Vitis 19, 338—345 (1980)

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The effect of mechanical harvesting on wines of Chenin blanc grapes in South Africa

by

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Der Einfluß der maschinellen Traubenernte auf den Wein der Sorte Chenin blanc in Südafrika

Zusammenfassung. — In einem Versuchsweinberg des Oenological and Viticultural Research Institute, Stellenbosch, wurden die Rebzeilen abwechselnd maschinell und von Hand gelesen. Der Einfluß der Lesetemperatur, der Wartezeit der Trauben zwischen Lese und Weinbereitung sowie der Verunreinigung (MOG) des maschinell geernteten Lesegutes auf die Weinqualität wurde untersucht; die so gewonnenen Weine wurden mit Weinen aus handgelesenen Trauben verglichen. Es zeigte sich, daß bei einer Steigerung von Lesetemperatur, Wartezeit der Trauben und MOG-Anteil der Gesamtpolyphenolgehalt in den Weinen zunahm. Diese Faktoren wirkten sich auch auf die sensorisch ermittelte Weinqualität nachteilig aus. Bei einer Wartezeit bis zu 4 h war bei niedrigem oder hohem MOG-Anteil kein ungünstiger Einfluß auf die Weinqualität nachweisbar, vorausgesetzt, daß die Trauben bei niedriger Temperatur gelesen wurden. Um bei höheren Lesetemperaturen Weine ähnlich guter Qualität zu erzielen, durfte die Wartezeit 3 h nicht überschreiten und mußte der MOG-Anteil niedrig sein. Bei hohem MOG-Anteil war die Weinqualität dagegen beträchtlich verringert, auch wenn die Wartezeit nur 1 h betrug.

Introduction

Chenin blanc comprises 25 % of all vines planted in the Republic of South Africa with a total of nearly 80 million vines of this cultivar under cultivation in all the major wine producing areas. It therefore stands to reason that if mechanical harvesting was to be practiced in South Africa, Chenin blanc would have to be the major cultivar to be subjected to this practice. Studies of cultivar response to mechanical harvesting of numerous varieties were done in 1976 at the Oenological and Viticultural Research Institute, Stellenbosch. Detail studies included the effect of material other than grapes (MOG) of mechanically harvested South African Riesling grapes on the quality of wine (Wagener 1977). Chenin blanc could not be included at that time. The only other work on Chenin blanc was done by Wildenrandt *et al.* (1975) who investigated the effect of leaves of Chenin blanc on wine quality. The parameters harvesting temperature and holding time were, however, not part of this study. In the light of the above work, investigations on the effects of MOG, temperature and holding time of mechanically harvested Chenin blanc grapes on wine quality were commenced in 1977.

Materials and methods

A Chenin blanc vineyard at the Oenological and Viticultural Research Institute, Stellenbosch, in its 9th leaf and trellised on a 3-wire Perold System Zeeman (1979) with the cropping zone approximately 80 cm from ground level, was used. Harvesting was carried out by a Chisholm-Ryder O. W. C. machine fitted with a horizontal shaker/beater system. Alternate rows were hand and mechanically harvested in the early morning and late afternoon, under relatively low and high temperature conditions (17 and 27 °C, respectively). Different amounts of MOG in the picked grapes were obtained by using the extraction fans of the harvester either at high speeds or completely shut off. Both the hand and machine-picked grapes were held for 1 or 18 h before vinification. Sulphur dioxide (100 mg/l) was applied automatically during machine harvesting and added manually to the hand-harvested grapes, when the grapes reached the cellars. Standard vinification procedures of the OVRI were used and duplicate fermentations were carried out at 12 °C, using pure yeast culture *Saccharomyces cerevisiae*, strain WE 14.

The study was continued during the 1978 vintage, using the same Chenin blanc vineyard. The grapes were again mechanically harvested at low and high temperatures with low and high MOG content, but the holding time of the grapes, before vinification, was set as 1, 2, 3 and 4 h intervals.

The musts and wines of each treatment were analysed by acceptable chemical methods (Amerine and Ough 1973) unless otherwise stated, as follows:

Musts. — Total soluble solids, total acidity, pH and total and free SO_2 concentration.

