

CFPA Canning Fruit Producers' Assoc. <u>Submit to:</u> Wiehahn Victor PO Box 426 Paarl, 7620 Tel: +27 (0)21 872 1501 inmaak@mweb.co.za	DFPT Deciduous Fruit Producers' Trust <u>Submit to:</u> Louise Liebenberg Suite 275, Postnet X5061 Stellenbosch, 7599 Tel: +27 (0)21 882 8470/1 louise@dfptresearch.co.za	DFTS Dried Fruit Technical Services <u>Submit to:</u> Dappie Smit PO Box 426 Paarl, 7620 Tel: +27 (0)21 872 1501 dappies@dtd.co.za	Winetech <u>Submit to:</u> Jan Booysen PO Box 528 Paarl, 7624 Tel: +27 (0)21 807 3324 booyensj@winetech.co.za
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Indicate (X) client(s) to whom this progress report is submitted.
Replace any of these with other relevant clients if required.

FINAL REPORT FOR JULY 2011

PROGRAMME & PROJECT LEADER INFORMATION

	Programme leader	Project leader
Title, initials, surname	Florian Bauer	Marianne McKay
Present position	Professor	
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PROJECT INFORMATION

Project number	IWBT Y 08/15
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Project title	Investigations into Burnt Rubber Aroma in South African wines
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Industry programme	CFPA	
	DFPT	
	DFTS	
	Winetech	✓
	Other	

Fruit kind(s)	Grape/ Grapevine
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Start date (dd/mm/yyyy)	01/08/2008	End date (dd/mm/yyyy)	31/12/2011?
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Industry programme leader	
Specialist committee	
Meeting date	
Amount awarded	

PROGRAMME & PROJECT LEADER INFORMATION

	Programme leader	Project leader
Title, initials, surname	Florian Bauer	Marianne McKay
Institution	Professor	Lecturer (Oenology)
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PROJECT INFORMATION

Project number	US: 38728/ Winetech:		
Project title	Burnt Rubber Aroma in South African wine		
Fruit kind(s)	Grape/ Grapevine		
Start date (dd/mm/yyyy)	01/09/2008	End date (dd/mm/yyyy)	01/8/2011

The project aim was to investigate the ‘burnt rubber’ (BR) aroma and/or flavour claimed to be associated with certain South African wines. An important objective that has been fulfilled has been the training of an expert panel for assessment purposes, the provision of detailed sensory evaluation so that this flavour is clearly and non-ambiguously identified from amongst other, similar characteristics, and a rigorous assessment of the frequency of occurrence of the character in commercial wines in SA.

This panel has assessed a large number of wines in the Cape for the last three years at wine shows, and those brought in by the industry because they were cited as having a BR taint. During the course of these tastings, it was found that a number of common taints (herbaceousness, brett, reduction and oxidation in particular) were often mistakenly identified as BR. This suggests that many factors across the full spectrum of viticultural and oenological practices may be involved in the formation of taints that are misrepresented as BR. Volatile Sulphur Compounds are one of the known causes of BR taint but VSC analysis of wines carried out by GC-MS showed that low VSC levels were not necessarily associated with a lack of the BR taint, and that other compounds were therefore responsible. Work is ongoing in related projects to locate causative factors and compounds, as well as ways of treating affected wines.

It was concluded that there are indeed ‘BR’ related issues in SA wines, but that these do not constitute more than a small percentage of faults in wine. “Burnt, rubbery, and smoky” smells can be caused by a number of different factors which are fairly well known to winemakers such as volatile phenols from barrels or other sources, and ‘herbaceousness’ linked to cultivar characteristics and unripe fruit. The majority of affected wines, therefore, do not show off-flavours that can be described as specific to, or typical of SA wines since these taints are found in wines from most, if not all wine-producing countries. Commonly found volatile sulphur compounds (particularly DMS) produced by yeast, and during wine aging may be fully responsible for the character if found at high levels.

2. Problem identification and objectives

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

The issue of an off-flavour that is prominent in and claimed-to-be specific to SA red wines surfaced first in 2008 when a “burned rubber” (BR) character was reported by several international wine writers. Since this issue was potentially damaging to the reputation of SA

wines in one of the most important export markets, these allegations were taken up by Wines of South Africa (WOSA) and it was agreed that the presence or absence of such a problem aroma in SA wines required immediate investigation in a collaborative effort by the various university departments and several role players in the wine industry.

