and investigated its formation from various precursors during fermentation.

I gained some ideas in my poster session from various people viewing my poster about trialling other ways of hydrolysis to release the volatiles of interest. This was something that I had been thinking about doing and to be given feedback that this would be an idea worth pursuing was promising. It will be good to trial hydrolysis under enzymatic conditions also. One person viewing my poster also said that I could perhaps look at base hydrolysis as an alternative to the acid hydrolysis that I had used to see if that results in any other compounds of interest.

Based on oral and poster presentations, 2-dimentional GC-MS is gaining popularity as a new analytical technique. The application of multi-dimensional chromatographic techniques to various food and wine matrices featured in several presentations throughout the conference, demonstrating the improved separation that can be achieved.

I met and talked with several researchers from Givaudan. Givaudan are a large flavour and fragrance company that develops aroma/flavour active volatiles for consumer products. I spoke with their representatives about the company’s role and structure. Boris Schilling (Givaudan) spoke in one of the sessions about ‘smell perception: the role of peri receptor events’. The research investigated olfactory receptors and their mechanistic component. They also looked at how you can smell some compounds but others can be blocked as some receptors can be agonists and others antagonists; Givaudan is looking further into receptor technology as an industrial interest. I was also introduced to one of the chemical technicians from Leco, Christian Zühlke. His work concerns separation science products and it was interesting to talk to him and hear about some of the new instruments that they have and their possible uses and applications, particularly relating to my project. Leco is a globally-based company that, amongst other analytical instruments, looks at time-of-flight mass spectrometry, GCxGC and fast GC technologies.

Dr. Michael Backes also spoke during the symposium on ‘new umami tasting molecules based on the p-menthane scaffolds’. This talk was focussed on the fifth taste quality, ‘umami’ that has been attributed to

monosodium glutamate in foods. The research aims to reduce or replace MSG in foods, using artificial umami compounds. Backes group have taken a synthetic approach starting with the preparation of terpene-like structures and an amide moiety they found was also important for the umami sensation. They also investigated neomenthal derived candidates and conducted some receptor based studies and found that the p-menthane scaffold with an amide or amide-like structure influenced umami taste.

The sudden disruption of the volcano eruption in Iceland delayed our return home. Initially it was an unwelcome setback, but it provided a unique opportunity to visit Symrise. This flavour and fragrance company had one of their buildings located in a small town in Germany called Holtzminden. Our extended trip allowed us to meet with one of the Symrise managers working in "flavour science and new molecules", "research and innovation" and "flavour and nutrition": Dr. Michael Backes and also one of the PhD students Katja Obst. It was a good experience to discuss Katja's work and to tour the Symrise facilities. It was interesting to see how they extract and identify various new compounds. It was very applicable to the work I am doing with smoke taint in wine. The range of analytical equipment available in their laboratory was very impressive, including their various extraction methods. They also had an interesting machine used for LC-taste; i.e. similar to my work using GC and a human detector for smelling, they use LC and a human detector for tasting the compounds that elute. This was fascinating to learn about and good to be exposed to some new techniques and instrumentation that is available.

6 Results/Discussion:

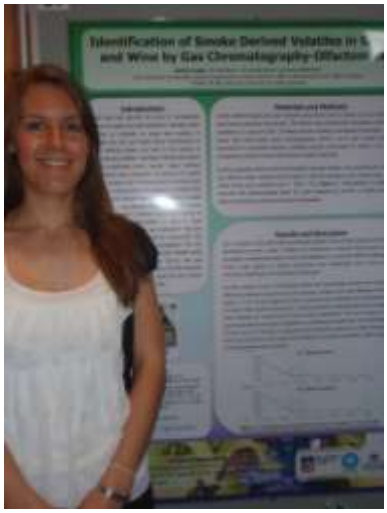
Not applicable

7 Outcome/Conclusion:

The 9th Wartburg Symposium on flavour chemistry and biology featured 42 oral and 55 poster presentations. The conference was divided into 6 themed sessions. Experts were invited from different areas of smell and taste research and plenary lectures were given by expert researchers from academia and industry from around the world. Of particular interest from wine and grape perspectives were presentations given by; Terry Acree (Cornell University, USA) 'The flavour chemistry of Riesling', Vincente Ferreira (University of Zaragoza, Spain) 'The influence of wine volatiles on wine taste and of wine non-volatiles on wine aroma', Peter Winterhalter (Technical University Braunschweig, Germany) 'Generation of norisoprenoid volatiles: recent advances', David W. Jeffery (The Australian Wine Research Institute, Australia) 'Formation of varietal thiol aroma compounds in wine; synthetic and analytical studies of grape and wine thiol conjugates' and Kerry Dungey (The University of Adelaide, Australia) 'Accumulation of guaiacol glycosides in grapes following vineyard exposure to smoke'.

