

Wine Tastes and Drinking Styles among Young Consumers in Japan

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Abstract

We investigated the wine drinking styles of people in their 20s and 30s. Results show that they drink wine when they celebrate special occasions at a restaurant or when they enjoy relaxing during dining out. Group interview panelist responses were analyzed for key words, which revealed that wine price is an important factor for wine selection by young consumers. Sensory evaluations were conducted for red wines and white wines to identify wines favored by young consumers. The data were analyzed using principal component analysis (PCA) and regression analysis. According to PCA results, sweetness contributed positively with harmony sensations and total evaluation; a sweet taste is the most important factor among wine tastes. Sensory evaluation regression analysis revealed that the values of sourness, astringency, and bitterness were decreased by sweetness, and that the effects of harmony of smell and taste were increased by adding sugar and acid. Results show that young consumers hope to buy inexpensive wine easily at convenience stores or supermarkets, and that it should be neither astringent nor bitter. They want a wine that can be drunk quickly, similarly to soda or juice.

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Key words : young consumers, taste, wine, statistics

INTRODUCTION

Alcoholic beverages have not shown increased sales for several years in Japan, according to a report by the National Tax Agency in Japan (<http://www.nta.go.jp/shiraberu/senmonjoho/sake/s-hiori-gaikyo/mokuji.htm>). In particular, sales of sake, a traditional Japanese alcoholic beverage, have decreased since 1975. Sake consumption in 2006 is 38% of the level in 1950. Low-alcohol beverages with 5 – 6% alcohol contents with a beer taste are now classified in Japan as three types: beer, *happoushu* (low malt beer, less than 50% malt used when brewing), and *zasshu* (non-malt beer-taste beverages). The latter have lower alcoholic tax levies according to their respective amounts of malt used in brewing.

Their sales volume has increased well: sales are 7.36 GL and have been increasing 2% per year for 10 years. Wine – about 280 ML annually – is also consumed, but consumption has increased very little over the past decade. In 2008, the average Japanese person drank 1.8 L or 2.4 bottles annually. Italian and French adults consumed more than 50 L: more than 66 bottles during 2008 (<http://www.wineinstitute.org/files/PerCapitaWineConsumptionCountries.pdf>).

Recently, wine has come to be drunk for health by many people in foreign countries as Europe and North/South America. Its consumption has increased greatly because of the reported decreased risk of heart disease from drinking wine: The so-called

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Table 1 Grouping of panelists in group interviews

	Sex	Age	Residence location	Times drinking per week	Number of panelists	Occupation
Type A	Female	20s	Local	Fewer	5	Student
Type B	Female	20s	Capital	Fewer	5	Student
Type C	Female	20s	Local	More	5	Student
Type D	Female	20s	Local	Fewer	5	Working
Type E	Female	20s	Local	More	5	Working
Type F	Female	30s	Local	Fewer	5	Working
Type G	Female	30s	Local	More	5	Working
Type H	Male	20s	Capital	Fewer	5	Student
Type I	Male	20s	Local	More	5	Student
Type J	Male	20s	Local	Fewer	6	Working
Type K	Male	20s	Local	More	5	Working
Type L	Male	30s	Local	Fewer	5	Working
Type M	Male	30s	Local	More	5	Working

Fewer—Fewer than two times weekly; More—More than three times weekly.
Local—living in Sendai or in northeastern Japan; Capital—living near Tokyo.

French paradox (1989). Recently, capsular wine/grape extract, actually evaporated wine/grape extract, is sold as a supplement in Japan, the USA, and Europe for health. According to a WHO report, resveratrol, a polyphenol, prevents heart disease. Reportedly, wine with enhanced resveratrol has been developed (Sboghi and others 1995; Bais and others 2000). Nevertheless, previous reports have not described wine taste preferences by consumers and consumers have not decreased because of the reports.

Furthermore, studies have been conducted by making wine not only from standard grapes such as Chardonnay, Merlot, Cabernet Sauvignon, etc., but also from kiwi fruit (Okuyama and others 1996; Yokotsuka 2003a, 2003b and 2003c) and other fruits: wine has been produced from Japanese wild grapes (Yonekura and others 2004). Such wines are popular, but not traditional. Japanese consumers associate alcoholic beverage consumption with foods, as reported by Kakee and others (2003). Four alcoholic beverages are compatible with many dishes. Japanese people choose some dishes for consumption of alcoholic beverages. However, tastes of alcoholic beverages were not reported by Kakee and others (2003).

Investigation of favorite wine tastes of young Japanese consumers is necessary to increase their consumption of alcoholic beverages. They might

come to prefer traditional wines as a result of their search for a favorite wine.

This study examines preferences of Japanese consumers in their 20s and 30s for wines made from grapes. Based on those results, wines that are preferred by Japanese young adult consumers can be developed.

