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Phenolic assessment of white musts: Varietal differences in free-run juices and pressings

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Bestimmung phenolischer Verbindungen in Weißmosten: Sortenunterschiede bei Vorlauf- und Preßsäften

Zusammenfassung: Die direkte Spektrophotometrie im Wellenlängenbereich von 250—400 nm ermöglicht eine schnelle Messung von Mostfraktionen, die mit den üblichen kellertechnischen Verfahren gewonnen werden. Hierbei werden die Gesamtflavonoide spektralphotometrisch bestimmt, die während des Kontaktes mit der Beerenhaut, mit zunehmender Mosttemperatur und besonders während der Klärung stark gepreßter Moste ansteigen.

Für drei Weinjahrgänge (1987, 1988, 1989) wurden die Spektraldaten zahlreicher Mostfraktionen aus Weinkellereien — von acht Rebsorten aus verschiedenen Bezirken — zusammengestellt. Diese Erhebungen zeigten die vorrangige Bedeutung der Rebsorte für die extrahierbaren Phenolverbindungen einer Mostfraktion auf. Die Daten führen zu der Vorstellung „spektraler Erkennungsprofile", die auf sortenspezifische Unterschiede in der Verteilung der Phenolkomponenten in den Traubenbeeren zurückgehen.

Damit erscheint die Flavonoidkonzentration als bedeutsame Variable für den Sortentyp trokkener Weißweine. Durch Differentialspektrophotometrie von Modell-Beerenhautextrakten bei 250—300 nm wurden auch qualitative Unterschiede in der Zusammensetzung der Phenolverbindungen aufgezeigt.

Die Schönung mit verschiedenen Klärungsmitteln hatte nur einen unbedeutsamen Einfluß auf die Flavonoidkonzentration von Preßsäften und ihren Weinen.

Key words: white variety of vine, must, wine, flavonoid, polyphenol, analysis, berry skin, temperature, press, draining, fining.

Introduction

The outcome of white vinification — the wine composition, its style and quality — is critically dependent on the technique and technology of juice preparation. In modern cellar practice, the clarified free-run juice — from minimal skin contact after crushing in cool conditions — may be regarded as the best vintage material. At the other extreme, there could be prolonged maceration of crushed (warm) grapes, resulting in wines likely to have quite different sensory characteristics of colour, nose and palate.

The effect of skin contact during juice preparation, as in maceration and in the recovery of light to heavy pressings (which may together be 20 % of the maximal juice yield) is progressive extraction of many components from grape solids. Thus there is increase in phenolics and in mineral extract, along with lower acidity and higher pH in the juice pressings (Terrier and Blouin 1975). Increased skin contact before draining has been shown also to result in higher concentrations of amino acids, proteins and polysaccharides (Dubourdieu *et al.* 1986).

Commercial preference for moderate rather than minimal skin contact with certain premium varieties such as Chardonnay and Semillon may be due to localisation of flavour components and their glycosidic precursors in grape skins, and to favourable sensory effect from flavonoid phenolics in skins. Volatile components in grape musts are more than doubled (to a few mg/l only) by several hours extra skin contact (BAUMES *et al.* 1988), and there are significant increases in most categories of the much larger concentrations of volatiles in the resultant wines (BAUMES *et al.* 1989). In related studies, Chardonnay wines were better appreciated following such must treatment, whereas other varietal wines were not improved or were adversely affected (BARILLÈRE *et al.* 1990). For Chardonnay in California, the effects of skin contact time (TEST *et al.* 1986) and temperature of must handling (RAMEY *et al.* 1986) were found to be inconclusive in sensory terms.

It is, however, the heavy pressings fraction of expressed juice — the final 10 %, 60—80 l/t — which does (separately) present oenological problems. Thus its inclusion with the main lot is generally a matter for empirical judgement by the winemaker. In warm to hot viticultural regions, much of the modern technology is in fact dedicated to the preparation of juice for white vinification. Cool cellar conditions, which may necessitate large refrigeration capacity for must cooling and settling, then represent the first and most important requirement for production of white wines comparable with those from cooler wine regions.

In process engineering terms, hydraulic screw presses are technically superior for 'dealing with' large quantities of crushed grapes, but less efficient batch-operated juice recovery systems are more appropriate to the production of premium wines — as is recognised in European regulations prohibiting the use of screw presses for many appellations. Analytical, commercial and legal aspects of the technology have been recently examined in a special issue of the Revue Française d'Oenologie (1989).

In our investigations of juice fractions from commercial practice in the South Australian vintages 1987-88-89, we have examined and compared data for up to eight grape varieties from seven wineries in several wine districts. Actual conditions of juice preparation varied widely, i.e. concerning degree of maceration, skin contact time and temperature, type of press and subsequent juice treatment. Direct spectral methods were applied to description of total juice or wine phenolics, enabling unique assessment of juices and wines in relation to parameters of processing (SOMERS and ZIEMELIS 1985; SOMERS and VÉRETTE 1988).

