

In 1984, a standardized wine aroma terminology was proposed to facilitate communication among members of the wine industry (4). The "Wine Aroma Wheel," as its graphic representation has been colloquially titled, has generally elicited a positive response from a wide audience, including wine writers, wine consumers, and personnel in the wine industry (1).

Utilizing the constructive suggestions provided by people in the wine industry throughout the world, several modifications of the original Wine Aroma Wheel are being proposed. In our initial wheel, the primary term "nutty" and its more specific descriptors were omitted as noted by Bruno Dutertre of Moët et Chandon (Bruno Dutertre, personal communication, 1985). The primary term nutty, with walnut, hazelnut, and almond as specific third-tier terms, has been added to the list. Some terms were removed because they were redundant with others or their occurrence was too infrequent to warrant their inclusion in the wheel.

Upon examination, the organization of the original wheel seemed inappropriate. Specifically, the "caramelized" and "wood" terms were located between terms denoting defects. In this modified version, the categories have been reorganized to make the order of terms more logical and to improve the ease of use as illustrated in Figure 1.

As acknowledged in the initial publication, the utility of the aroma wheel is improved by providing reference standards to define each term clearly. Reference standards have been suggested by Meilgaard *et al.* (3) to define beer flavor terminology. These standards are prepared using a single compound in a beer base. For example, 3-*cis*-hexenol and guaiacol were selected as standards for grassy and smoky, respectively. One of the major problems with Meilgaard's approach, which cannot be resolved, is the inability of a single compound to faithfully reproduce a complex aroma characteristic, for example, raspberry or asparagus.

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The authors thank Bruno Dutertre (Moët et Chandon, Epernay, France) for his many constructive criticisms and suggestions and Olivier Goniak (ENS BANA, Dijon, France) for developing the sulfur and woody/burnt standards.

This research conducted at the University of California, Davis, CA.

Manuscript submitted for publication 1 July 1986.

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An alternative approach, which provides representative aroma standards, is a commercial sensory kit, such as that distributed by Lenoir (2). "Le Nez du Vin" is a library of 54 concentrated flavor essences. However, the essences are extremely unstable and degrade readily. For either system of defining reference standards, major problems result from the difficulty in handling of the standard. Use of either single compounds or concentrated flavor essences is difficult in ordinary facilities. Without proper ventilation and very careful use, the atmosphere can become contaminated, masking all other aromas.

Consequently, to provide standards which have consistent, characteristic (representative) aromas at suitable intensities, we have used the approach suggested in our original publication. With only a few exceptions, the reference standards are prepared using foodstuffs available throughout the world during most seasons. To provide a wine aroma background, the standards are prepared in neutral red or white wines, *i.e.*, wines which are free of defects and which have low intensity aromas. Therefore, the "recipes" are only approximate since the exact amount of the "flavorant" which produces the desired aroma intensity will vary in different base wines and with temperature. In Table 1, the guidelines for preparation of reference standards are given beside each term. Generally speaking, it is best to prepare the standards and re-evaluate them after 30 minutes.

The desired intensity of the reference standard will vary with its function. To illustrate a specific note, an intensity which provides a very obvious aroma is most appropriate. In contrast, to train judges for descriptive panels, lower intensities are needed to better represent that aroma characteristic at the levels at which it may be encountered in wine.

Literature Cited

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Table 1. Modernized standardized wine aroma terminology of the American Society for Enology and Viticulture.