METHODS AND MATERIALS

Group interview

Group interviews were conducted according to procedures described by Kanda and others (2000), as described below. The panelists (66 people) were grouped according to times of drinking, age, and sex; then groups of 4–5 people were interviewed. The population is described in Table I. Furthermore, contents of group interviews are presented in Table II. The interviews took 70 min per group; one moderator worked with the 4–5 people equally, giving an introduction, then asking the young consumers about their drinking styles and opinions of wine.

Analyses of interview responses

The interview responses were recorded using a voice recorder. The responses were analyzed according to parts of speech using free software. Words that were spoken by panelists during the

Table 2 Contents of group interviews

Interview item	Period (min/each group)	Contents of group interview
Introduction	10	Explains this group interview: Name Occupation Members of family Living a single life
Drinking style	35	For what purpose and when do they drink wine? Where do they drink wine? With whom do they drink wine? What do they eat when drinking wine?
Opinions about wine from young consumers	25	Ideal wines Traditional wines Ideal wine for young consumer

interview were counted. The panelists' responses were analyzed for spoken words by panelists, which were then counted. The x-axis shows the ideal wine for young consumers; the y-axis shows consumers' wine that is drunk presently. Furthermore, the symbol diameter represents the 'degree of an ideal wine for young consumers' determined by the following equation.

Degree of an ideal wine for young consumers

$$= (\text{number of responses from young consumer as an ideal wine}) / (\text{number of responses from young consumers as traditional wine}) \times 100$$

Screening panelists

Panelists were screened using procedures described by Sueda and others (2004) and Alberti-Fidanza (1998) as recognizing thresholds of tree tastes. Saccharose solutions (40 mM, 20 mM, 10 mM, 5 mM, each 50 mL) and purchased mineral water as soft water (each 50 mL) were poured into the wine tasting glass of the international standard organization (Cat# GT066SC; Luigi Bormioli, Parma, Italy; Jackson 2002) as sweet samples. They were set randomly and evaluated; 60 panelists chose the solution of lowest concentration. After resting for 10 min and rinsing using tap water, citric acid (0.4 mM, 0.3 mM, 0.2 mM, 0.1 mM) and purchased mineral water were prepared as sour samples, evaluated, and recorded similarly to the sweet samples. After resting and rinsing again, caffeine (5.0 mM, 2.5 mM, 1.0 mM, 0.5 mM) and purchased mineral water were prepared as bitter samples and evaluated. The panelists who made high percentages of correct

answers (6 men panelists and 7 women) were selected from 66 panelists, including men and women in their 20s and 30s. The evaluation was conducted in a group interview room at 25°C. The samples were kept at 15°C within a cool incubator (PCI-300; Iuchi Co., Osaka, Japan).

Evaluation of the model wine

The 13 panelists were trained in basic wine tasting methods for 1 hr (Jackson 2002). To prevent bias about the wine, information related to the sample wines was not given to the panelists. Tasting was conducted in individual tasting booths in the Food Processing Building, School of Food Agricultural and Environmental Science, Miyagi University, where the room temperature was adjusted to 25°C. Purchased wines used for sensory evaluation were produced from each grape variety as follows: Chardonnay (Chilean), Riesling (Australian), Sauvignon Blanc (French), and Delaware (Japanese) as white wine; and Muscat Bailey A (Japanese), Cabernet Sauvignon (Chilean), Pinot Noir (French), and Merlot (Chilean) as red wine. By adding 2.0% and 4.0% sucrose (Cat.# 196-00015; Wako Pure Chemical Industries Ltd., Osaka Japan) to the wine, and 0.8% and 1.0% tartaric acid (L(+) Tartaric acid, Cat.#207-00055; Wako Pure Chemical Industries Ltd., Osaka Japan) to white wine or 1.0% or 1.2% tartaric acid to red wine according to Amerine and others (1980), nine combinations of wines were prepared as presented in Table III. The samples were adjusted to 15°C within the cool incubator (PCI-300; Iuchi Co., Osaka Japan). Samples

