Understanding Extended Berry Maturation: Implications of Fruit Sugar Content on Aroma Precursors and Green Aromas in Red Wine Grapes

Martin P. Mendez[1], Michael Cleary[1] and Nick Dokoozlian[1]

[1] E&J Gallo Winery, PO Box 1130, Modesto CA 95353

email: martin.mendez@ejgallo.com

Optimum berry flavor development is essential for reaching desired wine style targets and maintaining quality and market share of California wines. A major objective is to achieve an absence of green aromas or flavors in the fruit prior to harvest. Delaying grape harvest beyond traditional maturity levels is believed to enhance aroma development and promote degradation of undesirable green or vegetal aromas in red wine cultivars (Tilbrook and Tyerman 2006). As a result, harvest decisions are no longer based solely on fruit sugar content (ex 24 Brix) but now commonly include berry sensory evaluations to assess the potential for both fruit and vegetal aromas in the resulting wines.

Methoxypyrazines are a potent odorant present in vegetables such as bell peppers and beans and have also been identified in Vitis vinifera grape varieties such as Cabernet Sauvignon, Merlot and Sauvignon Blanc among others (Allen et al. 1989; Roujou de Boube et al. 2000). Among the different types of methoxypyrazines that have been found in grapes, a study done by Allen et al. (1993) showed that IBMP (3-isobutyl-2-methoxypyrazine) contributes the most to green aromas present in Cabernet Sauvignon and Sauvignon blanc wines.

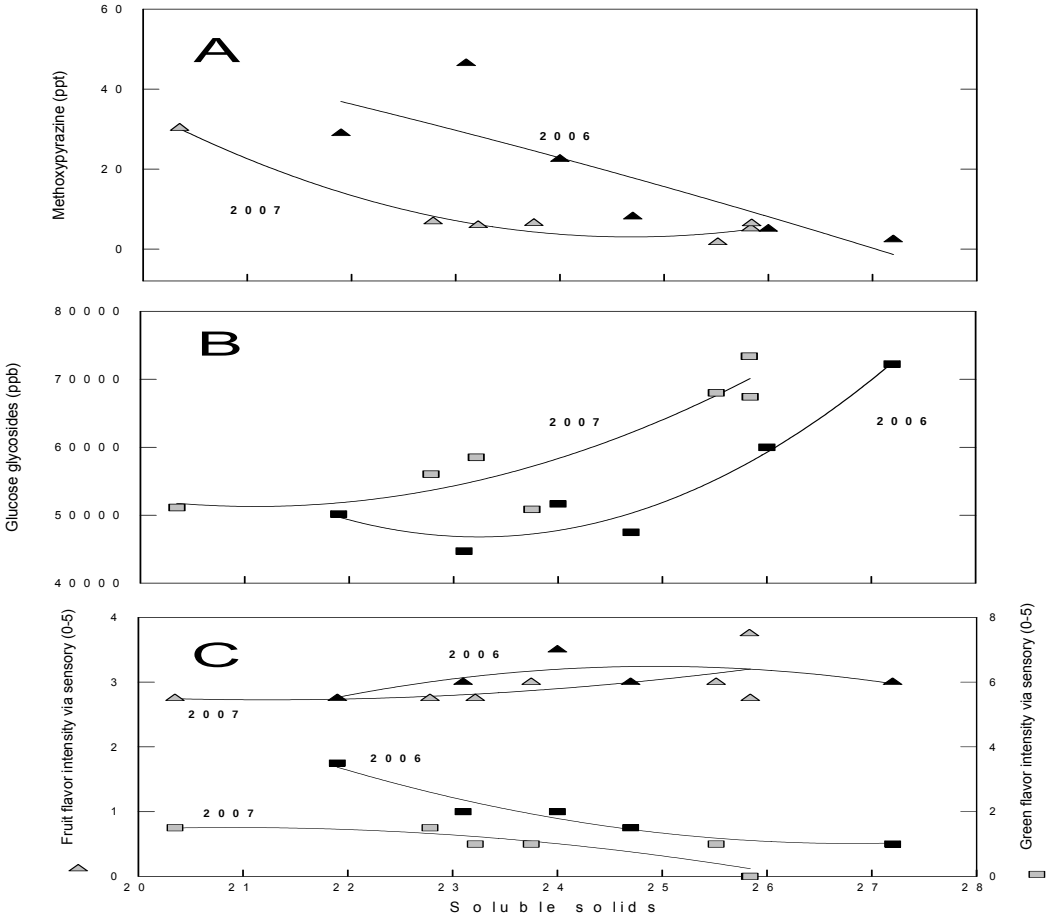
Many positive aroma compounds of grape berries are present in the free or volatile form, as well as bound to sugars in the odorless form of glycosides (Cordonnier and Bayonove, 1974). The relative importance of both fractions in grape berries has been studied for several different wine cultivars. Experiments done by Genoves et al (2005) and Gunata et al (1985) found the bound fraction in the berry (glycosides) to be about three times greater than the free form (volatiles).