Principal or 1st-tier term	2nd-tier term	3rd-tier term	Base ¹ wine	Reference composition ²
Floral	Floral	Linalool	W	1 mg (drop) linalool/100 mL white wine
		Orange blossom	W	Crushed orange blossoms
		Rose	W/R	1 mg 2-phenylethanol/150 mL white wine or crushed petals of one rose
		Violet	R	Petals from 10 crushed violets
Spicy	Spicy	Geranium	R	Piece of ripped geranium leaf (10mm × 10mm)
		Cloves	W/R	Soak one whole clove for 10-20 min and remove
		Black pepper	R	2-3 grains ground black pepper
		Licorice, anise	W/R	1 drop anise extract/50 mL wine
Fruity	Citrus	Grapefruit	W	5 mL juice and small piece peel of fresh fruit
		Lemon	W	5 mL juice and small piece peel of fresh fruit
	Berry	Blackberry	R	1-2 crushed fresh or frozen blackberries

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Table 1. (Continued)

Principal 1st-tier term	2nd-tier term	3rd-tier term	Base ¹ wine	Reference composition ²
		Raspberry	R	1-2 crushed fresh or frozen raspberries
		Strawberry	R	1-2 crushed fresh or frozen strawberries
		Black Currant/cassis	W/R	10 mL liquor from canned black currants and 5 mL Ribena® (sweetened concentrate) or 10 mL Cassis
	(Tree) Fruit	Cherry	R	10 mL brine of canned cherries
		Apricot	W	15-20 mL apricot nectar
		Peach	W	15-20 mL peach nectar or syrup from canned peaches
		Apple	W	Slice fresh apple, 5 mL apple juice
	(Tropical) Fruit	Pineapple	W	2-4 mL freshly opened canned pineapple juice
		Melon	W	1 piece fresh ripe canteloupe (20 mm cube)
		Banana	W	1 10-mm slice fresh banana
	(Dried) Fruit	Strawberry jam	R	1 tsp strawberry jam
		Raisin	R	5-8 crushed fresh raisins
		Prune	R	1-2 mL prune juice
		Fig	W/R	1/2 fig or 5-10 mL brine from canned figs
	Other	Artificial fruit	R	7-8 grains Tropical Punch Kool-Aid® or tropical fruit flavoring
		Methyl anthranilate	W/R	2-5 mL Welch's® grape juice
Herbaceous/vegetative	Fresh	Stemmy	W/R	4 crushed grape stems
		Grass, cut green	W/R	1 shredded 20-mm blade of green grass
		Bell pepper	W/R	12 mm × 10 mm slice of bell pepper; soak 30 min and remove
		Eucalyptus	W/R	1 crushed eucalyptus leaf
		Mint	W/R	1 crushed mint leaf or 1 drop mint extract
Herbaceous/vegetative	Canned/cooked	Green beans	W/R	3-5 mL brine from canned green beans
		Asparagus	W/R	2-3 mL brine from canned asparagus
		Green olive	W/R	4-6 mL brine from canned green olives
		Black olive	W/R	4-6 mL brine from canned black olives
		Artichoke	W/R	2-5 mL brine from cooked artichoke
	Dried	Hay/straw	W	Several pieces of hay, finely cut (no wine)
		Tea	W/R	3-4 flakes of black tea
		Tobacco	W/R	3-4 flakes of tobacco (least aromatic possible)
Nutty	Nutty	Walnut	W/R	1-2 walnuts, crushed (no wine)
		Hazelnut	W/R	1-2 hazelnuts, ground (no wine)
		Almond	W/R	1 drop almond extract/100 mL wine or 1-2 almonds ground (no wine)
Caramelized	Carmel	Honey	W	5-8 mL honey
		Butterscotch	W/R	1 butterscotch Life Saver® & 1 cut Kraft Caramel®
		Diacetyl (butter)	W/R	1 drop butter flavored extract/100 mL wine
		Soy sauce	R	1-2 drops soy sauce
		Chocolate	R	2-5 mL chocolate flavor or 1/2 tsp powdered cocoa
		Molasses	R	1-3 mL molasses
Wood	Phenolic	Phenolic	W/R	1 mg ethyl guaiacol
		Vanilla	W/R	1-2 drops vanilla extract
	Resinous	Cedar	R	1 drop cedar oil or few shavings of cedar wood
		Oak	W/R	2-3 mL of Oak flavor (Oak Mor, Finer Filter Products, Newark, CA)
	Burned	Smoky	W/R	1 drop smoky flavor extract/150 mL wine
		Burnt toast/charred	W/R	1 small piece burnt wood in 200 mL wine
		Coffee	R	2-4 grains ground coffee
Earthy	Earthy	Dusty	R	NA ³
		Mushroom	W/R	1 small mushroom, finely sliced/10 mL wine
	Moldy	Musty (mildew)	W/R	piece of mildewed cloth (no wine)
		Moldy cork	W/R	pieces of moldy cork (no wine)
Chemical	Petroleum	Tar	R	1 drop roofing tar, let sit overnight in wine
		Plastic	W/R	Cut up plastic tubing
		Kerosene	W/R	1 drop kerosene/150 mL wine
		Diesel	W/R	1 drop diesel/150 mL wine or 1 drop WD-40/50 mL wine
	Sulfur	Rubbery	W/R	1 10 mm × 5 mm piece of cut rubber tubing or bike tire (let sit several hours)
		Hydrogen sulfide	W/R	1 ppb hydrogen sulfide in wine; or 1/8 yolk of hard boiled egg (no wine)
		Mercaptan	W/R	5 ppb ethanethiol in wine; or smell natural gas which contains ethanethiol
		Garlic	W/R	1 5 mm × 5 mm piece crushed garlic in 150 mL wine; soak for up to 1 min and remove

