

Industry allocated project number

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Indicate (X) client(s) to whom this final report is submitted. Replace any of these with other relevant clients if required.

FINAL REPORT 2013

Programme & Project Leader Information

	Research Organisation Programme leader	Project leader
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Project Information

Research Organisation Project number	IWBT W 10/01
Project title	Investigating the correlation between chemical, sensory and consumer preferences of selected South African wines: Implementation of novel software

Fruit kind(s)	Grapes and wine		
Start date (mm/yyyy)	01/01/2010	End date (mm/yyyy)	31/12/2012

Project keywords	
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Consumer sensory novel software

Approved by Research Organisation Programme leader (tick box)

THIS REPORT MUST INCLUDE INFORMATION FROM THE ENTIRE PROJECT

Executive Summary

Give an executive summary of the total project.

The strong research focus on wine sensory and consumer aspects was relatively new for wine research in the South African (SA) wine industry when this project was launched in 2010. Therefore, a considerable effort was made to develop, test and optimise methods in these fields, as relevant to wine science. A large volume of outputs related to the chemical, sensory and consumer aspects of SA Chenin blanc was generated; both of academic importance in the form of postgraduate student training and publications, but also of industry benefit, as detailed in the relevant sections of this report. Also of importance are the multi-skilled students trained (chemical, sensory and consumer) that have taken up positions in industry where these skills are now applied in their working environments. The combination of chemical, sensory and consumer profiling was found to be popular with post graduate students who see career opportunities with training in these aspects, as is evident by 5 postgraduate students that have been trained in this project and three of those are currently employed at private cellars to use the skills gained during training.

Of outstanding value was the excellent collaboration between relevant role players from the SA wine industry, particularly the Chenin blanc Association (CBA), private cellars, Veritas Show organisers, individual winemakers and the research team at Stellenbosch University (SU). The significant input of our international collaborator, specifically in the person of program leader Tormod Naes from Nofima Mat, Norway, cannot be overemphasised. Valuable contributions from the Statistical Consultation Centre US (Martin Kidd) and consumer expert De Wet Schutte, Cape Town University of Technology, were also obtained.

Some 80 cellars participated in the project; more than 220 commercial Chenin blanc wines were tested. Toward this end, the CBA made a significant monetary contribution in that most of the wines were donated. In addition, 30 Chenin blanc wine experts (mostly wine producers) and 220 non-expert consumers participated in sensory profiling and style sorting tasks at SU. In addition, some 270 consumers who attended national wine shows in Johannesburg and in the Western Cape, were interviewed on their perceptions of Chenin styles at the shows.

The frequent consultations between academic and Chenin industry role players helped to keep this project focussed on industry needs as well. Numerous meetings and planning sessions between members of CBA, other industry role players and the researchers were held and ample opportunities were generated to disseminate the information generated by the research.

I believe that valuable contributions both from an academic nature as well as of industry benefit were generated in this project. Several additions were made to our analytical, sensory and consumer research methods. Gaps that need to be addressed in future research include expansion of rapid consumer-based sensory methods, that are fit for the specific research purposes. The need to establish as strong sensory facility at DVO, SU, where the statistical skills and sensory methods are implemented to support research at SU, Nietvoorbij and private cellars, is clear. The essentiality of involving the consumer when doing sensory research has emerged from the findings of this study and the opinions gained from the consumers, served as an important driver to focus research and keep the industry benefits of the research in mind. This aspect can also be expanded in future research projects.

Summaries of the research findings and outputs are given in sections.

Problem identification and objectives

State the problem being addressed and the ultimate aim of the project.

Chenin blanc is currently the most planted grape variety in South Africa and constitutes ~19% of the total area planted with wine grapes [SAWIS, 2012]. It is believed that the wines produced from this variety have the potential to become established as world-class white wines. In recent years, South African (SA) Chenin blanc has caught the attention of local and international media and reports on this topic, have been flooding magazines, newspapers and internet blogs. However, in the academic and research environment, this cultivar has not yet received the attention it deserves. With the recent advances made in wine science with respect to chemical analytical techniques, as well as integration with sensory and consumer science, much was to be gained by the South African (SA) wine industry in focussing on the wine styles produced locally from this cultivar. This study focussed on two of the genre's specialised categories, namely sweet styles and dry and off-dry styles.

