72

Sparkling wine sweetness: its influence on sensory properties and consumer acceptance

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INTRODUCTION

In the production of sparkling wine, the composition of the dosage can consist of wines (i.e. base wine or aged wines), wines aged in different containers, liquor/spirits, SO_2, citric acid, tannins, and sugar (0-50+ g/L)[1]. Sugar is an important component to the dosage. Commonly, wineries will use cane sugar or sucrose[2], beet sugar[1], grape must, concentrated grape juice, rectified concentrated grape juice, or a mixture of these ingredients[3,4,5]. The dosage composition contributes to wine complexity and residual sweetness, with the latter further defining the sparkling wine into one of six categories: *brut nature* (0-3 g sugar/L), *brut* (<12 g sugar/L) *extra brut* (12-17 g sugar/L), *sec* (17-32 g sugar/L), *demi sec* (32-50 g sugar/L), and *doux* (50+ g sugar/L).

Consumer acceptance of sweet white wines varies, with published studies being limited to table wines. In one study of white wines, German consumers displayed different sweetness preferences, with 28.9% of the consumers preferring semi sweet/sweet wines, 33.7% preferring semi-dry wines, and 36.0% preferring dry white wines[6]. Likewise, consumer preference studies of Chardonnay, Riesling, and Sauvignon blanc wines showed that one cluster of consumers preferred tropical fruit flavor, tree fruit flavor, and sweet taste while a second cluster preferred caramel, butterscotch and petroleum flavors, not liking sweet and fruity wines[7]. However, no study has yet examined the influence of sweetness on the consumer acceptance of sparkling wines.

The overall objective of the present study was to determine the influence of sugar type (ST) and residual sugar level (RSL) on the sensory properties and consumer acceptance of sparkling wines. Specifically, the sensory properties of the finished wines using descriptive profiling and consumer evaluations was performed. Ultimately, this study will provide insight into the complexity of sparkling wine evaluation, specifically the interaction among sugar and wine components, as well as the added knowledge of consumer perceptions of sparkling wines.

MATERIALS AND METHODS



Grapes were sourced from the Columbia Valley AVA in Washington state. Wines were produced and processed at a commercial winery.



Dosage treatments (n=7) included:

No sugar added (control)

Brut (~12.8 g/L) achieved using fructose, glucose, & sucrose

Demi sec (~37.8 g/L) achieved using fructose, glucose, & sucrose



Trained sensory panel (n=9) analyzed the wines for aroma, flavor, taste, and mouthfeels and a consumer panel (n=126) was used to assess acceptance of aroma, flavor, tastes, mouthfeels, overall, and refreshing intensity.

RESULTS AND DISCUSSION

Descriptive Analysis (DA)

Table 1. Mean separation of significant flavors and taste attributes of seven sparkling wines as evaluated by trained DA panel and analyzed using Fisher's LSD test.

RSL*ST	Flavor	Tastes	
	CVH	Sweet	Bitter
No sugar added			
Control	4.15[a] a	3.94 a	6.62 e
Brut			
Fructose	4.99 b	4.53 ab	5.88 d
Glucose	4.82 ab	4.43 a	5.52 cd
Sucrose	4.88 ab	4.66 ab	5.62 cd
Demi sec			
Fructose	5.93 c	7.82 c	4.83 b
Glucose	5.11 b	5.23 b	5.24 bc
Sucrose	7.00 d	8.16 c	4.15 a

- *Demi sec* wine sweetened with sucrose was rated the highest in CVH (caramel/vanilla/honey) flavor. *Demi sec* sparkling wines sweetened with glucose or fructose were higher in CVH flavor compared to the control ($p<0.05$).
- The *demi sec* wines sweetened with either fructose or sucrose were perceived as sweeter compared to the other treatments. The glucose *demi sec* treatment was significantly higher in sweetness than the control ($p<0.05$).
- For bitterness, the control was rated more bitter than all of the *demi sec* wines ($p<0.05$). Sucrose *demi sec* was lower in bitterness compared to the glucose *demi sec* wine ($p<0.05$). Both fructose and sucrose *demi sec* were less bitter compared to the fructose *brut* wine ($p<0.05$).