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Table 1. (Continued)

Principal 1st-tier term	2nd-tier term	3rd-tier term	Base ¹ wine	Reference composition ²
		Skunk	W/R	NA
		Cabbage	W/R	2-3 mL brine from boiled cabbage leaves
		Burnt match	W/R	Burn 1 wooden match, extinguish; when cool, add 150 mL wine
		Sulfur dioxide	W	250 mg/L sulfur dioxide
		Wet wool, wet dog	W	Small piece of heated wet wool (no wine)
	Papery	Filter pad	W/R	Soak 20 mm × 20 mm piece filter pad overnight in 100 mL wine
		Wet cardboard	W/R	Soak 20 mm × 20 mm piece cardboard overnight in 100 mL wine
	Pungent	Ethyl acetate	W/R	1 drop ethyl acetate/50 mL wine
		Acetic acid	W/R	2-5 mL vinegar/50 mL wine or 2 drops glacial acetic acid/50 mL wine
		Ethanol	W/R	10-15 mL ethanol/50 mL wine
		Sulfur dioxide	W	250 mg/L sulfur dioxide
	Other	Fishy	W/R	1 drop trimethylamine/50 mL wine or few grains anion exchange resin in hydroxide form (no wine)
		Soapy	W/R	Few flakes Ivory® soap or grains Borax®
		Sorbate	W/R	50 mg potassium sorbate
		Fusel alcohol	W/R	300 mg/L of 2-methyl-1-butanol and/or 3-methyl-1-butanol
Pungent	Hot	Alcohol	W/R	40% v/v ethanol in water or wine
	Cool	Menthol	W/R	NA
Oxidized	Oxidized	Acetaldehyde	W/R	40 mg/L acetaldehyde or 5 mL sherry/25 mL wine
Microbiological	Yeasty	Flor-yeast	W	NA
		Leesy	W/R	NA
	Lactic	Sauerkraut	W/R	2-5 mL brine from canned sauerkraut
		Butyric acid	W/R	1 drop <i>n</i> -butanoic acid/100 mL wine
		Sweaty	W/R	1 drop isopentanoic acid/100 mL wine
		Lactic acid	W/R	NA
	Other	Horsey	W/R	1 mg <i>p</i> -cresol/100 mL wine
		Mousey	W/R	0.5-1 mg 2-ethyl-3,4,5,6-tetrahydropyridine/L wine

¹ W, R, or W/R denotes whether white, red, or either white or red base wine should be used.

² In 25 mL wine unless volume otherwise specified.

³ Standard not yet developed.