This project was centred on commercially available SA Chenin blanc wines of eight selected styles as set out under **Workplan**. The ultimate aim was to increase the knowledge related to the chemical, sensory and consumer liking aspects, and their interactions, of SA Chenin blanc wines produced by different vinification techniques and to transfer the technologies developed to industry through appropriate routes, as set out under the sections **Accumulated outputs** and **Technology development**.

To reach this aim, individual research objectives were identified and formulated to deliver, for the selected styles, on:

- (i) In-depth chemical profiling of volatile aroma and major non-volatile compounds;
- (ii) In-depth descriptive profiling of sensory attributes;
- (iii) Introduction of alternative, rapid consumer-based sensory profiling methods;
- (iv) Consumer perception analysis of Chenin wine in general and of the selected styles;
- (v) Investigation into the influence of style-related label cues on consumer liking;
- (vi) Investigation into consumers' Chenin blanc wine style preference drivers;
- (vii) Investigation into young wine consumers', "generation Y", liking of Chenin and gaining insight into their consumption habits;
- (viii) Investigation into correlations between chemical, sensory and consumer preference data to gain insight into, each individually, but also interactively;
- (ix) Active contribution towards development of novel software, *ConsumerCheck*, to facilitate data analysis for consumer preference testing and segmentation mapping. This objective was the joint responsibility of the international *ConsumerCheck* research group initiated by Nofima Mat, Norway in 2010, and in which the research at Stellenbosch University on SA Chenin blanc wines from 2010-2012, formed part.

Workplan (materials and methods)

List trial sites, treatments, experimental layout and statistical detail, sampling detail, cold storage and examination stages and parameters.

WINES

SWEET WINES (n = 34)

Analysis Round one in 2010 (n = 18): only Chenin blanc wines. Four styles: (i) natural sweet (n = 5); (ii) special late harvest (n = 2); (iii) NLH (n = 7); (iv) straw wines (n = 4)

Analysis Round two in 2011 (n = 16): only NLH wines, different cultivars. Two sub-categories: (i) NLH Chenin (n = 9); (ii) NLH Weisser Riesling, Sauvignon blanc, Chardonnay, blends (n = 7)

DRY AND OFF-DRY WINES (n = 190)

Fresh and fruity (FF), rich and ripe unwooded (RRU), rich and ripe wooded (RRW) styles, of vintages 2006- 2011, and representative of most SA Chenin blanc wine producing areas, were sourced from more than 80 cellars. Style designation was verified with producing cellars.

In the experimental design, two sub-categories were targeted:

This document is confidential and any unauthorised disclosure is prohibited.

- (i) Bush wines (n = 25). These were wines produced exclusively from Chenin blanc grapes harvested from bush vines, as verified by the producer in follow-up contact;
- (ii) All categories FF, RRU, RRW: additional 165 Chenin blanc wines, all 100% Chenin, but no further information regarding viticultural aspects, were sourced from the producers.

CONSUMER TESTS

Two types of consumer tests were done; (i) perception testing and; (ii) preference testing.

PERCEPTION TESTING:

Locations: Two locations were selected: (i) Johannesburg Wine Show, Gauteng, June 2010 (122 wine consumers, 45 males and 77 females interviewed); (ii) Robertson Wine on the River Festival, Western Cape, October 2010 (152 wine consumers, 71 males and 81 females interviewed).

Questionnaire: The surveys used questionnaires designed by our group, based on the Associative Group Analysis technique [Szalay, 1970]. Categories (n = 86) specifically generated for the six concepts; “wine”, “cultivar”, “chenin blanc”, “bush vine”, “sweet wine” and “noble late harvest wine” were used. Consumers with different levels of education, income, employment and age groups were selected.

(ii) PREFERENCE TESTING:

Effect of label cues on preference: Tasting of wines by 70 consumers were done in three ways: (i) blind, with no information about the wines provided; (ii) informed, with information regarding style and extrinsic label cues such as trellising system, age of the vineyard, wine made from bush vines, was given. Intensity ratings for liking were done on a 9-point hedonic scale.

Consumer Y preference for specific Chenin blanc wines and correlation with sociodemographic information: For this purpose the preference of 150 young wine consumers, aged between 21 and 32 year of age, were recruited. A sorting task of dry and off dry Chenin wines was used to test preferences, while demographic information was obtained with a questionnaire designed by our group.