Table 2. Mean separation of significant attributes of seven sparkling wines of different residual sugar levels as evaluated by trained DA panel and analyzed using Fisher's LSD test.

Residual Sugar Level	Aroma	Flavors		Taste	Mouthfeels	
	Yeasty	Fruity	Yeasty	Sour	Foamy	Creamy
No Sugar Added	5.08 b	4.60 a	5.00 c	7.71 b	7.94 b	5.10 a
Brut	4.42 a	5.46 b	4.51 b	7.35 b	7.61 ab	5.64 b
Demi sec	4.30 a	6.47 c	3.87 a	5.69 a	7.49 a	6.04 c

- As sugar concentration increased, yeasty aroma and flavor decreased, while fruity flavor and creamy mouthfeel increased ($p<0.05$).
- *Demi sec* wines were less sour and had less foamy mouthfeel compared to the control ($p<0.05$).

Table 3. Mean separation of carbonation acceptance and overall acceptance (along a 9-pt scale) of seven sparkling wines as evaluated by a consumer panel (n=126) and analyzed using Fisher's LSD.

RSL*ST	Carbonation Acceptance	Overall Acceptance
No sugar added		
Control	6.01 a	5.17 a
Brut		
Fructose	6.28 ab	5.78 b
Glucose	6.53 bc	5.91 b
Sucrose	6.63 cd	6.02 b
Demi sec		
Fructose	6.87 de	6.62 c
Glucose	6.39 bc	6.16 b
Sucrose	6.95 e	6.90 c

- Wines with the lowest acceptance of carbonation were the control and fructose *brut* sparkling wines ($p<0.05$). Glucose and sucrose *brut* wines were more acceptable than the fructose *brut* ($p<0.05$).
- For *demi sec* wines, fructose and sucrose sweetened wines were more acceptable than the glucose sweetened wine ($p<0.05$).
- For overall acceptance, consumers had a higher acceptance of the fructose and sucrose *demi sec* wines over the other wine treatments ($p<0.05$). The control wine was the least accepted overall compared to the other wine treatments ($p<0.05$).

Consumer Acceptance

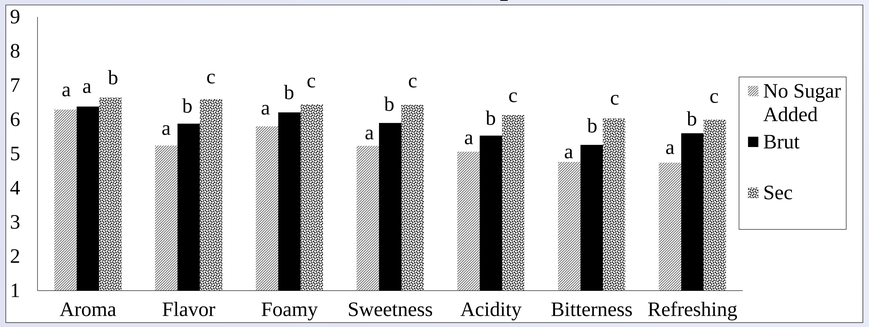

Figure 1. Influence of sparkling wine RSL on consumer acceptance of aroma, flavor, foamy, sweetness, acidity, and bitterness attributes of the wine (9-pt hedonic scale). Intensity of the perception of "refreshing" was also measure 1=not at all refreshing and 9=very refreshing.