Table 3 Characteristics of sample wine

Variety	Sugar (%)	Acidity g - /100 ml ^o	Alcohol (%)	Variety	Sugar (%)	Acidity g - /100 ml ^o	Alcohol (%)
Delaware A	0.70	0.68	11.0	Muscat Bailey A A	1.10	0.59	12.0
Delaware B	0.70	0.80	11.0	Muscat Bailey A B	1.10	1	12.0
Delaware C	0.70	1.00	11.0	Muscat Bailey A C	1.10	1.2	12.0
Delaware D	2.00	0.68	11.0	Muscat Bailey A D	2.00	0.59	12.0
Delaware E	2.00	0.80	11.0	Muscat Bailey A E	2.00	1	12.0
Delaware F	2.00	1.00	11.0	Muscat Bailey A F	2.00	1.2	12.0
Delaware G	4.00	0.68	11.0	Muscat Bailey A G	4.00	0.59	12.0
Delaware H	4.00	0.80	11.0	Muscat Bailey A H	4.00	1	12.0
Delaware I	4.00	1.00	11.0	Muscat Bailey A I	4.00	1.2	12.0
Chardonnay A	0.40	0.68	13.0	Merlot A	0.40	0.59	13.5
Chardonnay B	0.40	0.80	13.0	Merlot B	0.40	1.00	13.5
Chardonnay C	0.40	1.00	13.0	Merlot C	0.40	1.20	13.5
Chardonnay D	2.00	0.68	13.0	Merlot D	2.00	0.59	13.5
Chardonnay E	2.00	0.80	13.0	Merlot E	2.00	1.00	13.5
Chardonnay F	2.00	1.00	13.0	Merlot F	2.00	1.20	13.5
Chardonnay G	4.00	0.68	13.0	Merlot G	4.00	0.59	13.5
Chardonnay H	4.00	0.80	13.0	Merlot H	4.00	1.00	13.5
Chardonnay I	4.00	1.00	13.0	Merlot I	4.00	1.20	13.5
				Cabernet Sauvignon A	0.20	0.59	13.5
				Cabernet Sauvignon B	0.20	1.00	13.5
				Cabernet Sauvignon C	0.20	1.20	13.5
				Cabernet Sauvignon D	2.00	0.59	13.5
				Cabernet Sauvignon E	2.00	1.00	13.5
				Cabernet Sauvignon F	2.00	1.20	13.5
				Cabernet Sauvignon G	4.00	0.59	13.5
				Cabernet Sauvignon H	4.00	1.00	13.5
				Cabernet Sauvignon I	4.00	1.20	13.5

(Acidity is shown as tartaric acid g/100 ml)

sample() Date 2008,

Tasting sheet for wine

<Smell>

Top note 1 2 3 4 5 Weak Strong

Mouthful note 1 2 3 4 5 Weak Strong

Harmony of smell 1 2 3 4 5 Bad Good

Comments:

<Tastes>

Sour 1 2 3 4 5 Weak Strong

Sweet 1 2 3 4 5 Weak Strong

Bitter 1 2 3 4 5 Weak Strong

Astringency 1 2 3 4 5 Weak Strong

Harmony of teats 1 2 3 4 5 Bad Good

Comments:

Total evaluation 1 2 3 4 5 Bad Good
(Harmony of smell and tastes)

Comments:

Age: _____ Sex: F/M _____

Fig. 1 Tasting sheet for sensory evaluation.

(each 50 mL) were poured in an international standard organization wine tasting glass (Cat# GT066SC; Luigi Bormioli, Parma Italy; Jackson 2002). After tasting the sample wine, the panelists rinsed their mouths using purchased mineral water; then tasting was conducted for 30 min. The white wine tasting was conducted first. After 24 hr, tasting of red wine was conducted. Sensory evaluation was conducted with the rating method of a five-point scale using a sheet. (Fig. 1) by an absolute evaluation as each panel. An evaluation of 1 represented a weak sensation or dislike; an evaluation of 5 signified strong sensations or preference.

Statistical analyses

Statistical analyses were conducted using freely available software (Black-box; <http://aoki2.si.gunma-u.ac.jp/BlackBox/BlackBox.html>) and a spreadsheet program (Microsoft Office 2003 Excel; Microsoft Corp., Redmond, WA). Correlation analysis, principal

component analysis and regression analyses were done. Furthermore, the standardized partial regression coefficient was calculated.

RESULTS and DISCUSSION

1. Testing of drinking wine

The panelists were grouped into 13 types as types A—M according to their times of drinking opportunities, drinking habits, sex, and age (Table I).

First, the modes of thinking about alcoholic beverages of people in their 20s and 30s years were assessed. Results to four questions were obtained: ‘For what purpose and when do you drink wine?’, ‘Where do you drink wine?’, ‘With whom do you drink wine?’, and ‘What do they eat when drinking wine?’ (Fig. 2). Many unmarried people responded that they drank wine when ‘convenient’ and on ‘special days for dining’. They might go to a restaurant on a special day for a celebration or relax by dining out. However, they usually have dinner at home. It is considered that the reason for taking meals at home is that they usually take notice of

health issues.

Regarding the question of wine and meals, they drink wine during dining at home. The wine is not as expensive as that served in a restaurant. Wine is drunk while dining, at home, with friends or family, and with snack foods. They drink wine with snack foods during dinner time. They drink it as an aperitif with snack foods as an appetizer. They do not combine wine and certain dishes, as is done in other countries.