CHEMICAL TESTS

GCFID

- (i) Method 1: standard liquid-liquid extraction using diethyl ether, n = 26 compounds per run. Higher alcohols (n = 7); esters (n = 10), fatty acids (n = 9)
- (ii) Method 2: applied to 48 wines only: liquid-liquid extraction using dichloromethane, n = 55 compounds per run. Higher alcohols (n = 10); esters (n = 16), fatty acids (n = 9), carbonyl compounds (n = 3); terpenes (n = 12); wood-derived compounds (n = 5)

GCMS

- (i) Targeted analysis for quantification of diacetyl and acetoin
- (ii) Untargeted analysis, using **dichloromethane** extraction

ENZYME LINKED ANALYSIS

- (i) Organic acid: Gluconic acid
- (ii) Sugars: glucose, fructose
- (iii) Glycerol in sweet wines

FT-MIR SPECTROSCOPY

- (i) Generation of fingerprint spectra
- (ii) Quantification of major wine parameters, pH, alcohol, VA, glycerol (dry and off dry wines), malic acid, lactic acid, titratable acidity

UV-VIS SPECTROPHOTOMETRY

- (i) Wine colour at 420 nm

SENSORY TESTS

Two methods were used; (i) classical descriptive analysis using trained panels, and (ii) rapid consumer-based sensory sorting tasks.

(i) QUANTITATIVE DESCRIPTIVE ANALYSIS (QDA)

The method of Lawless, 1999, was used. Identification and intensity rating of the attributes were done. Panellists (n = 9 to 12 people) were trained, using reference standards and Chenin blanc wines. Panel training was done over 4-6 sessions over 2 weeks. Final sensory testing was done in 3-4 replicate sessions. Attributes evaluated were visual appearance, aroma, mouth-feel and overall quality (some instances). Intensity ratings were done on a 10-point scale. Experimental designs, either complete block design, or incomplete block design, depending on the number of samples, were set up in Compusense®. Testing was done according to ISO guidelines for sensory testing and in a specialised sensory evaluation laboratory at the Department of Food Science, Stellenbosch University.

(ii) RAPID CONSUMER-BASED SENSORY SORTING TASKS

The method of Chollet, 2011, was used and sets of wines were sorted by either expert (winemakers) or novice consumers (n = 12 to 21 people), according to similarity between the wine samples that were served. For each group of wines identified in the sorting task, a short list of main sensory descriptors was also recorded by each panellist. Three sets of wines, totalling 48, were tested by three separate panels, consisting of either experts (winemakers) and novice consumers.

DATA ANALYSIS

Compusense®, PanelCheck, Consumercheck, ExcelSTAT, Unscrambler and SASS software packages were used. Distatis and Multidimensional Scaling (MDS) were done in Statistica.

REFERENCES

Lawless, H.T., Heymann, H., 2010. Sensory evaluation of food. Principles and Practices. Springer, New York. pp 227-253.

Szalay, L. B., & Bryson, J. A. (1974). Psychological meaning: Comparative analyses and theoretical implications. *Journal of Personality and Social Psychology*, 30(6), 860-870.

Chollet, S., Lelièvre, M., Abdi, H. and Valentin, D. (2011). Sort and beer: Everything you wanted to know about the instructed sorting but did not dare to ask. *Food Quality and Preference*, 22, 507-520.

Results and discussion

State results obtained and list any industry benefits. If applicable, include a short discussion covering ALL accumulated results from the start of the project. Limit it to essential information only.

Objective: (i) In-depth chemical profiling of volatile aroma and major non-volatile compounds

Results:

Profiles of aroma compounds and major non-volatile compounds were established for 190 table wines and 34 sweet wines and data were analysis for each style group, FF, RRU, RRW and sweet NLH wines.

A new GC/FID method for 55 wine aroma compounds per run in Chenin blanc wines was developed and validated.

Clear distinguishing chemical profiles were found to be associated with the individual sweet wine styles. Glucose, fructose, glycerol and gluconic acid played an important role in separation between the different sweet styles.

Advanced statistical methods based on PARAFAC showed clear correlations between chemical profiles and FF, RRU, RRW dry and off-dry style categories.

Industry benefits:

The existing analytical platform at SU for quantification of aroma compounds was expanded with a high-capacity (n = 55 compounds) method. Our standard GCFID method has been optimised for sweet wines.

Infrared spectroscopy-based calibration models for glucose, fructose and glycerol were established and can be used for rapid low cost profiling of the compounds in this style. This addition adds value to the existing portfolio of IR-based spectroscopic methods used in industry.

