Comparing 3 Glass Vessels for Evaluation of Aroma Attributes Using Descriptive Analysis

September 2019

Disclaimer: This work was independently designed and conducted by Sensation Research.



Executive Summary – Glass Vessel Evaluations

- The Sensory Engineered Glass delivers lower nasal burn and lower perception of ethanol compared to the Tulip Shaped Whisky Glass and the Snifter Glass vessels.
- Delivery of aromas in the Sensory Engineered Glass allowed the panel to recognize the initial and more subtle aromas quickly in the spirits compared to the 2 other glass vessels.
- The Sensory Engineered Glass was the highest in most of the aromatics of all 3 spirits profiled for the 3 glasses studied while the Tulip Shaped Whisky Glass was in the middle and the Snifter Glass was the lowest.
 - In general, the Sensory Engineered Glass delivers much more fruit and sweet aromatics in Scotch, Cognac and tequila than either the Tulip Shaped Whisky Glass or the Snifter Glass. The Sensory Engineered Glass also delivers more mint, squash and cactus in tequila.
 - The Snifter Glass delivers more wood aromatics in Scotch but the Sensory Engineered Glass and Tulip Shaped Whisky Glass deliver more in Cognac.
 - The Tulip Shaped Whisky Glass delivers more smoke, grapefruit and green pepper in tequila.
- Evaluators should be cautious with the Sensory Engineered Glass as the aromas dissipate more quickly than in the other vessels causing the profiles to change. Products should be evaluated within 5-7 minutes of pouring and watch glass covers should be utilized whenever active sniffing is not being conducted.

Methods and Materials

Methods - Spirits Analysis for Glass Vessels

- This work was independently designed and conducted by Sensation Research, Mason, Ohio.
- 3 different glass vessels were evaluated using 3 different spirits. The 3 glass vessels evaluated were the Sensory Engineered Glass, the Tulip Shaped Whisky Glass, and a Snifter Glass. Forty-five ml of each spirit was poured into each glass and immediately covered with a watch glass. Samples were swirled 3 to 4 times in the glass before evaluation for 5-10 seconds. The watch glasses were replaced after each evaluation to preserve the aromas.
- The descriptive panel included 7 spirits profiling experienced panelists in a 74°F sensory evaluation panel room.
- A lexicon to fully describe the tequila, Cognac and Scotch samples was developed. Panelists trained for 1 day on the methodology to evaluate the different glass vessels. Differences and similarities for all sensory attributes were measured on a 150 pt. scale from 'none' to 'very strong'.
- After training was complete, panelists worked individually to rate each spirit in the 3 different glass vessels with 3 evaluations per sample per panelist (21 responses per glass per spirit) over 3 days.
- Serving order was rotated and balanced across panelists.
- Senpaq 6.03 was used for analysis of variance (ANOVA) at 95% Confidence Level with Fisher's LSD for the Post Hoc test.

Glass Vessels Evaluated using Aroma Descriptive Analysis



"Sensory Engineered Glass"

NEAT Glass theneatglass.com



"Tulip Shaped Whisky Glass"

Glencairn Whisky Glass glencairnwhiskyglass.com



"Snifter Glass"

5.5oz Libbey Snifter Embassy Glass libbey.com #LIB3702



Sniff Methods - Spirits Analysis for Each Glass Vessel



Sensory Engineered Glass



Tulip Shaped Whisky Glass



Snifter Glass

- Swirl glass 3 times on the desk surface.
- Remove watch glass cover.
- 3. Sniff for 10 seconds in the glass; this is 3-5 slow sniffs for most panelists. Mouth is closed.
- 4. Recover the glass and rate the product.
- 5. Repeat as needed to complete the ballot.
- All glasses must be covered with watch glass covers to minimize evaporative loss when active sniffing is not in process.
- The Sensory Engineered Glass evaluation should start immediately after spirits pouring and completed within 5-7 minutes to minimize evaporative loss of ethanol and aromatic compounds.
- The Sensory Engineered Glass position for evaluation is with the nostrils in the center of the glass.
- The Sensory Engineered Glass and Snifter Glass are evaluated on the desk with the nose in the glass.
- The Tulip Shaped Whisky Glass is lifted from the table to the nose and pressed lightly below the nostrils with the glass at a 45-degree angle.