Kakee and others (2003) reported that many Japanese people drink wine with cheese or beefsteak, salmon Meuniere, drink beer with soybeans and beef, and drink sake with sashimi (raw fish), and *oden* (Japanese stew). Japanese cocktails made with shochu, Japanese spirits, are drunk with roasted chicken and fried chicken. The foods examined in that study were not snack foods. The panelists were in their 20s to 70s. Furthermore, elderly people (older than their 59) showed preferences for drinking wine with food. However, with meals, young consumers drink wines that are not dry wines. Instead, they

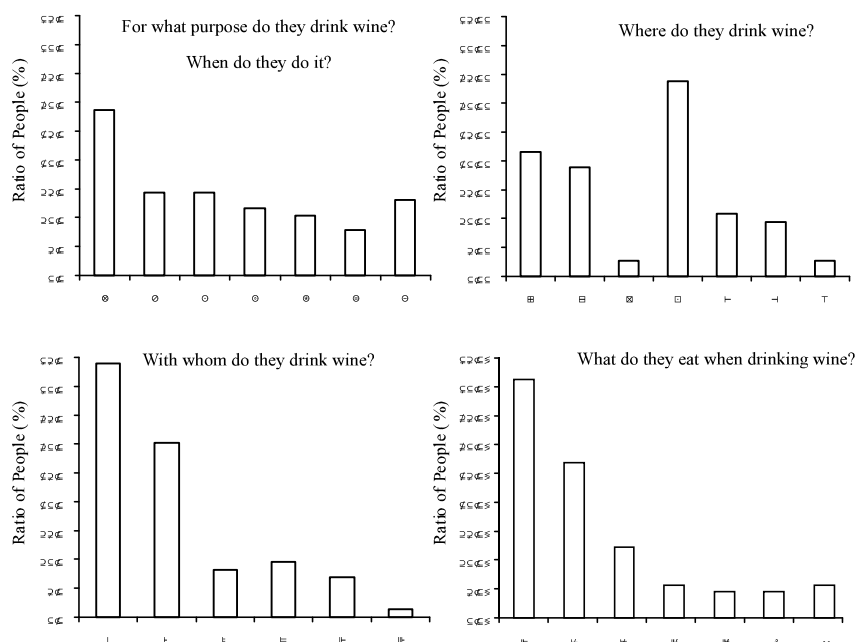


Fig. 2 Drinking style of young consumers in Japan.

A, Dinner; B, Meal at restaurant; C, Drinking party; D, After dinner/ dessert; E, Ceremony party; F, Other; G, Non-drinking; H, Japanese public bar; I, Restaurant; J, Wine bar; K, Home; L, Parent's home; M, Friend's home; N, Other; O, With friend; P, With family; Q, Colleague; R, Spouse; S, Alone; T, Other; U, Snack; V, Western dishes; W, Japanese dishes; X, Beef/meat/chicken; Y, Fish; Z, Other; a, Nothing.

prefer a sweet taste and prefer to drink wine as they would a soda or other beverage.

The panelists and the responses of panelists were analyzed for keywords, which were then counted. The results are presented in Fig. 3. On the 45-degree division on the graph, the upper area shows an ideal wine for young consumers; the lower area shows their present drinking consumption. Furthermore, the diameter denotes the calculated 'Degree of acceptability as an ideal wine for young consumers'.

Results show that 882 sentences were obtained as responses to the interview. In addition to 209 sentences obtained as answers about traditional wine, 231 sentences as answers about ideal wine, and 228 sentences as answers about young consumers were obtained. Furthermore, 214 sentences were given in other wine related matters. The parts of speech analyzed from sentences were grouped as 16. The key words are presented in Fig. 3. They indicate that the wine price is important for young consumers. Responses indicate that opinions were given 17 times.

White wine is drunk more than red wine. Regarding taste, 'sweet' was described 301 times. We therefore infer that sweetness is an important keyword for young consumers. Therefore, sweetness and price are important factors for young consumers.

An ideal wine for young consumers is 'smooth'. Furthermore, drinking specific wines with dishes was reported nine times, 'good taste' was described eight times, and 'good aftertaste' and 'non astringent' were given as responses seven times each. Therefore, results show that young people do not like bitter wine.

Regarding the ideal wine, as judged from young consumer responses, the most common response was for small bottles, and the bottle design, which was cited more than 201 times. Furthermore, the label design was reported often (101–150 times). It is inferred that young consumers seek a good appearance. Furthermore, they hope to obtain an inexpensive and non-astringent wine that can be drunk quickly. In light of those reasons, young

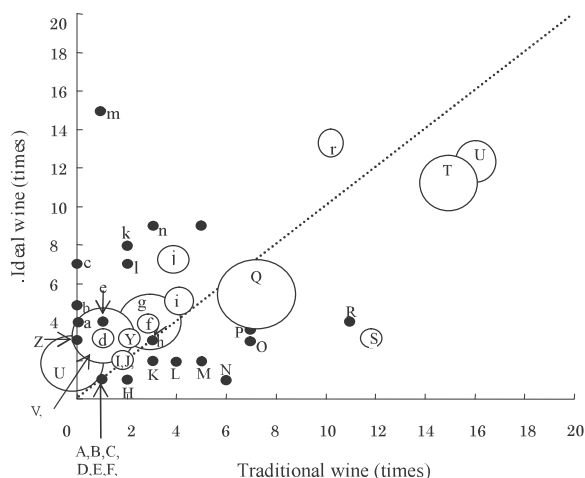


Fig. 3 Japanese young consumers' values for ideal wines and traditional wines.

Diameters represent the strengths of consumers' opinions.