By such means, large varietal differences have been recognised in response to skin contact and to pressing of the grape crush, differences which appear to be more important than the major processing variables. The data are interpreted as being a consequence of differing phenolic distributions in the intact berry. There are interesting implications for juice preparation from particular grape varieties.

Material and methods

Commercial juice fractions

Eleven sets of grape musts, a sample (700 ml) of each fraction being taken on site during commercial juice preparation, were examined in the 1987 vintage. These were from four winery sources in South Australia and involved six wine grape varieties processed in various conditions and with pneumatic or screw presses. After spectral measurement of a clarified sample, the remainder of each fraction was fermented to dryness at 20 °C for similar measurement of phenolic concentrations.

In the following seasons, the phenolic composition of commercial juice fractions from six wineries was studied in relation to requested information about district of origin, harvest conditions and variables of the juice preparation procedure, viz. skin contact time, must cooling or not, presence or absence of stalks, type of crusher, drainer and pressing equipment, and use or non-use of fining agents with pressings. Spectral data were collated for eight grape varieties from six wine districts.

Model extracts of grape parts

Random samples (200 berries) were taken of five marked vines of each variety, in the vineyard of the Waite Agricultural Research Institute in the 1988 season. Skins and seeds were separated, washed with water and each lot then briefly macerated (10 s) in an aqueous solution saturated with potassium bitartrate and containing 20 % sucrose (100 ml) before leaving for 24 h at room temperature. Grape stalk material from each variety was similarly treated. The clarified extracts were examined by use of normal and derivative spectrophotometry in the range of 250—300 nm (Varian DMS 200).

Flavonoid extract in juices and wines

Total flavonoid extractives were assessed, as absorbance units (a.u.) at 280 nm (10 mm path), by allowing for the contribution of non-phenolics at 280 nm and for absorbance at 280 nm of total hydroxycinnamates. This was done by use of the formula

$$\text{Flavonoid extract} = (E^{10}_{280} - 4) - 2/3\,(E^{10}_{320} - 1.4)\ \text{a.u.}$$

in which the values 4 and 1.4 are statistically based correction factors for non-phenolics at 280 and 320 nm respectively; and the fraction ⅔ refers to the ratio of hydroxycinnamate absorbance at 280 nm to that at 320 nm (SOMERS and ZIEMELIS 1985). Flavonoid concentrations in the juice or wine are then indicated by a linear scale ranging from – 1 to 0 for minimal amounts to values as high as 45 a.u. in heavy pressings.

Most commercial juice samples were analysed soon after their early receipt, others were stored at – 8 °C until required. For spectral measurement, a sample (0.5 ml) was generally diluted to 10.0 ml with 3 % aqueous acetic acid before membrane filtration. The spectrum 250—400 nm was then recorded with use of a 10 mm quartz cell. Spectra of clarified juices and new wines were measured directly in 1 mm pathlength after high speed centrifugation (Eppendorf) of 1.5 ml samples.

Results and discussion

1. Focus on flavonoid extract

The analytical basis for this investigation has been the realisation that, at whatever level of skin contact or grape solids extraction during pressing, the u.v. spectrum of the juice or wine provides comprehensive information about the total phenolics. Interpretation of the spectrum is quite simple as the C_9-based hydroxycinnamates and the C_{15}-based flavonoids (each category having distinctive absorbance features) are together responsible for the major part of light absorbance in juices and wines (SOMERS and ZIEMELIS 1985).

Thus the hydroxycinnamates (present in grapes as tartaric acid esters) and their transformation products in wines all have closely similar spectra, with strong absorbance in the range 300—330 nm (SOMERS *et al.* 1987). They are frequently the main phenolic components, at concentrations up to about 200 mg/l as 'caffeic acid equivalents' in white wines from free-run juice.

As will be illustrated, concentrations of both hydroxycinnamates and flavonoids increase during skin contact and during juice recovery by pressing. The flavonoids (which include grape tannins as oligomers of the C_{15} monomers) are then usually the dominant phenolics, as they are localised in grape skins and seeds. With characteristic λ_{max} around 280 nm, the total flavonoid content is measured as absorbance units (a.u. for 10 mm path) at 280 nm, after correction for contributions from hydroxycinnamates to absorbance at 280 nm. Application of this analytical concept over several years has shown that minimal flavonoid concentrations, as in free-run Riesling juices and resultant wines, are associated with estimates close to 0 a.u., whereas flavonoid content in heavy juice pressings and resultant wines can be as high as 45 a.u., about as much as occurs in red wines of generous extract.

The corrected absorbance reading at 280 nm is therefore used as an essentially linear measure of flavonoid extract or concentration in juices and wines. Conversion to a weight concentration is hardly possible (as it is with spectral measures of total hydroxycinnamates) because of the number and diversity of total flavonoids. As a rough guide, however, 1 a.u. would correspond to about 70 mg/l as 'catechin equivalents'. Varietal, regional and seasonal differences affecting phenolic composition are probably responsible for the slightly negative to zero estimates in some free-run juices and wines. Thus the 'base level', signifying minimal flavonoid concentration is generally in the range of − 1 to + 1 a.u. in comparative assessments of juices and wines.