The FTIR spectral fingerprints together with the chemical profiles of the wines, can be used for verification of the vinification technique in Chenin wine, and has potential for the purpose of wine authentication.

An extensive chemical database for SA Chenin blanc was established and is available to industry for the purposes of benchmarking and establishment of typical ranges (minimum and maximum), for a large number of volatile and non-volatile compounds.

Statistical tools for handling of typical problems in complex chromatograms, such as overlapping peaks and shifting peaks were mastered and this skill has been added to our portfolio of data handling techniques.

All these technologies developed are transferred to industry through application of the methods in routine analysis of (i) experimental samples in other concurrently running Winetech funded projects of IWBT-DVO, (ii) ARC Infruitec projects and, (iii) wines of private producing cellars.

Objective (ii) In-depth descriptive profiling of sensory attributes

Results:

A flavour wheel for sweet Chenin blanc wines was established. Knowledge regarding occurrence and intensity of 21 sensory attributes (visual appearance, aroma, taste and mouth-feel) was generated.

An extensive list of 11 first tier and 25 second tier sensory attributes, their occurrence and intensity ratings in FF, RRU, RRW Chenin (120 wines) was established.

Clear distinctions between the sensory profiles of unwooded (FF, RRU) and wooded wines were found, but not between FF and RRU styles.

Industry benefits:

Novel insights into the sensory profiles associated with 5 major categories of Chenin wines were generated (FF, RRU, RRW, NLH)

The Wine Sensory platform was expanded with training of panellist to do QDA of Chenin blanc dry and off dry wines and sweet wines.

Monitoring panel performance with PanelCheck software was implemented successfully, and is now part of the standard operating procedure for sensory analysis at SU.

Databases on sensory attributes in sweet and dry and off dry Chenin wines were created that have been made available to industry.

The sensory style names FF and RRU, need to be revisited by the Chenin blanc industry, since these they do not provide unique descriptions and may lead to confusion amongst consumers.

PanelCheck and Compusense software packages, as well as other packages required for statistical analysis of sensory data, were mastered by the postgraduate students. These skills were transferred to industry through training of the post graduate students. Two MSc's that graduated from this program are currently employed as sensory/consumer analysts by industry.

Objective (iii) Introduction of alternative, rapid consumer-based sensory profiling methods:

Results:

The results obtained with rapid consumer-based sorting tasks were in accordance with those obtained with the classical QDA method, thereby demonstrating the potential of using much faster and lower cost sensory tests, as opposed to QDA.

The rapid consumer-based sorting tasks showed that neither expert consumers (winemakers), neither novice consumers could distinguish between FF and RRU styles.

Core sensory attributes, conveying the most important information for labelling the respective styles, have been identified.

Three sets of wines were independently tested, by different panels, each time consisting of expert consumers (winemakers) and novice consumers. In all cases tested, the results obtained compared very well between the three rounds of testing, as well as with results obtained with the classical QDA method. This confirms the overall suitability, accuracy and repeatability of this rapid profiling method.

Industry benefits:

Students were trained in the rapid consumer-based methods and implement these in their workplaces. A sustainable (cost and time) alternative to classical sensory analysis using QDA, was tested and validated.

With this sensory profiling method, the consumer's opinion is brought into account when doing sensory profiling thereby bringing the sensory profiling in direct contact with the end-user, the consumer.

Objective (iv) Consumer perception analysis of Chenin wine in general and selected styles:

Results:

Based on a total of 5261 responses obtained, significant conclusions could be drawn. Main findings are summarised below.

The position of Chenin blanc in the consumers' minds, relative to other SA cultivars, is on the lower end.

Consumers have very little knowledge of the sweet wine category.

Consumers' associations with regards to the socio-economic drivers of natural sweet wines are mainly negative, which should be addressed by industry, in a constructive manner.

In general, the responses showed a lack of knowledge and exposure to Chenin blanc wine by the respondents. Once again, coordinated action by the industry is necessary.

Interesting trends with respect to consumers' consumption habits of sweet wines, in the different demographic groups, income group, age, employment, education level, were revealed.

Industry benefits:

The benefit of being aware of these findings to the Chenin blanc Association (CBA) and SA Wine industry are clear. Upon making these findings known to the CBA, numerous initiatives aimed at rectifying negative aspects, and capitalising on the positives, have been launched by the CBA. All the above findings have been transferred to the Chenin blanc Association at various conferences presentations (see Presentations/papers delivered and Accumulated Outputs), as well as in a written report to the CBA.