'Degrees of an ideal wine for young consumer' = (number of responses from young consumers as an ideal wine)

/(number of responses from young consumers as traditional wine) × 100

Diameter = (number of responses from young consumer as 'ideal wine')

/(number of responses from young consumer as 'traditional wine') × 100

A, Volume; B, Select/Combination with wine; C, High alcohol; D, Ceremony; E, Foreign; F, Sparkling wine; G, Aged; H, Rosé wine; I, Bitter; J, Sour; K, Dry; L, No peculiarity; M, Dry; N, Cool; O, Astringent; P, Not Sweet; Q, Purchase; R, Red wine; S, White wine; T, Cheap; U, Suitable price; V, Small Bottle; W, Bottle design; X, Hangover; Y, Good aftertaste; Z, Selecting wine for dishes; a, Healthy; b, Not sick from drinking; c, Fruity; d, Dessert wine; e, Not sour; f, Low alcohol concentration; g, Label Design; h, Refreshing; i, Sweet; j, Non-astringent; k, Good taste; l, Aftertaste; m, Smooth; n, Marriage of dishes; q, Aroma; r, Drinking (gulping down)

Symbols: ●, <100; ○, 100–149; ○, <150; ○, 150–200; ○, 201–300; ○, ≥ 301.

Table 4 Correlation Matrix

Top note	1.0000								
Mouthful note	0.3776	1.0000							
Harmony of smell	0.1139	0.1352	1.0000						
Sour	-0.0227	0.0381	0.0898	1.0000					
Sweet	0.0433	0.1872	0.3643	-0.1626	1.0000				
Astringent	0.2126	0.2598	-0.1875	0.1408	-0.2209	1.0000			
Bitter	0.1715	0.2179	-0.1893	0.1384	-0.2045	0.7256	1.0000		
Harmony of tastes	0.0275	0.0591	0.5115	-0.0832	0.4671	-0.3279	-0.3559	1.0000	
Total evaluation	0.0337	0.0490	0.5632	-0.0578	0.4719	-0.3106	-0.3429	0.8764	1.0000
	Top note	Mouthful note	Harmony of smell	Sour	Sweet	Astringent	Bitter	Harmony of tastes	Total evaluation

consumers do not drink wine because it is expensive and astringent, and cannot be drunk quickly.

The values shown on the y-axis do not represent a presently available wine. The axis shows Healthy, No hangover from drinking, Fruity, and Reasonable price point. All of these qualities cannot be developed together into a single wine. However, those evaluations were useful for assessment of the wine preferences of young consumers.

2. Analyzing sensory evaluation data of preparing a model wine using statistical analysis

Sensory evaluation was conducted for red wine and white wine to identify a favorite wine of young consumers. Sensory evaluation was conducted according to a sheet depicted in Fig. 1 for Riesling, Chardonnay, Sauvignon Blanc, and Delaware as white wines, and for Muscat Bailey A, Pinot Noir, Cabernet Sauvignon, and Merlot as red wines. The grape varieties with a high score in the upper ranks were selected; sugar and tartaric acid were added according to a method described in the literature (Beelman and Gallander 1979). The panelists performed threshold tests on 66 people for sour, sweet, salty, and bitter tastes, from whom 13 panelists were selected. They were trained in wine tasting as panelists for this study. The evaluations were done using a maximum five-point scale (data not shown).

As a pre-evaluation, Delaware was given 3.92 points and Chardonnay was assigned 3.85 points as

white wines; the two wines made from the grape show a high score. Riesling was said to have a gasoline-like smell; the wine is not a favorite among Japanese people. Muscat Bailey A received 3.69 points, Merlot garnered 3.00 points, and Cabernet Sauvignon was assigned 2.85 points. The panelists did not like Cabernet Sauvignon, which has a unique aroma resembling that of green pepper. They also assigned Pinot noir a low score. Consequently, two white wines (Delaware and Chardonnay) and three red wines were chosen (Muscat Bailey, Merlot received 3.00 points, and Cabernet Sauvignon). Then 45 wines were prepared by adding sugar and tartaric acid to create wines of nine types. Details of the resultant 45 wines are presented in Table III: top note, mouthful note, balance of smell, sourness, sweetness, bitterness, astringency, harmony of taste, and the overall evaluation. The data were analyzed using freely available software (Black-box) for the correlation matrix and regression analysis, the results of the standardized partial regression coefficient are presented in Table IV.