Associated HPLC data have been impossibly complex. It is in any case considered that it is the integrated measures, as provided by spectral readings of the intact juice or wine which are of prime importance in relation to sensory effect. The spectral estimate of flavonoid content has therefore been the analytical feature by which commercial juice fractions have been compared in this investigation. The hydroxycinnamates did not warrant any similar scrutiny, as they are largely present in the grape flesh (i.e. in free-run juice) at a wide range of concentrations, and, further, do not have any taste properties in wines (VÉRETTE *et al.* 1988).

Typical data for total flavonoids from our first analytical survey of commercial juice preparations are shown in the Table. Thus there were indications of varietal differences in flavonoid concentrations, and it was evident that more than 80 % of such extract is generally retained after vinification.

2. Varietal characteristics

The modern technology for juice preparation can enable widely variable control of skin contact (where previously there may have been unavoidable maceration and extraction); but organoleptic effects arising from moderate skin contact have appeared to depend on the particular grape variety, and are often adverse (BARILLÈRE *et al.* 1990). Thus, there are sensory characteristics of 'mouth-feel' and rounded flavour in Chardonnay which may relate to higher flavonoid concentrations in those varieties, whereas Riesling quality has come to be associated with minimal extract and free-run juice.

Whereas there has been no corresponding or supportive data in the technical literature for the above statement, we have detected varietal differences in model extracts of grape parts (and also in the response of wine grapes to pressing, Section 3). It was noted that phenolic extraction from stalks was greater with Chardonnay and Semillon than with Riesling, and that phenolic composition was similar in stalks and seeds. The composition of skin extracts was, however, reproducibly quite distinct for each variety (Fig. 1). The analytical technique, which comes from recent advances in computerized spectrophotometry, involves taking the second derivative spectrum in the region 250—300 nm, where skin extractives show maximal absorbance — the broad, rather featureless zero order spectrum is then replaced by 2, 3 or 4 negative peaks in this region. This easy discrimination between extracts refers to compositional differences in contributing materials and their partial 'resolution' by differentiation of gradual absorbance change. (In related studies involving 153 dry white wines, λ_{max} was found to vary from 264—289 nm, indicating considerable diversity of phenolic composition for exploration by derivative spectrophotometry.)

Thus the derivative technique offers much precision from routine measurement and has considerable potential in oenology. It can be used e.g. to establish identity or to distinguish between similar wines and juices. Its application was not explored further in this investigation than already stated, as quantitative features seemed to be of greater importance. These are provided by the taking of normal (zero order) spectra of juices and wines.

Spectral estimates of total flavonoids in commercial juice fractions and in corresponding wines (1987) [1]

Spektralbestimmung der Gesamtflavonoide in Mostfraktionen aus Weinkellereien und in den zugehörigen Weinen (1987)

Grape variety and type of press	Juice fractions	Juice		Wine	
		E^{10}_{280}	Total flavonoids	E^{10}_{280}	Total flavonoids
Chardonnay, Pneumatic tank	Free-run	12.4	3.2	11.6	3.4
	Press, 0.2 bar	20.0	6.8	16.8	6.1
	Press, 0.5 bar	23.2	7.6	20.4	7.2
	Press, 1.0 bar	26.8	9.3	22.4	8.5
	Press, 1.5 bar	29.6	10.9	24.4	9.4
	Press, 2.0 bar	32.4	13.6	26.8	11.1
Semillon, Pneumatic tank	Free-run	8.4	1.1	8.3	1.4
	Press, 0.2 bar	12.8	3.5	12.2	4.1
	Press, 0.5 bar	14.8	4.4	13.2	3.9
	Press, 1.0 bar	15.8	5.1	14.4	4.6
	Press, 1.5 bar	16.4	5.4	15.0	4.9
	Press, 2.0 bar	17.6	6.4	15.8	5.5
Riesling, Hydraulic screw	Free-run	9.4	0	8.4	0.2
	Press 1	10.1	0.1	10.5	0.2
	Press 2	13.8	0.7	13.2	1.2
	Press 3	15.2	2.2	14.0	2.4
Muscat Gordo, Hydraulic screw	Free-run	8.6	1.1	8.8	1.8
	Press 1	11.6	3.1	11.3	3.3
	Press 2	55.6	43.8	52.0	41.5

[1]) Measures are as absorbance units of undiluted juice or wine in 10 mm path length.

3. Profile recognition in commercial juices

The idea that white grape varieties could differ significantly in the distribution and expression of phenolic constituents emerged from our spectral observations of many sets of grape juices from various commercial sources in the 1987-88-89 seasons.