Objective (v) Investigation into the influence of style-related label cues on consumer liking:

Results:

Consumers tend to associate the terms “old bush vine” and “old vine” with higher quality wines and these influence their degree of liking of the wines.

The style designations “fresh and fruity” and “rich and ripe unwooded” do not convey a clear message to the consumer, as to what can be expected when tasting the wine.

Industry benefits:

This information can be used to re-evaluate the style names FF and FFU and consider alternative routes, devices, terminology to convey style information to consumers. Efforts to really understand how consumers relate to the different styles should be made. Following these findings, the CBA has launched several initiatives to investigate options in this regard.

Objective (vi) Investigation into consumers' Chenin blanc wine style preference drivers; and Objective (vii) Investigation into young wine consumers', “generation Y”, liking of Chenin and gaining insight into their consumption habits:

Results:

A large volume of information regarding the drivers of liking and consumption habits of consumers has been generated.

Consumers and specifically the Y generation had significantly higher preferences for the wines if information about viticultural aspects and vinification techniques regarding the wines is provided.

No specific preference for one of the FF, RRU and RRW styles was found, indeed, the wines were equally liked.

The notion that consumers need to be educated regarding wine styles needs reconsideration; it is more a matter of providing information and exposure to the different products, and monitoring how consumers relate to the cues given.

Industry benefits:

The benefits of gaining a better understanding of how consumers relate to Chenin blanc wine styles and what their expectations are when choosing a specific style are clear. This information was transferred to the CBA and general public at numerous conference activities and meetings, as indicated in the relevant sections.

Objective (viii) Investigation into correlations between chemical, sensory and consumer data:Results:

This stage of the data analysis is currently being done and it is of interest, to understand how the chemical profiles correlation to sensory profiles and consumer preference data. One scientific publication is currently being prepared on this data.

Industry benefits:Objective (ix) Active contribution towards development of novel software, *ConsumerCheck*Results:

ConsumerCheck version 0.7.7 was released at the start of 2013. The software is in use by the research partners of the ConsumerCheck project and future updates will be made.

Industry benefits:

This software makes a very big contribution towards proper statistical handling, experimental design and data analysis and interpretation, for preference mapping and consumer segmentation studies. Technology is transferred through student training on this software, and via this route this expertise is transferred to industry where the graduates are employed. Students are being trained and take this expertise to their new working environments.

Complete the following table

Milestone	Target Date	Extension Date	Date Completed	Achievement
1. Chemical and sensory profiling of sweet wines, and dry and off-dry styleless	2010 and 2011		2010 and 2011	
2. Consumer perception profiling of dry/off dry Chenin blanc wine styles	2010		2010	
3. Chemical and sensory profiling of dry/off dry Chenin blanc wine styles	2010-2012		2010-2012	
4. Consumer preference test, consumption habits, consumer Y insights	2010-2012		2010-2012	
5. Consumercheck software released and updated (First edition, update)	2012, 2013		2012, 2013	
6. Journal publication/s – final milestone	2013			

Accumulated outputs

List ALL the outputs from the start of the project. The year of each output must also be indicated.

- In-depth chemical profiling of volatile and non-volatile compounds in 34 sweet wines; natural sweet, special late harvest, straw and NLH (including 16 Chenin NLH wines): 2010 and 2011.
- In-depth chemical profiling of volatile and non-volatile compounds in 190 dry and off dry Chenins 2011 and 2012.
- Establishment of Excel data base on chemical information: 2013.
- Establishment of flavour wheel for 21 sensory attributes in sweet wines: 2010
- FTIR spectral library of SA sweet wines and dry and off-dry Chenin wines: 2010 and 2011
- Sensory panels trained for quantitative descriptive analysis of 120 dry and off-dry wines 2010 and 2012.
- Establishment of Excel data base on sensory information: 2013.
- Rapid consumer-based sensory method tested and validated for dry and off-dry Chenins: 2012.
- Re-evaluation of the current style designations FF, RRU, RRW.
- Consumer perception testing done on Chenin blanc wine styles: 2010.
- Influence of label cues “bush vine” and “old vine” on consumer preference evaluated.
- Consumer Y preference for dry and off dry Chenin styles evaluated and insights gained on Consumer Y wine consumption.
- Consumercheck software released

Conclusions

It can be concluded that the results obtained in this study, contributed to a much better understanding of current SA Chenin blanc wine and its individual styles. Clear directions for future expansion are working further on the rapid sensory methods. In this study, only commercial wines were used and the direct effect of vinification techniques is often not possible to investigate in this scenario, due to blending prior to bottling. A clear need is to expand the current approach to also include investigations on the effect of vinification techniques on Chenin blanc sensory profiles, and consumer liking, through collaboration with private cellars and sampling during the winemaking process. Valuable insights were transferred to the industry, particularly CBA, regarding style designations, consumer perception and drivers of liking in this genre.