The conference allowed me to present my research findings and with extra time due to the volcano I was able to have some useful discussions with several scientists and other PhD students in the flavour chemistry and biology field. During the poster sessions I received some useful feedback on my research and will pursue those ideas. The introduction and tour of Symrise were important and allowed me to gain

new ideas for my project and also some possible new techniques or collaborations with people in the flavour industry. The talks by researchers looking at identifying and quantifying various aroma compounds in different foods and beverages allowed me to be exposed new technologies, equipment and methods that could be utilised in my project, such as 2D-GC-MS. This information has since been disseminated locally through Wine Science and Business research group meetings.



Picture: Presentation of my poster at the poster session.

8 Recommendations:

The conference enabled the identification of new analytical techniques relevant to smoke taint research; in particular, two-dimensional gas chromatography-mass spectrometry (GC-MS) techniques. GC-MS is a powerful technique for the qualitative and quantitative compositional analysis of highly complex matrices, including grape juice and wine. Wine analysts rely on sharp peaks and baseline resolution of volatile analytes of interest, but in reality, the chromatographic analysis of complex matrices, such as wine, is challenging due to the vast number of chemical components present; each with different polarity, volatility, solubility, molecular weight and concentration. Given the complex nature of both smoke and wine, 2D-GC-MS was identified as a new technique with potential for application to smoke taint research.

9 Appendix 1: Communication:

Not applicable - The knowledge and ideas gained from participation at the Wartburg Symposia have been outlined within this report and disseminated via a presentation to colleagues in my research group at the University of Adelaide.

10 Appendix 2: Intellectual Property:

Not applicable - This project has no intellectual property attached to it.

11 Appendix 3: References:

Not applicable

12 Appendix 4: Staff:

Anthea Fudge, The University of Adelaide

13 Appendix 5: Abstract of conference presentation:

Identification of Smoke Derived Volatiles in Grapes and Wine by Gas Chromatography-Olfactometry (GC-O)

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Smoke taint has become an issue of considerable concern for grape and wine producers, following major bushfires in proximity to some wine regions in Australia, the United States of America and South Africa. Fermentation of smoke affected grapes can lead to the release of smoke derived volatiles [1], resulting in tainted wine which exhibits undesirable 'burnt', 'smoky', 'bitter', 'ashtray' and 'smoked meat' characters. [2] At present, the volatile phenols guaiacol and 4-methylguaiacol are being used as marker compounds for the detection of smoke taint in wine; these phenols have been identified in wines made from smoke affected grapes, but not in control (unsmoked) grapes. [3] However, since the presence of guaiacol and 4-methylguaiacol in wine is more commonly associated with oak maturation, [4] they are unlikely to be solely responsible for smoke taint; the current study describes the identification of other smoked derived volatile compounds using gas chromatography-olfactometry and gas chromatography-mass spectrometry techniques.

Smoke affected grape juice was extracted using XAD-2 resin to obtain a pool of glycosidic (and other bound) precursor compounds. This fraction was subsequently hydrolysed (under mildly acid conditions) and the resulting hydrolysates were fractionated by reverse-phase high performance liquid chromatography. GC-O and GC-MS analysis was conducted on those hydrolysate fractions exhibiting aromas reminiscent of 'smoke' in an attempt to elucidate the identity of new smoke derived volatile compounds. Details of this study will be presented; the outcomes of which are expected to assist the wine industry in understanding and managing smoke taint.

1. K.R. Kennison, M.R. Gibberd, A.P. Pollnitz, K.L. Wilkinson, Smoke-derived taint in wine: The release of smoke-derived volatile phenols during fermentation of Merlot juice following grapevine exposure to smoke, J. Agric. Food Chem. 56 (2008) 7379-7383.

2. *The Australian Wine Research Institute, Annual Report*, Høj, P., Pretorius, I. and Blair, R. Eds; Adelaide, Australia: The Australian Wine Research Institute, 2003; 37–38.

3. K.R. Kennison, K.L. Wilkinson, H.G. Williams, J.H. Smith, M.R. Gibberd, Smoke-derived taint in wine: Effect of postharvest smoke exposure of grapes on the chemical composition and sensory characteristics of wine, J. Agric. Food Chem. 55 (2007) 10897-10901.

4. Chatonnet, P.; Boidron, J. N. Dosages de phénols volatils dans les vins par chromatographie en phase gazeuse. *Sci. Aliments* **1992**, *8*, 479-488.

14 Appendix 6: Budget Reconciliation:

The Budget Reconciliation has been provided separately using GWRDC Form B.