Whereas all juice fractions examined showed either a broad maximum or a high shoulder at about 280 and 320 nm, there was large variability in the spectral profile, reflecting variation in the relative concentrations of flavonoids and of hydroxycinnamates. Surprisingly, in view of the processing variables of skin contact, draining and pressing, these features have appeared to be a characteristic of the wine grape variety,

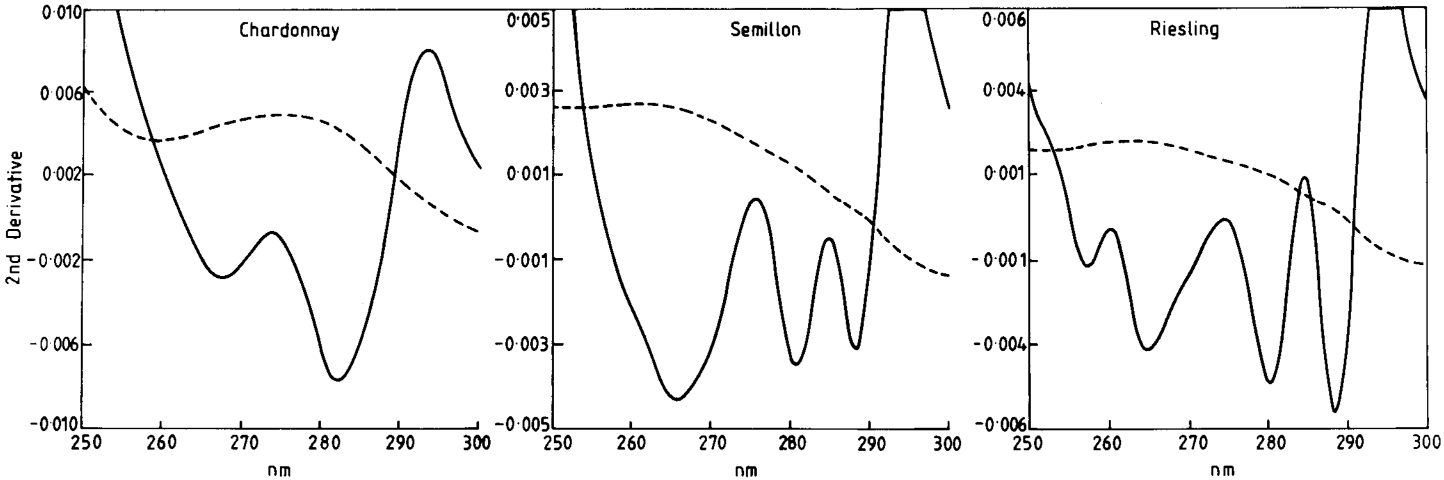

Fig. 1: Second derivative spectra of grape skin extracts from three varieties. Normal spectra are also shown (---). — Instrument parameters for derivative spectra were: slit spectral band width 2.0 nm, smoothing filter time 1.0 s, scanning speed 100 nm/min. The data sampling interval for derivative calculation was then 1.0 nm.

Scanningspektren (2. Ableitung) der Beerenhautextrakte von drei Rebsorten. Die normalen Spektren (---) werden ebenfalls gezeigt. — Geräteparameter für die Scanningspektren s.o.

suggesting the possibility of its identification by such means. The subject is introduced by discussion of data from the study of commercial juice fractions and wines, wherein it should be noted that free-run juice is generally 550—650 l/t, with successive juice fractions amounting to as much as 200 l/t.

C h a r d o n n a y , S e m i l l o n : The progressive nature of phenolic extraction is illustrated in the set of spectra for Chardonnay juice fractions from a tank press, and for the corresponding (laboratory-fermented) wines (Fig. 2). Estimates from these data of the increasing flavonoid concentrations have been given in the Table.

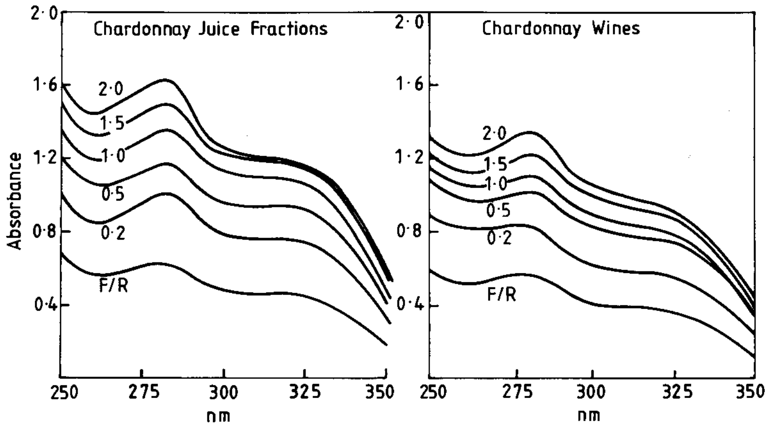

Fig. 2: Spectral profiles of Chardonnay juice fractions from a Willmes tank press — free-run (F/R) and juices from increasing pressures 0.2—2.0 bar — and profiles of the corresponding wines. All samples were diluted, 0.5 ml to 10.0 ml with 3 % aqueous acetic acid before filtration, measurement in 10 mm pathlength.