Wines

- Alcohol by means of distillation and determination by pycnometer by the IUPAC method (Anonymous 1968).
- Total acidity by means of titration against 0.1 n NaOH solution to an end point of pH 8.2 using a pH meter.
- pH by means of a pH meter.
- Volatile acidity by means of distillation and titration against a 0.1 n NaOH solution using phenolphthalein as indicator.
- Free and total SO_2 by means of the Ripper method.
- Sugar by means of the Lane and Eynon method.
- Total polyphenols by means of the Folin-Ciocalteu method (Singleton and Rossi 1965).
- Colour by spectrophotometer at wavelength 420 nm.
- Sensory evaluation of the wines was done by a panel of 15 experienced judges using the score card described by Tromp (1977).

Results and discussion

1. Composition of harvest

The composition of mechanically harvested Chenin blanc grapes with low and high MOG contents is summarised in Table 1. The physical composition of the samples of the low and high MOG content was further investigated and its composition expressed in percentage by mass of each component of the total sample. The

Table 1

Composition of the mechanically harvested Chenin blanc (a) as well as of the MOG (b) expressed as percentages by mass (1977 vintage)

Zusammensetzung des Lesegutes von Chenin blanc bei maschineller Ernte (a) sowie des MOG (b) in Gewichtsprozenten (Jahrgang 1977)

a) Composition of grapes at two MOG concentrations

Constituent	% of total sample	
	Low MOG	High MOG
Bunches (whole and parts)	5.8	5.4
Whole berries	43.7	38.6
Broken berries	45.2	44.9
Juice	3.5	1.1
MOG	1.8	10.0

b) Composition of MOG in the "low" and "high" MOG samples

Constituent	Low MOG		High MOG	
	% of MOG sample	% of total sample	% of MOG sample	% of total sample
Whole green leaves	0	0	22.9	2.3
Leaf fragments	50.3	0.9	68.3	6.8
Dried leaves	0	0	4.0	0.4
Petioles	11.9	0.2	3.4	0.3
Stalks	24.3	0.4	0	0
Green shoots	5.9	0.1	0	0
Dry canes	0	0	0	0
Pips and other material	7.6	0.2	1.4	0.2

composition of the low and high MOG samples differs mainly in their juice and MOG contents. Breakdown of the MOG fractions of the low and high MOG samples shows that it was made up mostly of broken senescent leaves which presented 50.3 % and 68.3 % of the MOG samples and 0.9 % and 6.8 % of the total sample, respectively. In the sample of low MOG, stalks made up 24.3 % of the MOG. In this experiment, however, the effect of the total MOG fractions on the quality of wine was investigated under different holding times and harvesting temperatures.

2. Must and wine composition

The values of chemical analysis of musts and wines of mechanically and hand-harvested grapes are summarised in Tables 2 and 3. No big differences occurred in the total acidity of the wines made from hand and machine-harvested grapes. Although the total acidity of wines, made from mechanically harvested grapes at different temperatures, showed little differences, pH of the wines made from grapes harvested at the higher temperature tended to be higher.

The colour of the wines measured at 420 nm was affected by the temperature, MOG and holding time of mechanically harvested grapes. The wines with the highest colour intensity were produced from mechanically harvested grapes at high MOG

Table 2

Mean wine scores and must and wine analysis of mechanically and hand-harvested Chenin blanc grapes at different temperatures, MOG concentrations and holding times (1977 vintage)

Durchschnittswerte der sensorischen Weinbeurteilung sowie der Analysendaten von Most und Wein aus maschinell- und handgeernteten Chenin-blanc-Trauben bei unterschiedlicher Temperatur, MOG und Wartezeit (Jahrgang 1977)

Low harvesting temperature (17 °C)

Property		1 h holding time			18 h holding time		
		Hand harvest	Mechanical harvest		Hand harvest	Mechanical harvest	
			Low MOG	High MOG		Low MOG	High MOG
Sugar (g/l)	must	219	211	217	227	227	231
	wine	1.7	1.6	2.4	1.8	2.0	2.8
Total acid (g/l)	must	7.7	8.1	7.6	8.3	7.7	8.4
	wine	6.7	6.4	6.1	6.4	6.4	6.5
pH	must	3.3	3.3	3.3	3.4	3.4	3.4
	wine	3.5	3.5	3.5	3.7	3.7	3.8
Free SO_2 (mg/l)	must	45	38	26	28	30	36
	wine	14	24	20	17	20	13
Total SO_2 (mg/l)	must	85	98	95	73	87	98
	wine	105	110	111	105	110	100
Colour (OD 420)	wine	0.60	0.60	0.70	0.66	0.81	0.93
Total phenols (mg/l)	wine	280	284	315	308	329	387
Alcohol (vol. %)	wine	12.6	12.5	12.5	13.1	13.2	13.6
Mean scores (%)	wine	54.6[1])	60.0	56.0	53.6	39.6	33.6