From the averaged data of sensory evaluation with sample wines, we calculated the results of a correlation matrix, which show that the top note and mouthful note scores contributed to the smell. They are low contributions, but astringency and mouthful note also gave contributions of 0.26. Probably, many panelists did not feel a mouthful smell because they did not hold wine by the astringency of wine polyphenol. Harmony of smell, harmony of taste, and

Table 5 Standardized partial regression coefficient in regression analysis of sensory evaluation of white wine with added tartaric acid and sugar

	No addition of tartaric acid	Acid content 0.8%	Acid content 1.0%	Without sugar addition	Sugar content 2%	Sugar content 4%
Top note	-0.1286	0.0326	0.0626	-0.0356	0.0864	-0.0030
Mouthful note	0.0099	0.1650	-0.149	-0.1320	-0.0431	-0.0674
Harmony of smell	0.2002	0.1476	0.2596	0.3149	0.0913	0.0507
Sour	0.1018	0.0354	-0.1502	0.0782	0.2393	0.1551
Sweet	0.0854	-0.0580	0.0807	0.2149	-0.1508	0.2964
Astringent	-0.0150	-0.0894	0.1556	0.0637	-0.1504	-0.0219
Bitter	-0.0973	0.0375	-0.0197	-0.2633	0.0793	0.3423
Harmony of tastes	0.6240	0.9011	0.7468	0.3398	1.0441	0.8017

Addition of tartaric acid in the wine; multiple correlation coefficient $R=0.90088$; coefficient of determination, $R^2=0.811584$; adjusted coefficient of determination, $R^2_{adj}=0.789739$; standard error of mean, 0.465476; observed value, 78.

Addition of sugar in the wine; multiple correlation coefficient $R=0.895954$; coefficient of determination, $R^2=0.802734$; adjusted coefficient of determination, $R^2_{adj}=0.709903$; standard error of mean, 0.534447; observed value, 26.

Table 6 Standardized partial regression coefficient in regression analysis of sensory evaluation of red wine with added tartaric acid and sugar

	Without addition of tartaric acid	Acid content 1.0%	Acid content 1.2%	Without sugar addition	Sugar content 2%	Sugar content 4%
Top note	0.0598	0.0297	-0.0834	-0.0387	-0.0608	0.0232
Mouthful note	-0.0623	0.0191	-0.0095	-0.1097	-0.1148	0.1052
Harmony of smell	0.1910	0.1947	0.1341	0.2084	0.2153	0.0401
Sour	-0.0231	-0.0391	-0.0404	0.0764	-0.0748	0.0024
Sweet	0.0829	0.1150	0.1331	0.1162	0.0572	0.0540
Astringent	0.0584	0.0254	0.0150	0.0899	0.0669	-0.0222
Bitter	-0.0619	-0.0477	-0.0884	-0.0905	-0.0554	-0.0434
Harmony of tastes	0.7272	0.6362	0.8755	0.6418	0.7170	0.8374

Addition of tartaric acid in the wine; multiple correlation coefficient $R=0.908364$; coefficient of determination, $R^2=0.825126$; adjusted coefficient of determination, $R^2_{adj}=0.812051$; standard error of mean, 0.478279; observed value, 116.

Addition of sugar in the wine; multiple correlation coefficient $R=0.926808$; coefficient of determination, $R^2=0.858973$; adjusted coefficient of determination, $R^2_{adj}=0.820068$; standard error of mean, 0.464367; observed value, 38.

overall evaluation share mutual contributions (0.51 – 0.56). Therefore, it is important that there be harmony of smell and taste in the wine for panelists during wine tasting.

Regarding the taste, sourness did not contribute with other tastes: it was less than 0.1. However, the contribution was 0.05 and sourness was related with the total evaluation. We inferred that sourness did not contribute to the total evaluation and that sourness is not a negative factor for wine. The contribution is -0.2; sweetness is therefore related negatively with

astringency and bitterness. We considered that the astringency, bitterness and/or sourness in wine were not felt by sweetness according to the obtained comments. That result differs from those described in an earlier report (Ishikawa and Noble 1995; McBride and Finlay 1990). Sweetness contributed positively to harmony and the overall evaluation.

Results show that bitterness and astringency contribute the most against items (more than 0.8). The substance causing bitterness is the same as that of astringency in the wine: polyphenol. Generally,

astringency might be confused with bitterness (Lea and Arnold 1978). However, other researchers reported that astringency attributable to components such as tannins might partially mask their bitterness (Arnold and Noble 1978). Flavonoid phenolics are the primary bitter compounds in wine with tannin monomers (catechins); they are bitterer than their polymer (Robichaud and Noble 1990). The contribution is 0.3; bitterness and astringency are related with the total evaluation. The distribution is 0.876; the harmony and total evaluation were closely related. A favorite wine might be a balanced wine. Generally, bitterness is an important factor for red wine and a necessary taste in beer, coffee, chocolate, and wine (Mizuma and others 1992).

Regarding statistical analysis to show changes of the evaluation when adding sugar and tartaric acid in wine, regression analysis was conducted using sugar and acid concentrations as explanatory variables and sensory evaluations of respective wines as response variables (Tables V – VI).