Objectives for the project were as follows:

1. Continuation of the expert BR panel testing of SA wines
2. Training of panel members on using spiked samples as well as samples cited as BR by those in industry.
3. Further increase of the BR database and treatment of data using statistical package to try to highlight common factors and verify or refute trends that seem to be showing in the data.
4. Development of a GC-MS method in collaboration with Vinlab for identifying possible Volatile Sulphur Compound contributors

3. Workplan (materials & methods)

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

1. Training of an expert panel using standards for a range of different taints in order to differentiate BR from other aromas (Verification of the nature of BR aroma)
2. Assessment of SA wine samples at shows, as well as samples cited as BR by those in industry, WOSA tastings and other sources
3. Statistical treatment of tasting data to try to highlight common factors and verify or refute trends that seem to be showing in the data.
4. Development of a GC-MS method in collaboration with Vinlab for identifying possible Volatile Sulphur Compound contributors

4. Results and discussion

State results obtained and list any benefits to the industry. Include a short discussion if applicable to your results.

This final discussion must cover ALL accumulated results from the start of the project, but please limit it to *essential* information.

Milestone	Achievement
1. Task 1: Verification of the presence of BR aroma	Achievement April 2010
2. The training of an expert panel for the assessment of the BR aroma in SA wines, and research samples	Panel for this project finished training Dec 2009
3. .Establishment of a database of the frequency of BR and related aromas in South African wines	Stopped June 2011
4. Assessment of frequency of occurrence of problem aroma and establishment of historic database on	Ongoing as part of additional, related

viticultural and oenological practices used to prepared the affected wines.	projects
5. Establishment of GCO-MS at SU.	Stopped December 2009
Task 6: GC-MS method development and analysis for Volatile Sulphur Compounds	Stopped June 2011

Task 1: Verification of the presence of BR aroma: (Achievement April 2010) A tasting organized in response by WOSA in 2009, which included several of the writers who had reported on the off-flavour, yielded around 10-15 faulty samples (depending on interpretation of tasting notes) out of forty tasted samples. None of the samples was identified as 'BR' by all tasters, and descriptors ranged from "green" to "rubbery" to "smoky". What was found was that the so-called BR aroma forms part of a continuum of off-odours ranging from 'green' and 'vegetative' through to 'popcorn', 'sulphurous' and 'rubbery'. As a number of these descriptors are well-recognised as applying to volatile sulphur compounds (VSCs), it was realised that VSCs may be contributing to the issue to a significant degree

Task 2: The training of an expert panel for the assessment of the BR aroma in SA wines, and research samples

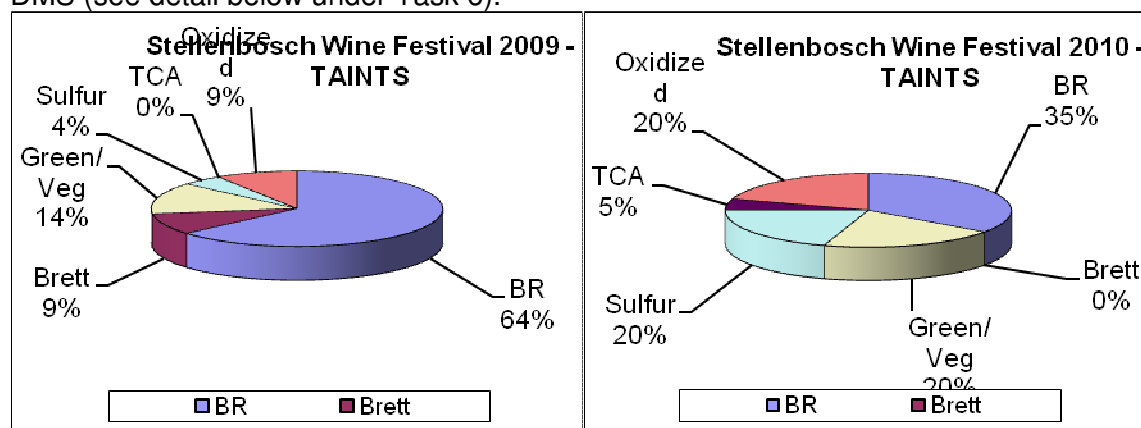
As a result of the ambiguity of results from tastings, a panel was selected and trained, with most of the foundation work conducted during 2008 and 2009. The panel tasted at wine shows and estates continuously from 2008 onwards, and have also been involved in the assessment of wines that are brought to the University showing faults. Regular alignment sessions (where recognised examples of BR wine are presented as well as a range of other related faults) were held and the agreement on identification of faults has now significantly improved although this aspect constantly needs attention.