High harvesting temperature (27 °C)

Sugar (g/l)	must	213	208	209	220	219	216
	wine	2.1	2.0	1.5	1.4	2.6	2.8
Total acid (g/l)	must	7.8	7.8	8.0	8.9	8.7	8.9
	wine	6.4	6.0	6.2	6.5	6.4	6.5
pH	must	3.4	3.4	3.4	3.3	3.5	3.6
	wine	3.5	3.7	3.8	3.6	3.8	3.9
Free SO_2 (mg/l)	must	26	32	34	33	28	27
	wine	20	20	20	23	13	16
Total SO_2 (mg/l)	must	73	86	91	89	98	92
	wine	107	122	120	111	110	117
Colour (OD 420)	wine	0.64	0.66	0.87	0.66	1.55	1.65
Total phenols (mg/l)	wine	280	300	362	307	382	475
Alcohol (vol. %)	wine	12.6	12.1	12.1	12.6	12.8	12.7
Mean scores (%)	wine	54.7[1])	51.3	40.0	46.7	36.7	30.7

[1]) Significant differences between scores = 6.8 (P = 0.05).

and temperature levels and 18 h holding time. As expected, the colour of hand-harvested grapes was not appreciably affected by temperature and holding time because the grapes were held over in an uncrushed state before vinification. However, at low temperatures with 1 h holding time no difference in colour was found between wines made from hand-harvested grapes and mechanically harvested grapes with low MOG.

Table 3

Mean wine scores and wine analysis of mechanically and hand-harvested Chenin blanc grapes at different temperatures, MOG concentrations and holding times (1978 vintage)

Durchschnittswerte der sensorischen Weinbeurteilung sowie der Analysendaten von Most und Wein aus maschinell- und handgeernteten Chenin-blanc-Trauben bei unterschiedlicher Temperatur, MOG und Wartezeit (Jahrgang 1978)

	Holding time (h)	Mean scores (%)	Alcohol (vol. %)	Tot. extract (g/l)	Tot. acidity (g/l)	Free SO_2 (mg/l)	Tot. SO_2 (mg/l)	Vol. acidity (g/l)	pH
Low harvesting temperature (17 °C)									
Low MOG	1	58.6[2]	13.05	25.3	7.0	20	134	0.59	3.5
	2	58.8	13.03	22.4	7.0	35	134	0.55	3.5
	3	60.7	12.84	22.9	6.5	24	137	0.53	3.5
	4	57.4	12.57	25.0	6.8	25	140	0.54	3.5
High MOG	1	61.3	12.67	19.9	5.6	15	122	0.52	3.4
	2	66.3	12.04	21.1	6.1	18	132	0.48	3.5
	3	51.2	12.59	21.1	5.6	18	125	0.50	3.5
	4	59.4	12.57	19.8	6.4	18	140	0.58	3.5
Hand harvest[1]	1	63.3	12.59	21.4	6.5	24	128	0.54	3.6
High harvesting temperatures (27 °C)									
Low MOG	1	59.8[2]	12.92	22.9	6.0	20	132	0.43	3.6
	2	64.3	12.11	21.4	6.1	20	136	0.43	3.6
	3	55.1	13.64	22.9	6.6	20	130	0.42	3.6
	4	53.8	13.77	22.9	6.4	23	136	0.57	3.7
High MOG	1	38.3	13.30	23.0	5.5	25	122	0.60	3.7
	2	46.7	13.97	23.0	5.4	27	120	0.63	3.7
	3	41.5	13.20	23.2	5.5	26	126	0.58	3.7
	4	45.3	13.40	21.9	5.8	25	126	0.71	3.8

[1]) Control sample.

[2]) Significant differences between scores = 6.0 ($P = 0.05$).