Technology development, products and patents

Indicate the commercial potential of this project, eg. Intellectual property rights or commercial product(s)

No intellectual property rights or commercial products are envisaged, since the information was made freely available to industry.

Suggestions for technology transfer

List any suggestions you may have for technology transfer

The current Excel databases on the chemical and sensory data can also be created in Access, so that the search function is enhanced.

The FTIR calibration models for chemical compounds in sweet wines can be used by cellars and laboratories where this technology is used.

FTIR spectral database of wines can be used, in combination with chemical data generated, toward authentication purposes of SA wines.

Human resources development/training

Indicate the number and level (eg. MSc, PhD, post doc) of students/support personnel that were trained as well as their cost to industry through this project. Add in more lines if necessary.

Student level (BSc, MSc, PhD, Post doc)	Cost to Project
Hanneke Botha Hons.BScAgric; Graduated Dec. 2010	R15 000
Inneke Bester MScAgric; Graduated December 2011	R17 000
Nina Lawrence MScAgric; Graduated March 2012	R0
Lindi van Niekerk MScAgric; Graduated March 2013	R34 000
Evette Hanekom MScAgric; Graduated March 2013	R0
Hanneke Botha Training as sensory technologist IWBT 2011	R7 000
Jeanne Brand Training as sensory technologist DVO 2011	R0

Publications (popular, press releases, semi-scientific, scientific)

Popular publications:

- (1) Inneke Bester. **2012**. Generation wYne: the new generation wine consumer. *WineLand* 271:96. March 2012.
- (2) Inneke Bester. **2012**. Generaie wYN: die nuwe wyngebruiker generasie. *WynLand* 271:96. Maart 2012.
- (3) Inneke Bester. **2012**. Consumers don't stress when buying wine, or do they? *WineLand* 270:86. February 2012.
- (4) Inneke Bester. **2012**. Verbruikers stres nie oor wynaankope nie... of hoe dan? *WynLand* 270:86. Februarie 2012.
- (5) Hélène Nieuwoudt, Lindi van Antwerpen, Evette Hanekom, Inneke Bester, Nina Muller & Andreas Tredoux. **2013**. Terugvoer: Omvattende driejaar (2010-2012) navorsingsprojek oor SA Chenin blanc-wyn (Deel 1). *WynLand* 283:88-89. Maart 2013.
- (6) Muller, N., Hanekom, E., Tredoux, A.G.J. & Nieuwoudt, H.H. **2013**. Nuwe, vinniger metodes om wyn sensories te karakteriseer. *WynLand* 284:78-81. April 2013.
- (7) Hanekom, E., Nieuwoudt, H.H., Tredoux, A.G.J. & Muller, N. **2013**. Etiket-inligting – beïnvloed dit verbruikerstevredenheid en wynaankope? *WynLand* 285:75-77. Mei 2013.
- (8) Andreas Tredoux, Lindi van Antwerpen, Nina Muller & Hélène Nieuwoudt. **2013**. Profiel van aromakomponente in droë en half-droë Chenin blanc-wyne. *WynLand* 286:76-79. Junie 2013.
- (9) Hélène Nieuwoudt, Lindi van Antwerpen, Evette Hanekom, Inneke Bester, Nina Muller & Andreas Tredoux. **2013**. Feedback: Comprehensive three-year (2010 – 2012) research project on SA Chenin blanc wine: Part 1. *WineLand* March 2013.
- (10) Nina Muller, Evette Hanekom, Andreas Tredoux & Hélène Nieuwoudt. **2013**. Novel sensory tools for wine characterisation. *WineLand* April 2013.
- (11) Evette Hanekom, Hélène Nieuwoudt, Andreas Tredoux & Nina Muller. **2013**. Chenin blanc label cues: do they influence consumer liking and choice of wine? *WineLand* May 2013.