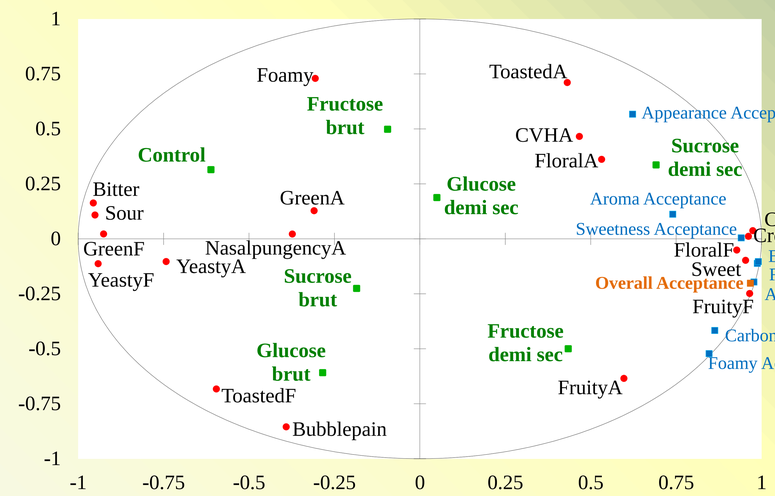

Figure 2. Partial Least Squares Regression (PLSR) biplot correlating trained panel evaluations (red dots) to acceptance ratings of the consumer panel (blue italics) for sparkling wine treatments made to vary in RSL and ST (denoted with blue squares and labelled with the specific treatment).

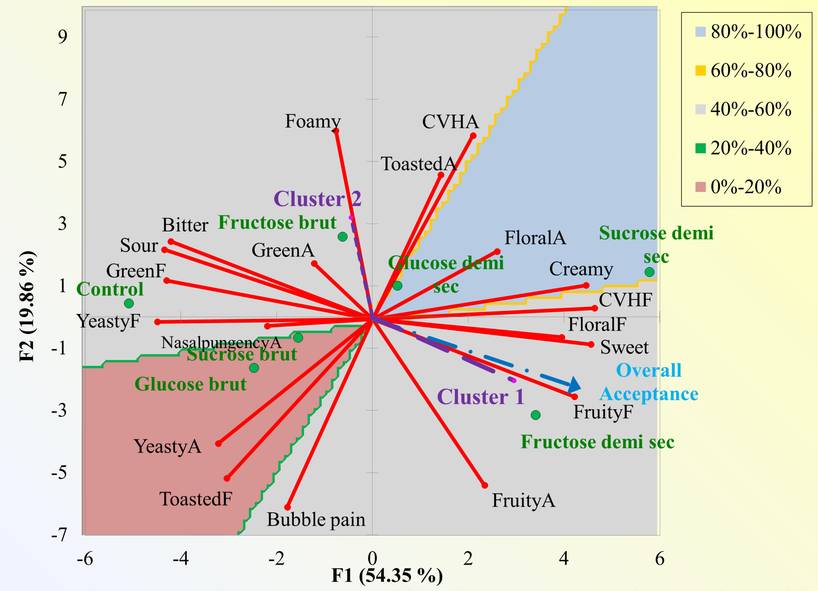

Figure 3. Preference map of consumer (n=126) liking for the sensory attributes of the sparkling wine treatments (green), attribute vectors from trained data (in red), and consumer clusters (purple). Shaded areas, representing the percentages of consumers as labelled in the legend, signify which clusters have a liking above average in a given region of the preference map.

CONCLUSIONS

- Seven sparkling wine treatments were created by varying the processing methods using different RSL (no sugar added, *brut* and *demi sec*) and ST (fructose, glucose, and sucrose).
- DA results revealed the influence of RSL on flavor perception, with an enhancement of fruity, but suppression of green and yeasty with increased RSL. Differences in sweetness were influenced by the relative sweetness value of the sugar type.
- To consumers, *demi sec* wines were more acceptable overall compared to the other sparkling wines; greater consumer acceptance was also found for sparkling wines sweetened with fructose and sucrose.
- Through cluster analysis, two consumer clusters were revealed. Cluster 1 preferred sparkling wines having fruity, floral, and CVH flavors, sweet taste, and creamy mouthfeel, while Cluster 2 preferred a sparkling wine with a foamy mouthfeel and green aroma.

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