Spektralprofile der Mostfraktionen von Chardonnay mit Willmes-Tankpresse — Vorlauf (F/R) und unter steigenden Drucken (0,2—2,0 bar) gepreßte Moste — sowie Profile der zugehörigen Weine.

Close similarities in such spectral profiles were seen between Chardonnay sets from different sources and in different seasons, regardless of variations in skin contact time and temperature, and of pressing procedures. Temperature could indeed be shown to have influence on phenolic extraction and must composition. Must temperature during the juice preparation is probably a most important parameter of vinification, but there is uncertainty about its optimal management. Thus a Chardonnay wine from pressing of whole fruit after overnight storage at 0 °C had much less flavour and 'mouth-feel' than wine from fruit which was crushed and drained at 5 °C, with otherwise similar processing (Fig. 3).

Chardonnay was distinctive in that all of the different lots of free-run juice (six lots in two seasons from four districts), even including those from treatment at low temperatures (Fig. 3) have had appreciable flavonoid concentrations (1.8—3.4 a.u.). Moderate skin contact at 10—15 °C, with inclusion of pressings, has seemed to be appropriate for processing of this variety.

Spectra from sets of Semillon juices were somewhat similar in this regard (Fig. 4). It is noted that these two varieties are associated with robust wine styles which can benefit from maturation in oak barrels.

P a l o m i n o , R i e s l i n g : Quite different spectral features were seen in examination of juice sets from these two more delicate grape varieties. Free-run juices contained minimal levels of flavonoids, particularly in the case of Palomino, where the spectrum closely resembled that of total hydroxycinnamates alone. Even more remark-

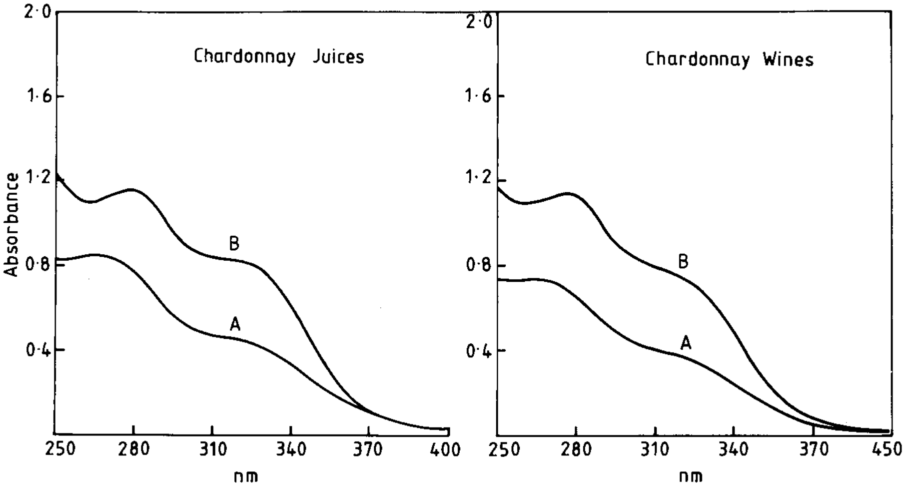

Fig. 3: Effect of juice preparation procedure on spectral profiles on Chardonnay juices and wines. Direct measures on 1 mm pathlength. — Juice (A) hand harvest, Willmes tank pressing of chilled whole fruit (0 °C overnight storage), draining time for free-run 2.25 h, yield 515 l/t to 1.2 bar. Flavonoid content 1.8 a.u. Juice (B) hand harvest, Vaslin crusher after 2—3 h at 18 °C, must cooling to 5 °C, draining time with stalks 3 h, yield 650 l/t to 0.7 bar. Flavonoid content 2.8 a.u.

Einfluß der Mostgewinnungsverfahren auf die Spektralprofile von Chardonnaymosten und -weinen. — Most (A) Handlese, Kühllagerung der Trauben über Nacht, Willmes-Tankpresse. Most (B) Handlese, Vaslin-Traubenmühle, Mostkühlung.

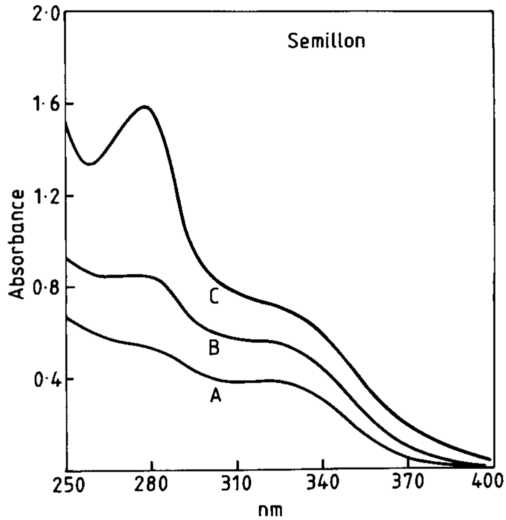

Fig. 4: Spectral profiles of Semillon juice fractions, samples × 20 dilution, 10 mm light path. — (A) hand harvest, Miller crusher/destemmer after 14 h at 20 °C, must cooling to 4 °C, Miller drainer 16 h, 8—10 °C, 550 l/t, flavonoids 3 a.u. (B) inclined drainer, 130 l/t, flavonoids 6 a.u. (C) heavy pressings from Coq screw press, 90 l/t, flavonoids 17 a.u.