The effects of extended maturation on both aroma precursors (glycosides) and methoxypyrazine in the fruit were studied in field-grown Cabernet Sauvignon grapevines in the Sonoma Valley of California. Clusters samples were taken on a weekly basis starting around 20-22Brix until commercial harvest during the 2006 and 2007 seasons, and analyzed for phenol-free glucose glycosides (Whiton and Zoecklein, 2002) and methoxypyrazines (modification of Chapman et al., 2004 to analyze grape homogenate). An additional fruit sample was collected weekly and subjected to berry sensory analysis using a trained panel. Each treatment (harvest date) was replicated six times using 5 vine plots arranged in a randomized complete block design.

The practice of extended maturation significantly increased aroma precursors and decreased green notes in both seasons (Figure 1). Methoxypyrazine fruit levels were below the berry sensory threshold (15 ppt, Roujou de Boubee - 2003) by the time that berries reached 23 Brix in 2007, but remained above this level until the fruit reached 25 Brix in 2006. Higher levels of aroma precursors were also reached at a lower Brix in 2007 compared to 2006. Berry sensory showed similar results, but greater differences between years, and higher correlation with the fruit chemistry data were observed for green notes compared to fruit flavors. This is explained by the volatile nature of the compound that contributes the most to green aromas (methoxypyrazine) and the predominance of the positive aroma compounds in the bound fraction (odorless - glycosides). Therefore, fruit sensorial evaluations might be more accurate assessing fruit vegetal characteristics than determining positive fruity aromas.

These results show that fruit sugar content is not an accurate estimation of neither aromatic potential or degradation of vegetative notes, and suggest therefore that berry sugar loading is not directly related to the development of critical aroma compounds in the fruit.

Figure 1: Effects of extended maturation on vegetative notes (A), fruit aroma precursors (B) and berry sensory (C) of Cabernet Sauvignon grapes during two seasons.



References

ALLEN, M. S., M. J. LACEY, et al. (1989) Ocurrence of methoxypyrazine in grapes of Vitis vinifera cv. Cabernet Sauvignon and Sauvignon Blanc. IV Symposium d'Enologie de Bordeaux. Paris: 25-30.

ALLEN, M. S., M. J. LACEY, et al. (1993) Contribution of methoxypyrazines to the flavour of Cabernet Sauvignon and Sauvignon Blanc grapes and wines. Seventh Australian Wine Industry Technical Conference: 113-116.

CORDONNIER, R.E., BAYONOVE, C.L. (1974) Mise en evidence dans le baie de raisin var. Muscat d'Alexandrie de monoterpenes lies revelables par une ou plusiers enzymes du fruit. C.R. Acad. Sci. Paris 278:3387-3390.

GENOVES, S, et al (2005) Assesment of the aromatic potencial of Palomino Fino grape must using glycosidases. American Journal for Enologie and Viticulture, 56:2 188-191.

GUNATA, Y.Z. et al (1985) The aroma of grapes – Extraction and determination of free and glycosidicaly bound fractions of some grape aroma components. Journal of Chromatography, 331 83-90.

ROUJOU DE BOUBEE, D., C. VAN LEEUWEN, et al. (2000) Organoleptic impact of 2-methoxy-3-isobutylpyrazine on red Bordeaux and Loire wines. Effect of environmental conditions on concentrations in grapes during ripening. Journal of Agricultural and Food Chemistry 48(10): 4830-4834.

ROUJOU DE BOUBEE, D. (2003) Research on 2-Methoxy-3-Isobutylpyrazine in grapes and wines. Bourdeax, School of Oenology.

TILBROOK J., TYERMAN S. (2006) Water, sugar and acid: how and where they come and go during berry ripening. In "Finishing the job" - Optimal ripening of Cabernet sauvignon and Shiraz'. Mildura, VIC. (Eds D Oag, K DeGaris, S Partridge, C Dundon, M Francis, R Johnstone, R Hamilton) pp. 4-10. (ASVO)

WHITON, W. ZOECKLEIN, B.W. (2002) Evaluation of Glycosyl-Glucose analytical methods for various glycosides. American Journal of Enology and Viticulture, 53:4 315-317