Task 3. Establishment of a database of the frequency of BR and related aromas in South African wines

A panel of the five best BR- tasters and ten non-regular tasters was trained intensively over a two-year period to distinguish the taint from amongst other taints in wine. Over one thousand three hundred wines were tasted during this period at wine shows, and in a formal sensory environment. Many of these wines were brought to the panel because they had previously (by other tasting panels etc) been identified as presenting a problem, As a consequence, the percentages given below are not indicative of averages in SA wines, but represent a biased sample.

Approximately 20% of this large, but biased collection of wines was found to show some burned or smoky taints by the trained panel. Importantly, as a trained panel was used to detect the character even at low levels, many of these wines would not be perceived negatively in a normal tasting, and individual tasters diverged in their subjective response to the taints. Aside from "BR / rubberiness" being present in 10.5% of the samples to varying degrees, a range of other descriptors were used, including herbaceousness, tarriness, smokiness, oxidation, "brettiness", fishiness, TCA, sulphur and chemical smells and tastes. It has become very apparent that this range of aromas are often misdiagnosed as BR or may be found simultaneously with it, and it is difficult to assess their contributions separately.

Merlot, Pinotage, Cabernet Sauvignon and Shiraz were the cultivars most often affected by such issues. It is important to note that these cultivars display sensory characters that will enhance the presence of such faults (for example, Merlot and Cabernet may show some 'herbaceousness'), and that these cultivars are usually subjected to skin contact and extended maturation (often in wood), which will also have an exacerbating effect on any 'smoky' or oxidised characteristics in the wine. Chemical analysis also confirmed that many of the 'BR' wines contained volatile sulfur compounds (VSCs) such as dimethyl sulfide (DMS) that are usually fermentation-derived and well known to lead to 'burned' and 'rubbery' characters. Twelve samples that were particularly strong in taints were analysed for VSCs, and of these, six had concentrations between two and ten times the sensory threshold for DMS (see detail below under Task 6).



Stellenbosch Wine Festival 2009 vs 2010 – BREAKDOWN OF TAINTS

	July 2010		2009	
Total wines tasted	142		232	
BR	7	5%	14	6%
Brett	0	0%	2	1%
Green/Veg	4	3%	3	1%
Sulphur	4	3%	1	0%
TCA	1	1%	0	0%
Oxidized	4	3%	2	1%
Clean	122	86%	210	91%

TASTING	Vintages	Total tasted	BR	sulf/red	ox	TCA	green	brett
Red blends 2008	2001-2008	158	27	2	3	4	3	5
CAB SAUV Veritas etc 2008-2008	1999-2008	55	5	1	2	1	3	2
CAB F Veritas etc 2008-9	2005-2008	16	4	0	0	0	0	0
MERLOT Veritas etc 2008-9	2003-2008	39	3	0	0	0	0	2
SHIRAZ Veritas etc 2008-9	2003-2008	63	16	1	1	0	1	2
PINOTAGE Verit etc 2008-9	2004-2009	34	3	0	0	0	1	0
PINOT NOIR Verit 2008-9	2004-2008	10	0	0	0	0	0	2
CRWR 2009	2004-2008	58	4	2	2	1	4	2
CRWR 2010	2004-2009	58	4	0	3	1	5	5
OM PT 2010	2001-2009	67	9	1	0	0	5	0

SWF 2010	2002-2010	142	11	9	9	2	8	3
TOTALS		700	86	16	20	9	30	23

Task 4: Assessment of frequency of occurrence of problem aroma and establishment of historic database on viticultural and oenological practices used to prepared the affected wines.

Visits to wine farms to talk to winemakers and viticulturalists were initially carried out, with some interesting observations made, which has led to the development of other related projects. The use of medium-heavy and heavily toasted oak may certainly play a role in enhancing rubbery characteristics, and the role of yeast, and fermentation conditions which may cause stress to the yeast with the concomitant production of VSC precursors are also highlighted. Work on specific viticultural practices which may contribute to BR is ongoing, and forms part of another project.