Spektralprofile der Mostfraktionen von Semillon. — (A) Handlese, Miller-Traubenmühle mit Abbeervorrichtung, Mostkühlung, Miller-Entsafter. (B) Geneigter Entsafter. (C) Starker Preßdruck mit Coq-Schraubenpresse.

able — particularly in view of the fact that there was no must cooling, there was considerable skin contact before draining and further, that pressings were obtained by use of a continuous screw press — were the observations that there was scarcely any qualitative change in phenolic composition during skin contact and pressing of this grape variety (Fig. 5). The data therefore indicate very low concentrations of flavonoids in all parts of the berry.

Whereas the spectra of Riesling free-run juices were rather similar to those of Palomino, with estimated flavonoid concentrations also close to 0 a.u., there were generally strong indications that must-cooling and brief skin contact are necessary to maintain this condition in the free-run juice. Pressings contained significantly high levels of flavonoids, as shown by spectral changes around 280 nm (Fig. 5). (In local practice, heavy pressings from Riesling are often excluded from the main lot because of increasing bitterness.)

Trebbiano, Pedro Ximenez: These two varieties were exceptional in that, whereas flavonoid concentrations in free-run juices were low, there was rapid increase from skin contact (i.e. during draining) and particularly during pressing. Recovery of the final 150 l/t was associated, in these varieties, with flavonoid concentrations of 14 and 18 a.u. (Fig. 6). Colombard was quite similar, with pressings also showing the characteristic spectral hump around 280 nm.

From these varieties, the pressings are so far different in phenolic profile from free-run juices as to suggest the need for separate management. Such pressings are indeed often consigned to use in the making of sweet fortified wines or to spirit production, but unsuitability for dry white wine production is not necessarily due to the high phenolic concentration *per se*. The latter may be, however, an indication of extensive compositional faults affecting sensory appreciation of the subsequent wine.

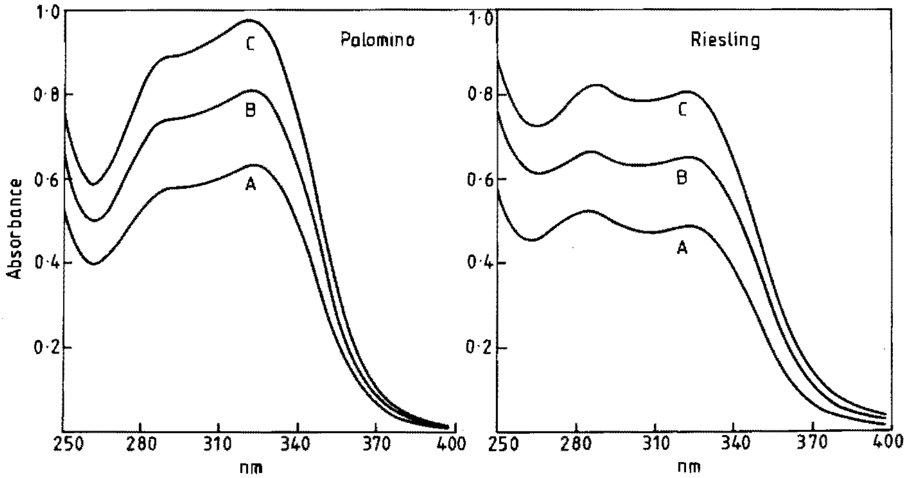

Fig. 5: Spectral profiles of commercial juice fractions; samples × 20 dilution, 10 mm light path. — Palomino: (A) hand harvest, Miller roller crusher after 12 h, 20 °C, no must cooling, stalks not removed, 500 l/t, flavonoids − 0.8 a.u. (B) Miller drainer, 20 °C, 30 min, 150 l/t, flavonoids − 0.3 a.u. (C) Blachère screw press, 20 °C, 60 l/t, extract 0.4 a.u. — Riesling: (A) machine harvest, Miller roller crusher after 6 h, 14 °C, must cooling 8—10 °C, Miller drainer, 575 l/t, flavonoids 0.8 a.u. (B) inclined drainer, 115 l/t, extract 1.4 a.u. (C) Coq screw press, 60 l/t, flavonoids 2.2 a.u.

Spektralprofile von Mostfraktionen aus Weinkellereien. — Palomino: (A) Handlese, Miller-Zylindertraubenmühle, keine Mostkühlung, keine Entrappung. (B) Miller-Entsafter. (C) Blachère-Schraubenpresse. — Riesling: (A) Maschinelle Lese, Miller-Zylindertraubenmühle, Mostkühlung, Miller-Entsafter. (B) Geneigter Entsafter. (C) Coq-Schraubenpresse.

