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## Genomics Programs

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### Grape and Wine Genomics

Field of Activity:	Agriculture
Project Leader:	Drs. <a href="#">Steven Lund</a> and <a href="#">Hennie van Vuuren</a>
Involved Institutions:	University of British Columbia
Approved Project:	\$3.44 million
Technology Applications:	Wine production

#### Summary

Wine brings pleasure and is also becoming an important Canadian agricultural product. The Canadian wine industry, accounting for about \$4.2B in sales each year, began to thrive on the world stage in the 1990s following a switch from the native *Labrusca* grapes to the European *Vinifera* varieties. Exports of Canadian wine, primarily to the U.S. and Taiwan markets, accounted for \$832M. Canadian wine making creates many jobs among the growers, suppliers, distributors, and service providers that comprise the industry.

Wine making traditionally has been regarded as more of an art than a science, subject to the vagaries of nature and insulated from the advantages of scientific study. This is changing rapidly. The application of new genomics and related techniques now make it possible to uncover fundamental gene functions in wine grapes and yeasts. These methods are already leading to the development of protein biomarkers that can assist viticulturists to monitor how the vine and berries respond to natural and human-made environmental changes along each season, ultimately allowing greater consistency in high value wine grape production.

Yeast has been studied as a model organism for more than 40 years and was the first eukaryote whose genome was fully sequenced. The functions of 5,000 of the 6,000 genes in *S. cerevisiae* have been elucidated. During wine making, yeasts are exposed to many stress conditions such as osmotic pressure, nutrient limitation and ethanol. We have recently discovered that yeast cells adapt to wine making stress conditions by switching on 62 genes of unknown functions which we named Fermentation Stress Response genes. Our objective is to discover function for each of these 62 genes.

New technology in the wine industry brings new questions about where science and society interact. First, are Canadian wine producers willing to adopt new technology for both berry growing and wine production and how does their adoption of new genomic technology compare with their competitors in other countries? Second, are members of the public willing to purchase wine products that apply certain genomics technologies and what determines these preferences? For wine-making, neither of these questions has

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straightforward answers because of traditional artisanal methods of production, concerns for purity and subjective notions of quality in pricing and consumption.

Our ethical and social research group will approach these questions on two fronts. First we will identify and highlight areas of similarity between the BC and Canadian wine industry and any patterns of successful introduction of new technologies found in other countries. This will help identify and possibly correct barriers to innovation present in the BC and Canadian berry growing and winemaking sectors. Some of this information will come from looking at wine producers' attitudes towards adopting new genomics-based methods in Canada and comparing them to other key wine-producing countries.

Second, we will survey citizens/consumers and others regarding their attitudes toward the introduction of genomic technologies in the Canadian wine industry and we will conduct comparative studies of public opinion both in Canada and in other wine-producing countries. We will take care to explain the difference between using genomics solely as a diagnostic tool, such as determining important genetic markers in food production, and the more intrusive application of genetics through modification of food products. We will investigate how citizens' socio-economic characteristics, political attitudes and views on a range of biotechnological innovations shape their openness to and support for the specific genomic technologies being developed in the *Grape and Wine Genomics* project.

These studies will help the Canadian industry and regulatory bodies better understand public concerns regarding the use of genomics technologies in the production of wine and the general food industry. In the long run, this knowledge will be important in guiding appropriate and responsible ways of introducing genomic technological innovations to the wine industry.

#### More on the Science

Our project will apply genomic and genetic techniques to the study of important wine varieties. Specifically, we will do the following:

- 1) clarify how nitrogen fertilization affects hormone regulation of metabolic pathways important for berry ripening, chemical composition and wine quality;
- 2) determine the relationship between gene expression patterns and variation in amino acid composition at maturity in ripening berries;
- 3) develop biomarkers for vineyard monitoring of vine water stress;
- 4) use a systems biology approach to identify functions for each of the genes involved in the fermentation stress response and the regulation of molecular sugar and amino-acid transporters during wine fermentation; and
- 5) deliver knowledge that leads to understanding the complex scientific, policy, industry and public issues involved in the application of genomics to the wine industry.

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