In the sensory evaluation with white wine, the value of mouthful note was increased in the smell items. Furthermore, a tendency was that the taste showed more effects than that of smell for the ‘sweet white wine’. The value of taste in the sensory evaluation was therefore more important than that of

smell of wine when sugar had been added to white wine. The value of sourness was low against the total evaluation of wines with added sugar. The values of bitterness and astringency were also related with the values of sweetness. It is considered that sugar, as sweetness, made it difficult to sense bitterness and astringency, as had been reported earlier in the literature (McBride and Finlay 1990). Many panelists were affected by sugar in their evaluation. The sensory evaluation was improved by the addition of sugar because irritation attributable to sourness, bitterness, and astringency was masked by the sugar (Jackson 2002). Fructose decreases the volatility of acetaldehyde, but it enhances the volatility of ethyl acetate and ethanol as a smell substance (Maier 1970; Nawar 1971).

In the white wine with added tartaric acid, the top note value was affected by acid. It is a tendency by which the sourness value was decreased by sugar. Acidity was confirmed not to be a negative factor for wine, according to data of the regression coefficient. Addition of acid affected the values of astringency (-0.0894 or 0.1556) or bitterness (0.375 or -0.195) in white wine. The values of harmony of taste were 0.8 and the largest value. Addition of acid also affected the value of harmony of taste.

In the evaluation using red wines, the value of

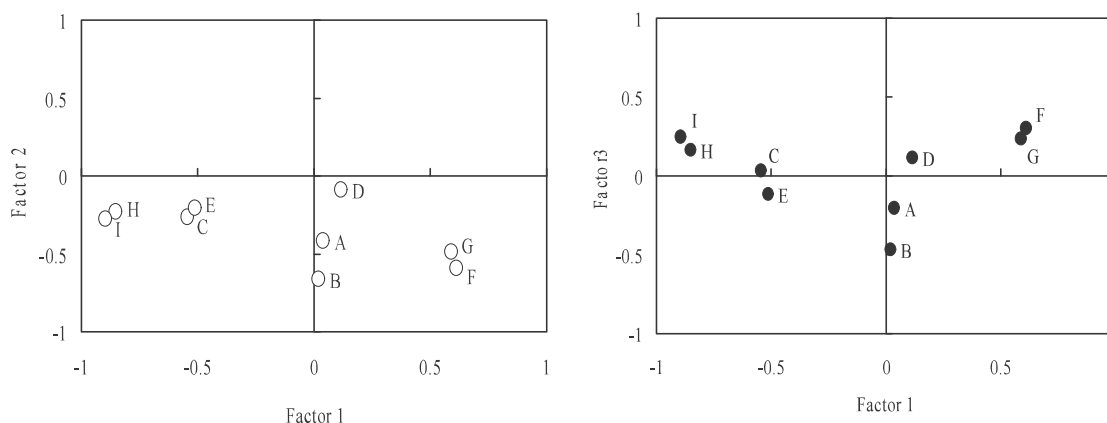


Fig. 4 Principal component analysis of sensory evaluation of white and red wine with added tartaric acid and sugar.

A, top note; B, mouthful note; C, harmony of smell; D, sour; E, sweet; F, astringent; G, bitter; H, harmony of tastes; I, total evaluation.

Factor 1, Eigenvalues, 2.82668; Contribution ratio, 31.40758; Cumulative contribution, 31.40758

Factor 2, Eigenvalues, 1.44342; Contribution ratio, 16.03802; Cumulative contribution, 47.4456

Factor 3, Eigenvalues, 0.52279; Contribution ratio, 5.80874; Cumulative contribution, 53.25434

harmony of smell decreased concomitantly with the increase of sugar in red wine. The values of sourness, sweetness, and astringency were decreased by adding sugar. It is considered that taste was more important than smell when sugar was added to red wine, as was true also for white wine.

In red wine with added tartaric acid, the top note value decreased concomitantly with increased tartaric acid and remained unchanged for white wine, which was true also for white wine.

The principal component analysis results are portrayed in Fig. 4. Scores of 'Harmony' (-0.8519) and 'Total evaluation' (-0.8965) were higher than those of others in Factor 1. We considered that Factor 1 represented 'Taste'. The scores of 'mouthful note' and 'astringency' were higher than those of others in Factor 2. We considered that Factor 2 represented 'a Stimulation' in the mouth. The score of 'mouthful note' (-0.6610) and 'astringency' (-0.5924) were higher than those of others in Factor 2. The score of 'mouthful note' (-0.4661) was higher than those of others in Factor 3. We considered that Factor 3 referred to the 'After taste' in the mouth. The data are portrayed in Fig. 4. Symbols H and I (harmony of tastes and total evaluation), Symbols C and E (harmony of smell and sweet), Symbols F and G (astringent and bitter) and Symbols A and B (top not and mouthful not) have relation. Symbol D (sour) located to differ from location of other tastes. It is considered that the sour taste has a different effect on wine tasting.