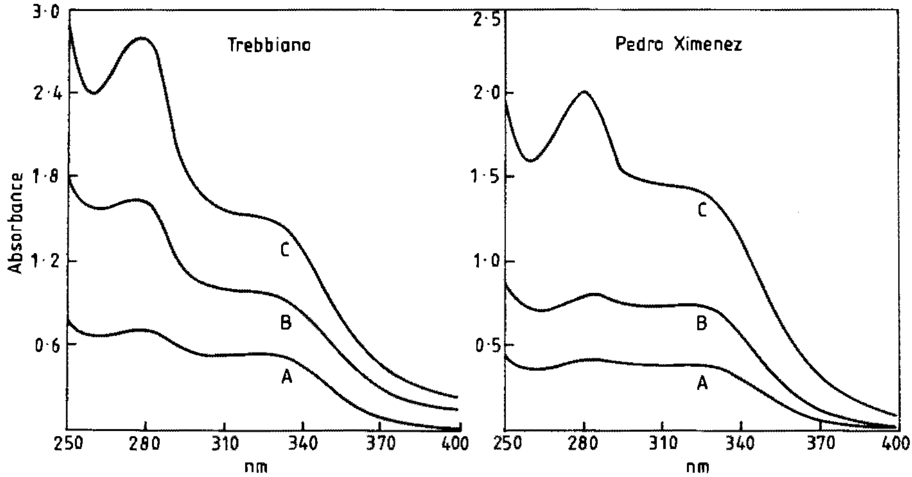

Fig. 6: Spectral profiles of commercial juice fractions; samples × 20 dilution, 10 mm light path. — Trebbiano: (A) hand harvest, Miller roller crusher after 4 h, 20 °C, no must cooling, stalks removed. Miller static pressure drainer 20 °C, 550 l/t, flavonoids 0.2 a.u. (B) drainings, 120 l/t, flavonoids 6.6 a.u. (C) Blachère screw pressings, 70 l/t, flavonoids 14.3 a.u. — Pedro Ximenez: (A) hand harvest, Miller roller crusher after 10 h, 20 °C, no must cooling, stalks removed, Miller drainer, 550 l/t, flavonoids 0.2 a.u. (B) drainings 115 l/t, flavonoids 2.8 a.u. (C) Coq screw pressings, 60 l/t, flavonoids 18 a.u.

Spektralprofile von Mostfraktionen aus Weinkellereien. — Trebbiano: (A) Handlese, Miller-Zylindertraubenmühle, keine Mostkühlung, Entrappung, Miller-Entsafter mit konstantem Druck. (B) Abtropfsaft. (C) Blachère-Schraubenpresse. — Pedro Ximenez: (A) Handlese, Miller-Zylindertraubenmühle, keine Mostkühlung, Entrappung, Miller-Entsafter. (B) Abtropfsaft. (C) Coq-Schraubenpresse.

4. Effects of fining agents

Historically, the various proteinaceous fining agents have served as important aids to clarification and stabilisation of wine. Compositional influences from such treatments have never been precisely defined, but they are generally considered to include an effect on phenolics, and particularly on the tannin fraction. Partial removal of the latter by the protein-like synthetic agent polyvinyl polypyrrolidone (p.v.p.p.) is well established, but massive fining levels (100 g/l) are actually needed to completely remove the phenolic components from white wines (SOMERS and ZIEMELIS 1985). In commercial practice, where additions of p.v.p.p. and of other fining agents, are generally less than 1 g/l, any favourable sensory effect is attributed to removal of oxidised or bitter tannin components — specifically those of higher molecular weight — or to removal of other unknown flavour components. Such treatments are quite empirical, and there is little objective information on the subject.

Thus the fining of pressings may sometimes involve use of a mixture of more than one agent, and the expense can be considerable. The apparently similar effects of three different fining agents at standard levels of addition to heavy juice pressings are shown in Fig. 7. Casein and p.v.p.p. were more effective than gelatine, but tannin removal was marginal in all cases. Similar observations were made with the fining of wines from juice pressings, though the fining of clarified juice pressings has been generally the preferred treatment.

As mentioned, however, such focus on phenolic extraction does distract attention from the fact that the composition of pressings can differ from that of free-run juice in many other aspects, of which the principal ones would be pH, titratable acidity and potassium content. These are well recognised faults — even in free-run juices, much less drainings and pressings of white wine grapes in warm to hot viticultural regions — so that their correction by tartaric acid addition is a routine measure before fermentation. In sensory terms, this is a fundamental amelioration of the vintage, much more so than attempts to remove unwanted tannins by fining treatments. This statement is supported by our findings that panel assessments of such commercially made wines from free-run juices and from pressings (Riesling, Semillon and Chardonnay) showed recognition of a difference, but the wines of lower phenolic extract were not clearly preferred.