Table 4

Effect of MOG, temperature and holding time on wine quality (% score) of mechanically harvested Chenin blanc grapes of 1977 and 1978 vintage

Einfluß von MOG, Temperatur und Standzeit auf das Ergebnis der sensorischen Qualitätsbeurteilung (%) von Wein aus mechanisch geernteten Chenin-blanc-Trauben der Jahrgänge 1977 und 1978

Vintage	Holding time (h)	Low temperature		High temperature	
		Low MOG	High MOG	Low MOG	High MOG
1977	1	60.0[1])	56.0	51.3	40.0
	18	39.6	33.6	36.7	30.7
1978	1	58.6[2])	61.3	59.8	38.3
	2	58.8	66.3	64.3	46.7
	3	60.7	51.2	55.1	41.5
	4	57.4	59.4	53.8	45.3

[1]) Vintage 1977: Significant differences between scores = 6.8 ($P = 0.05$).
[2]) Vintage 1978: Significant differences between scores = 6,0 ($P = 0,05$).

Increases in the MOG content, harvesting temperature or holding time of mechanically harvested grapes caused increases in the polyphenol concentrations of the corresponding wines. For example, the increased MOG content of the grapes causes an increase in the polyphenol concentrations of the wines, irrespective of harvesting temperature or holding time. Similarly, harvesting temperature (at both holding times and MOG contents) or holding time (irrespective of harvesting temperature and MOG) caused an increase in the polyphenol content of the wines (Table 2). The wines of hand-harvested grapes showed an increase in polyphenol concentration as holding time was increased to 18 h. An increase in harvesting temperature had no affect on the polyphenols of wines regardless of holding times.

3. Wine quality

Effect of MOG. — Table 4 presents the mean scores of wines made from mechanically harvested grapes with low and high MOG content at low and high temperatures. Results showed that MOG had a significant negative effect on wine quality made from grapes harvested at high temperatures at all holding times. At low harvesting temperatures, MOG affected wine quality to a lesser extent irrespective of holding time. However, if the grapes were held for 18 h, wine quality was generally poor, independent of MOG or harvesting temperature.

Effect of harvesting temperature. — The 1977 experiments showed that harvesting temperatures had a significant negative effect on wine quality at high or low MOG content and short holding time (1 h). In 1978 the results show that high harvesting temperatures produced wines which were significantly lower in quality only if the MOG content of the grapes were high for all holding times.

Effect of holding time. — The results obtained in the study of short holding time on wine quality (1978 data) were inconclusive. Although significant differences in wine quality were found, the absolute values of the differences have

little practical consequence. However, where the holding time was increased to 18 h (1977 data) the wine quality deteriorated to such an extent that wines were no longer acceptable.

Effect of harvesting method. — Evaluation of wines made from hand and mechanically harvested grapes is summarised in Tables 2 and 3. No significant difference in wine quality between wines of hand-harvested grapes picked at low temperature and 1 and 18 h holding time could be found. However, grapes picked at high temperatures and kept for 18 h produced wines which were significantly lower in quality (Table 2). No significant differences were found between wines made from hand-harvested grapes and machine harvested grapes picked at low temperature with low or high MOG content and kept for 1 h. Mechanically harvested grapes picked at high temperature and low MOG content with short holding time (1 h) produced wines of similar quality as was obtained from hand-picked grapes. However, as soon as the mechanically harvested grapes were picked at high temperatures with high MOG content and kept for 1 h, the wines were significantly lower in quality than the hand-picked wines. The results obtained in 1978 showed similar trends (Table 3). It is clear, therefore, that Chenin blanc can be mechanically harvested without negative effects on wine quality provided MOG content, harvesting temperature and holding times are kept as low as possible.

Summary

Alternate rows of a Chenin blanc test vineyard in its 9th leaf on the experimental farm of the Oenological and Viticultural Research Institute, Stellenbosch, were harvested by hand and machine. The effects of harvesting temperature, MOG content and holding time of mechanically-harvested grapes on wine quality were evaluated; these wines were compared with wines from hand-harvested grapes. Results showed that increases in the MOG content, harvesting temperature and holding time singly or cumulatively caused an increase in the total polyphenols of the wines. Similarly, increases in MOG content, harvesting temperature and holding time were deleterious to wine quality and the effects were cumulative. Furthermore, a holding time of up to 4 h brought about no significant decrease in wine quality, provided the grapes were harvested at low temperatures. When grapes were harvested at high temperatures, the holding time had to be reduced to 3 h with a low MOG content in order to produce wines of similar quality. With high MOG content the quality significantly lower even with a holding time of only 1 h.

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Eingegangen am 6. 6. 1980

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