(12) Andreas Tredoux, Lindi van Antwerpen, Nina Muller & Hélène Nieuwoudt. **2013**. Aroma chemistry of dry and semi-dry Chenin blanc wines. *WineLand* June 2013.

Peer reviewed scientific journal publications:

(1) Fracassetti, D., N. Lawrence, A. Tredoux, A. Tirelli, H. Nieuwoudt, W. du Toit. **2011**. Quantification of glutathione, catechin and caffeic acid in grape juice and wine by a novel ultra-performance liquid chromatography method. *Food Chemistry* 128: 1136-1142.

Peer reviewed scientific journal publications under preparation:

(1) Lawrence, N., A. Tredoux, T. Skov, H. Nieuwoudt. Untargeted GC-MS analysis of South African Chenin blanc table wines and application of PARAFAC for resolution of complex data.

(2) Nieuwoudt, H., L. van Niekerk, E. Hanekom, T. Naes, A. Tredoux, N. Muller. Chemical and sensory characteristics of Chenin blanc wine.

(3) Bester, I, N. Muller, T Naes, H. Nieuwoudt. Investigating Chenin blanc wine style preference drivers and Generation Y wine consumer insights.

Project Reports (Academic):

(1) Hanneke Botha, Hons.BScAgric (Enology), **2010**. *The consumer-perception, sensory and chemical profiling of South African Natural Sweet Chenin blanc wines*.

Published MSc Theses:

(1) Nina Lawrence, MSc (Wine Biotechnology), **2012**. *Metabolic profiling of SA Chenin blanc wines: Development of analytical methods for flavour compounds (aroma and mouthfeel) and application of chemometrics for resolution of complex analytical measurements*. E thesis available at [http://library.sun.ac.za/ SunScholar/](http://library.sun.ac.za/SunScholar/)

(2) Inneke Bester, MSc (Wine Biotechnology), **2012**. *Classifying South African Chenin blanc wine styles*. E thesis available at [http://library.sun.ac.za/ SunScholar/](http://library.sun.ac.za/SunScholar/)

(3) Lindi van Niekerk, MSc (Wine Biotechnology), **2013**. *Chemical, Sensory and Consumer profiling of South African Chenin blanc wines: special focus on dry table wines*. E thesis available at [http://library.sun.ac.za/ SunScholar/](http://library.sun.ac.za/SunScholar/)

(4) Evette Hanekom, MSc (Food Science), March **2013**. *Chemical, Sensory and Consumer profiling of South African Chenin blanc bush wines*: E thesis available at [http://library.sun.ac.za/ SunScholar/](http://library.sun.ac.za/SunScholar/)

Presentations/papers delivered

(1) Lawrence, N., A. Tredoux, H. Nieuwoudt & T. Skov. **2010**. Development of an advanced multidimensional technique for ultra-high performance liquid chromatography with photodiode array detector (UPLC-PAD) for more adequate handling of complex data in wine analysis. International Conference on Analytical Sciences, Stellenbosch. POSTER (5-9 December)

(2) Lawrence, N., D. Fracassetti, H. Nieuwoudt, A. Tirelli, W. du Toit & A. Tredoux, **2010**. Development and validation of an analytical method for the quantification of glutathione in white wine and juice by ultra-performance liquid chromatography (UPLC). International Conference on Analytical Sciences, Stellenbosch. POSTER (5-9 December)

(3) Van Niekerk, L., A. Tredoux, T. Naes, N., Muller & H. Nieuwoudt. **2010**. South African Chenin blanc wines: New insights on the chemistry, sensory profiles and consumer preference. 32nd SASEV Congress, Lord Charles Hotel, Somerset West. POSTER (18-19 November)

(4) Lawrence, N. **2010**. Development of ultra-performance liquid chromatography (UPLC) methods for the analysis of antioxidants in wine. 32nd SASEV Congress, Lord Charles Hotel, Somerset West. PAPER (18-19 November)