Task 5. establishment of GCO-MS at SU.

Optimisation of GCO-MS at SU was initiated and requires further development. So far only solvent extracts of SA BR tainted wines have been injected, and assessed through the sniffing port. Certain areas of the chromatogram (later eluting compounds) were definitely 'rubbery' in character, but far more selective sample preparation procedures will be required to pinpoint the compounds responsible for the specific 'burnt rubber' flavour. Development and validation of new methods for potential target analytes will require time- and personnel-intensive research. Further refining of data analysis methods, and potentially training of panel members, might also be required to interpret the data. This aspect of the project was put on hold due to lack of resourcing for the GCO work.

Task 6: GC-MS method development and analysis for Volatile Sulphur Compounds

Closer analysis of these initial samples displaying a 'BR' character revealed several compounds which may have been responsible for the detected off-flavors. These included volatile phenols that are usually associated with *Brettanomyces* and smokiness, as well as the presence of volatile sulfur compounds (VSC) in some of the wines. Volatile phenols and VSCs are however commonly found in wines from all over the world, and do not constitute a SA-specific problem.

The technician first appointed for the method development, Dr B. Weldergergis, selected heterocyclic sulphur compounds for analysis, some of which have been implicated by previous workers as having 'rubbery' characters. SPME in combination with gas chromatography-nitrogen phosphorus detector (GC-NPD) was chosen for the initial development phase of investigating the presence of these compounds in wine. The method showed some promise, and further development work would probably have led to a successful extraction and transfer to GC-MS, but unfortunately Dr Weldergergis accepted a post in Belgium and left the project at extremely short notice. Analysis of VSCs was therefore handed over to Emmanuelle Lapalus at Vinlab. As can be seen below, the BR taint is sometimes, but not always associated with higher levels of VSC (particularly dimethyl sulphide), and it has been our experience that wines which are cited as BR do not necessarily have higher levels of VSCs.

CLIENT SAMPLE ID

AROMA

PC MFM	MER T14	MER T21A	MER T12	MER T22	E05
Pongy, fishy, kelp, marmite, rubber	Merlot, not much fruit, slight tarriness	Very slight fishiness, dry tannins	chemical, slightly green, astringent	Clean/ slight chemical	BR, tarry, VA

PALATE	tarry					
VINTAGE	2010	2010	2010	2010	2010	2010
METHIONOL µg/l	nd*	nd*	nd*	nd*	nd*	nd*
DIETHYLSULFIDE µg/l	nd*	nd*	nd*	nd*	nd*	nd*
BUTANETHIOL µg/l	nd*	nd*	nd*	nd*	nd*	nd*
DIMETHYLDISULFIDE µg/l	nd*	nd*	nd*	nd*	nd*	nd*
DIETHYL DISULFIDE µg/l	nd*	nd*	nd*	nd*	nd*	<0,1
ETHANETHIOL µg/l	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
(DI)METHYL SULFIDE µg/l	7,0	17,6	18,1	16,7	19,6	7,7
CLIENT SAMPLE ID	CS/MER KPF	MGR	F SB	SH PINO	HCM	LC MER
AROMA	Rubber bands, green beans, cooked veg	Marmite, wet dog	Old Riesling, vinyl straw; hay,	Rubbery, high wood	TCA, fishy, kelp	Fishy, black currant
PALATE	Bitter, harsh, rubbery		Rubber, tar	Bitterness, astringency		
VINTAGE	2006	2003	2009	2006	2006	2007
METHIONOL µg/l	nd*	nd*	nd*	nd*	nd*	nd*
DIETHYLSULFIDE µg/l	nd*	nd*	nd*	nd*	nd*	nd*
BUTANETHIOL µg/l	nd*	nd*	nd*	nd*	nd*	nd*
DIMETHYLDISULFIDE µg/l	nd*	nd*	nd*	nd*	nd*	nd*
DIETHYL DISULFIDE µg/l	nd*	<0,1	nd*	nd*	nd*	nd*
ETHANETHIOL µg/l	<0,1	<0,1	<0,1	<0,1	<0,1	nd*
(DI)METHYL SULFIDE µg/l	108,8	78,7	107,4	54,0	25,1	102,8

The issue is still under intensive investigation. Further analysis is being carried out to identify compounds in the small number of SA wines that are not affected by VSC or by any other well-characterized off-flavour causing fault, but which display a “BR” related character. Currently, approaches based on GC coupled to olfactory analysis (GC-O) as well as non-target GC-MS approaches comparing affected wines with negative samples to identify other, as yet unknown BR-causing agents are underway.