According to Fig. 4, Factors 1 and 2, the Symbol C (harmony of smell), E (sweet), H (harmony of tastes and I (total evaluation) signify good wine. Factors 1 and 3, Symbol E represents good wine and D, G, and F show bad wine. In principal component analysis, sugar affected the astringency and bitterness, those tastes did not feel by sugar. In the figure of the standardized partial regression coefficient in regression analysis, sweet and harmony of tastes/smell represent positive evaluation. Therefore sugar, astringency and bitterness show relations. According to locations of symbol H/I group and symbol F/G group were symmetric against the vertical axis. It is

considered that mouthful note was not affected

This finding contrasts with that of Guinard and others (1986). In general, ethanol augments the perceived intensity of bitterness by phenolic compounds, while decreasing the sensation of tannin-induced astringency (Lea and Arnold 1978). According to their results, effects of tastes were decreased, and effects of harmony of smell and taste were increased by addition of sugar. In addition, astringency and bitterness were unaffected by sugar. Sugars diminish the harsh aspects of wines: excessive acidity, bitterness, or astringency.

Regarding taste on the human tongue, sweetness and sourness were sensed quickly; bitterness and astringency were perceived slowly (Jackson 2002). Furthermore, the perceptions of sweetness and bitterness have similar modes of activation (Beidler and Tonosaki 1985; Margalit 1997): taste buds accept stimulation of sweetness by sugar and thereby become unable to accept a bitter sensation. Therefore, bitterness and astringency were not felt to be difficult problems with the sweet wine. We inferred that the young consumers did not like alcohol smell in alcoholic beverages, but that they will drink the beverages with snack foods or during meals if they find a favorite beverage that resembles soft drinks or non-alcoholic beverages.

Results of the interview show that the present image of wines is that they are astringent, bitter, and expensive. Young consumers hope to buy wine easily at a convenience store or supermarket; they want inexpensive that is not astringent or bitter. They want to gulp it down, drinking it quickly as they would juice or a soft drink.

The bitter taste sensation is reported to differ according to age: young people sense bitterness more than older people. The bitter taste is also exacerbated by stress (Mizuma and others 1992). Kakee (2003) reported that young beer drinkers in their 20s did not sense a bitter taste when they drank beer, but that it was sensed by drinkers who were over 30. Apparently, middle-aged beer consumers find the bitter taste difficult to abide because of stress. Young consumers do not like bitterness or astringency, but

sweetness was preferred. Furthermore, young consumers do not like bitter wine, as judged from the interview responses. To increase wine consumption of young people, the beverages must not be bitter. Furthermore, wine that is suitable for younger consumers can be developed by wine producers.

We will investigate effects of the quality of wine and other beverages on bitterness and astringency in greater detail in a later study.

CONCLUSIONS

We investigated the drinking style of wine for consumers in their 20s and 30s. Wine was drunk in the following situations: with meals, in the home, with friends or family, and with snack foods. The panelists' responses were analyzed for keywords, which were counted. Wine prices are important for young consumers. White wine is drunk more than red wine. An ideal wine for young consumers is 'smooth'; young consumers also value 'combining wine with dishes', 'good aftertaste', 'non-astringent', 'small bottle', and 'bottle design'. Sensory evaluation was conducted for red wine and white wine to identify a preferred wine for young consumers. Data were analyzed using statistical analysis. The PCA results show that the harmony of smell and total evaluation have mutual contributions. Sweetness contributed positively with harmony and total evaluation. The sweetness taste is the most important factor in wine taste. During regression analyses, some characteristics were assessed against other items of the evaluation. In sensory evaluation using white wine, the value of the mouthful note was important among the items of smell. The value of sourness was lower than that of the total evaluation for wines that had been sweetened with sugar. In the white wine with added tartaric acid, the top note value was affected by acidity. For evaluation of red wines, the value of harmony of smell decreased concomitantly with increasing sugar contents, as they had with white wine. The values of sourness, astringency, and bitterness were decreased by sweetness. The effects of the harmony of smell and taste were increased by adding sugar and increasing acidity.

Results show that young consumers hope to buy wine easily at convenience stores or supermarkets. They want to buy wines that are neither expensive nor astringent and bitter. Moreover, they want to drink wine quickly, as they would a soft drink or juice.

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日本の若年消費者のワインの嗜好及び飲酒スタイル

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我々は20～30代若者について、ワインの飲酒スタイルの調査を行った。その結果、レストランでの特別なお祝いや、外食中にリラックスして楽しむ時にワインを飲むということが示された。さらにパネリストの回答をキーワード分析した結果、ワイン購買時最も重要視しているのは、ワインの価格であることが明らかとなった。次に若い世代の消費者に好まれるワインを検討するために、赤ワインと白ワインの官能評価を行い、主成分分析と回帰分析を用い、解析した。主成分分析の結果、甘味が、調和と総合評価に寄与することが示された。すなわち、若者にとって、甘味はワインの味で最も重要な要素であった。さらに回帰分析を行い、酸味、収斂味、苦味が甘さによって軽減され、また、糖と酸の添加は、香味を調和させることを明らかとした。

以上の結果より、若い世代のワイン消費者はコンビニエンスストアやスーパーで安価なワインを購入すること、味に関しては、収斂味あるいは苦味がないワインを好んでいた。従ってワインがソーダやジュースと同様に、「ゴクゴク」と飲めることが望まれていることが、示唆された。

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