- (5) Fracassetti, D., N. Lawrence, A. Tredoux, A. Tirelli, H. Nieuwoudt, W. du Toit. **2010**. Quantification of glutathione in must and wine by ultra-performance liquid chromatography. 32nd SASEV Congress, Lord Charles Hotel, Somerset West. POSTER (18-19 November)
- (6) Botha, H. **2010**. Sweet Chenin blanc wines: Chemical, sensory and consumer preference profiling. 32nd SASEV Congress, Lord Charles Hotel, Somerset West. PAPER (18-19 November)
- (7) Botha, H., W.J. du Toit, A.G.J. Tredoux & H. Nieuwoudt. Consumer-perception, Sensory and Chemical profiling of South African natural sweet Chenin blanc wine. 32nd SASEV Congress, Lord Charles Hotel, Somerset West. POSTER (18-19 November)
- (8) H  l  ne Nieuwoudt, **2010**. Report back on Consumercheck studies on Chenin blanc. Annual General meeting, Chenin Blanc Association. Stellenbosch. PAPER (19 November)
- (9) H  l  ne Nieuwoudt, **2009**. Chemical, sensory and consumer profiling of South African Chenin blanc wine styles. Chenin blanc Association Annual General meeting, Stellenbosch. PAPER (26 November)
- (10) Lawrence, N., A. Tredoux, H. Nieuwoudt & T. Skov. **2011**. Improved handling of chromatographic wine aroma data. 12th Scandinavian Symposium on Chemometrics. Billund, Denmark. POSTER (7-10 June)
- (11) H  l  ne Nieuwoudt, **2012**. Driving Chenin blanc as the South African white wine category using sensory and consumer research strategies. SAAFOST seminar on Sensory and Consumer Science, Stellenbosch, PAPER (2 April)
- (12) H  l  ne Nieuwoudt, **2012**. SA Chenin blanc wine benefits from Sensometrics. 2nd South African Chemometrics Society Conference, Irene, South Africa. PAPER (9-11 May)

Technology transfer

Workshops presented and dissemination of results:

- (1) H  l  ne Nieuwoudt, **2011**. Workshop 3: *South African Chenin blanc: diversity profiles*. Thirty third Conference of the South African Society for Enology and Viticulture, Protea Hotel, Technopark, Stellenbosch (10-11 November)
- (2) Evette Hanekom, **2011**. Workshop 3: *South African Chenin blanc: diversity profiles*. Thirty third Conference of the South African Society for Enology and Viticulture, Protea Hotel, Technopark, Stellenbosch (10-11 November)
- (3) Lindi van Niekerk, **2011**. Workshop 4: *Different styles of wine. Style characterisation of dry SA Chenin blanc wine*. Thirty third Conference of the South African Society for Enology and Viticulture, Protea Hotel, Technopark, Stellenbosch (10-11 November)
- (4) H  l  ne Nieuwoudt, **2011**. Feedback: Comprehensive three-year (2010 – 2012) research project on SA Chenin blanc wine. Chenin blanc Association International Seminar, Joostenberg Conference Centre, Stellenbosch (14 November)
- (5) Evette Hanekom, **2011**. Chemical, sensory and consumer profiling of South African Chenin blanc bush vine wines. Chenin blanc Association International Seminar, Joostenberg Conference Centre, Stellenbosch (14 November)
- (6) Inneke Bester, **2011**. Generation w-Y-ne: Consumer insights & Chenin blanc wine style preference. Chenin blanc Association International Seminar, Joostenberg Conference Centre, Stellenbosch (14 November)
- (7) Lindi van Antwerpen, **2011**. Chemical and Sensory profiling of dry Chenin blanc wine styles. Chenin blanc Association International Seminar, Joostenberg Conference Centre, Stellenbosch (14 November)
- (8) Lindi van Antwerpen and H  l  ne Nieuwoudt, **2011**. Sensory and chemical profiling of dry Chenin blanc wine styles. Cape Winemakers Guild, Tulbagh (1 December)

(9) H el ene Nieuwoudt, **2012**. Feedback: Chenin blanc Wine Style Research. Chenin blanc Association Conference, Cape Town (24 September)

(10) H el ene Nieuwoudt, **2013**. Chenin blanc Wine Research. Chenin blanc Association Mini-Workshop, Stellenbosch (11 January)

Total cost summary of the project

TOTAL COST IN REAL TERMS	YEAR	CFPA	DFTS	Deciduous	SATI	Winetech	THRIP	OTHER	TOTAL
YEAR 1	2010	0	0	0	0	150 000	75 000	0	225 000
YEAR 2	2011	0	0	0	0	165 000	82 500	0	247 500
YEAR 3	2012	0	0	0	0	126 500	63 250	0	189 750
YEAR 4		0	0	0	0	0	0	0	0
YEAR 5		0	0	0	0	0	0	0	0
TOTAL		R 0	R 0	R 0	R 0	R 441 500	R 220 750	R 0	R 662 250