5. Accumulated outputs

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

Technology development, products and patents

Indicate the commercial potential of this project (intellectual property rights or a commercial product(s)).

GC-NPD method for detection of selected Volatile Sulphur Compounds at ARC Nietvoorbij
(Possible publication as a result of the work: Development and validation of analytical methods for the analysis of sulfur-containing compounds in South African wines by Berhane T. Weldegergis

Human resources development/training

Indicate the number and level (e.g. 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.

Sensory panel training for five regular (expert) and ten non-regular tasters in BR identification
Berhane Weldergergis in GC-NPD at ARC-Nietvoorbij
Valeria Panzeri in ongoing management of the tasting database, and in Sensory Evaluation statistical software

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

Article in Winetech News:

McKay, Panzeri and Bauer: Burnt Rubber Facts and Fiction, wineland Magazine, April 2011

Presentations/papers delivered

McKay: 2007, 2008, 2009, 2010: Regular presentations on Burnt Rubber to industry via SASEV conferences and Workshops.

4. Total cost summary of project

	Year	CFPA	Deciduous	DFTS	Winetech	THRIP	Other	TOTAL
Total cost in real terms for year 1								
Total cost in real terms for year 2								
Total cost in real terms for year 3								
Total cost in real terms for year 4								
Total cost in real terms for year 5								
TOTAL								

Patents

NA

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

Presentations/papers delivered

McKay, M.A. 2008. Burnt Rubber Aroma research at Stellenbosch University. SASEV Workshop: Chemical taints in the SA wine industry: trends and developments. Infruitec, Stellenbosch. [12 Sep]

5. Budget for the 4th year: 2011 (IWBT Y 08/15: Burnt Rubber)

	CFPA	DFPT	DFTS	Winetech	THRIP	Other	TOTAL
PROJECT FUNDING REQUIRED FOR 4th YEAR: TOTAL				R 80,000	R 40,000		R 120,000
Overheads (only if part of project costs)				R 5,000	R 2,500		R 7,500
Personnel costs				R 50,000	R 25,000		R 75,000
Running costs				R 25,000	R 12,500		R 37,500
Local travel and accommodation							
Local conferences (only specify separately for THRIP purposes)							
Equipment (capital items*) [List capital items HERE]							
Other							

* Industries will only fund capital items under exceptional circumstances

6. Total estimated budget for project (insert actual cost if available)

	Year
Total cost in real terms for year 1	2008
Total cost in real terms for year 2	2009
Total cost in real terms for year 3	2010
Total cost in real terms for year 4	2011
Total cost in real terms for year 5	
TOTAL	

CFPA	DFPT	DFTS	Winetech	THRIP	Other	TOTAL
			R 61,000	R 28,975		R 89,975
			R 120,000	R 60,000		R 180,000
			R 50,000	R 19,350		R 69,350
			R 80,000	R 40,000		R 120,000
			R 311,000	R 148,325		R 459,325

EVALUATION BY INDUSTRY

This section is for office use only

Project number:

Project title:

Name of Subcommittee*:

Comments on project:

Committee's recommendation:

- Accepted.
- Accepted provisionally if the subcommittee's comments are also addressed.
Resubmit this progress report by _____
- Unacceptable. Must resubmit progress report.

Chairperson: _____

Date: _____

*SUBCOMMITTEES:

Winetech

Viticulture: Organic Cultivation and Production; Cultivation; Soil Science; Plant Biotechnology; Vine Virus Committee; Plant Protection; Plant Improvement; Resource Poor Producers

Oenology: Production Technology; Bottling, Packaging & Distribution; By and Waste Production Handling; Brandy and Distilling; Microbiology

Deciduous Fruit

Producer Research Advisory Committees (RAC's): Pome fruit, Stone fruit, Table grapes

Peer Work Groups (PWG's): Biotechnology, Breeding & Evaluation (Pome Fruit), Breeding & Evaluation (Stone Fruit), Entomology, Horticulture, Pathology, Post Harvest, Soil Science, Table Grape Production