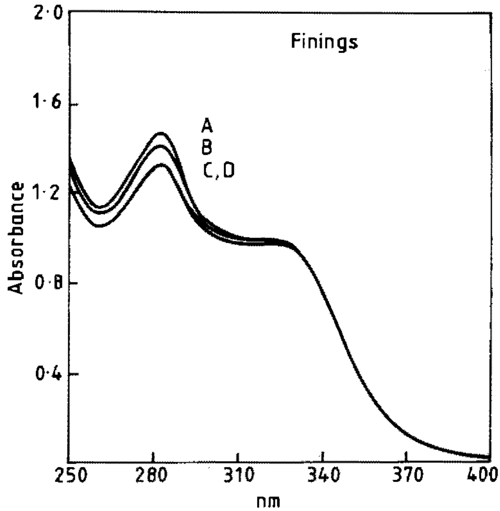

Fig. 7: Influence of fining on the spectrum of Semillon juice pressings. Direct measures in 1 mm light path. Untreated juice (A); after gelatine, 100 mg/l (B); after casein, 400 mg/l (C); after p.v.p.p., 700 mg/l (D).

Einfluß der Schöung auf das Spektrum von Chardonnaypreßsäften. (A) Unbehandelt; (B) Gelatine; (C) Casein; (D) PVPP.

Conclusion

Varietal differences in the phenolic composition of expressed juices during commercial juice preparation can be interpreted as being fundamentally due to genetically controlled variability in the distribution of phenolic components within grape berry structure. These features, with emphasis on spectral estimates of total flavonoid concentration, are retained during vinfication.

Thus the concept of 'profile recognition', referring to the juice or wine spectrum (250—400 nm), allows, for the first time, a routine analytical approach to consideration of the different wine styles, as of Riesling vs. Chardonnay wines, and of appropriate parameters of juice preparation. More detailed information is accessible by differential spectrophotometry, which enables spectral resolution of major components contributing to absorbance at 250—300 nm.

Use of this direct spectral method for appraisal of juice and wine phenolics has also indicated that the wine grape variety is the dominant factor — even more, within reasonable limits, than skin contact time and must temperature — in considerations of flavonoid concentration during juice preparation. The following impressions about varietal influences on phenolic composition have emerged from our investigations of commercial juice fractions:

- Flavonoid concentrations in free-run juices ranged from extremely low in Palomino, Sauvignon blanc, Riesling, Pedro Ximenez, Colombard and Trebbiano to moderately high in Semillon and Chardonnay.
- Flavonoid concentrations in drainings (i.e. with skin contact) and in pressings remained very low in Palomino and Sauvignon blanc, were moderately high in Riesling, Semillon and Chardonnay, and were extremely high in Pedro Ximenez, Colombard and Trebbiano.
- Such features have appeared to be rather consistent for the particular varieties, suggesting the notion of profile recognition. Varietal juices can hardly be identified by such means, but they do fall into the several categories so far indicated.

Varietal wine style may therefore be partially due to such phenolic features, e.g. the lightness of Palomino and Riesling vs. the characteristic depth and body of Chardonnay and Semillon; for the latter appear to have characteristically higher flavonoid concentrations in the free-run juices.

Wider exploration of these matters is obviously necessary, and this is now much facilitated by the availability of scanning spectrophotometers; for it is the spectral scan rather than simple absorbance readings which is the most informative measure, from which the flavonoid concentration or extract is easily assessed as absorbance units.

Hydroxycinnamate concentrations are unaffected and flavonoid concentrations are decreased by proteinaceous fining agents and by use of p.v.p.p. However, the decreases were rather marginal in treatments of heavy pressings, and it may be that any perceived sensory amelioration of such juice or wine is due to other effects, e.g. the removal of trace volatiles associated with pressings.

There could be economic advantage, when dealing with grapes from warm to hot viticultural regions, in dispensing entirely with any form of fining treatments for phenolics, and in relying for amelioration on early clarification and acid adjustment of juices before fermentation. Further, it would be prudent not to compromise the quality of the vintage by any preoccupation with juice yield. Where hydraulic screw presses are in use, the final 30—50 l/t must always be regarded as being a potentially adverse influence on the vintage product.

Summary

Direct spectrophotometry over the range 250—400 nm enables rapid assessment of juice fractions from commercial juice preparation systems. Attention is focused on spectral estimates of the total flavonoids which increase during skin contact, with increasing must temperature, and particularly during recovery of heavy pressings.

Spectral data from many sets of commercial juice fractions, concerning eight grape varieties in several districts, were collated over three seasons, 1987-88-89. Such observations have indicated the prime importance of grape variety in relation to phenolic extract in the juice fractions. The data have suggested the notion of 'spectral recognition profiles' arising from intrinsic varietal differences in the distribution of phenolic constituents within wine grapes.

Thus the flavonoid concentration appears to be a significant variable of varietal dry white wine style. Qualitative differences in phenolic composition have also been demonstrated by differential spectrophotometry of model skin extracts at 250—300 nm.

Fining treatments with various commercial fining agents had only minor effect on flavonoid levels in juice pressings and in press wines.

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