Spirits Evaluated - Spirits Analysis for Glass Vessels

PRODUCT	PROOF	LOT CODE	Bottle Number	Date of Manufacture
Casa Dragones Tequila Blanco	80	15	4687	5/11/2016
Casa Dragones Tequila Blanco	80	15	4341	5/11/2016
Casa Dragones Tequila Blanco	80	15	4623	5/11/2016
A. de FUSSIGNY Les Crus Du Cognac VSOP	80	LAFC018120303		3/26/2019
A. de FUSSIGNY Les Crus Du Cognac VSOP	80	LAFC017020901		2/13/2019
A. de FUSSIGNY Les Crus Du Cognac VSOP	80	LAFCO18120303	1/29/2019	
The Glenlivet 15yr Scotch	80	LPCM2478		11/13/2018
The Glenlivet 15yr Scotch	80	LPCN0263	13:22	2/14/2019
The Glenlivet 15yr Scotch	80	LPCN0263	16:47	2/14/2019



Comparison of Glass Vessel Profiles

Scotch, Cognac and Tequila Mean Scores by Glass Vessel

Glass Vessels Evaluation - Scotch

Highest in attribute

Lowest in attribute

Glass Vessel Evaluation; Scotch: n=21 responses	Sensory Engineered	Tulip Shaped Whisky Glass	Snifter Glass	LSD	Prob
	Glass	-			
Nasal Burn	27.3c	63.0 <mark>b</mark>	72.8 <mark>a</mark>	2.6	0.0001
Overall Aroma	83.8 <mark>a</mark>	80.4 <mark>b</mark>	82.0 <mark>ab</mark>	2.2	0.0200
Fruity Aromas Complex	69.2 <mark>a</mark>	60.2 <mark>b</mark>	51.1c	2.4	0.0001
Banana Aroma	21.5 <mark>a</mark>	13.6 <mark>b</mark>	6.8 <mark>c</mark>	5.1	0.0002
Apple Aroma	63.5 <mark>a</mark>	55.1 <mark>b</mark>	46.9 <mark>c</mark>	2.0	0.0001
Pear Aroma	41.5 <mark>a</mark>	29.9 <mark>b</mark>	17.7 <mark>c</mark>	2.9	0.0001
Raisin Aroma	30.0 <mark>a</mark>	27.4 <mark>b</mark>	22.7 <mark>c</mark>	2.2	0.0001
Rose Floral Aroma	29.9 <mark>b</mark>	31.6 <mark>ab</mark>	33.8 <mark>a</mark>	2.5	0.0158
Sweet Aromas Complex	67.1 <mark>a</mark>	51.7 <mark>b</mark>	40.9c	2.1	0.0001
Caramel Aroma	52.4 <mark>a</mark>	44.5 <mark>b</mark>	37.4c	2.5	0.0001
Vanilla Aroma	59.9 <mark>a</mark>	45.5 <mark>b</mark>	29.7c	4.3	0.0001
Brown Sugar/Light Molasses Aroma	36.1 <mark>a</mark>	26.5 <mark>b</mark>	18.3c	2.6	0.0001
Coumarin Aroma	26.9 <mark>a</mark>	22.3 <mark>b</mark>	17.8c	2.8	0.0001
Cinnamon Aroma	15.7 <mark>a</mark>	5.0 <mark>b</mark>	0.0c	2.8	0.0001
Black Pepper Aroma	18.5 <mark>b</mark>	21.0 <mark>b</mark>	27.5 <mark>a</mark>	3.4	0.0003
Coffee Aroma	5.9 <mark>a</mark>	2.9 <mark>ab</mark>	0.3 <mark>b</mark>	4.1	0.0392
Creamy/Nutty Aroma	12.9 <mark>a</mark>	4.5 <mark>b</mark>	0.0 <mark>b</mark>	4.7	0.0002
Wood Aromas Complex	68.7 <mark>b</mark>	71.0 <mark>b</mark>	75.6 <mark>a</mark>	3.2	0.0015
Fresh Oak Aroma	40.3c	45.4 <mark>b</mark>	51.6 <mark>a</mark>	3.4	0.0001
Charred Oak Aroma	63.8c	66.9 <mark>b</mark>	70.5 <mark>a</mark>	2.9	0.0013
Smoky Aroma	26.0c	33.3 <mark>b</mark>	37.2 <mark>a</mark>	2.6	0.0001
Phenolic Aroma	1.4 <mark>b</mark>	5.2b	15.8 <mark>a</mark>	3.9	0.0001
Leather Aroma	29.0 <mark>b</mark>	39.0 <mark>a</mark>	39.1 <mark>a</mark>	3.7	0.0001
Tobacco Aroma	26.2 <mark>b</mark>	39.0 <mark>a</mark>	37.9 <mark>a</mark>	3.8	0.0001
Fresh Hay	22.9 <mark>a</mark>	12.1 <mark>b</mark>	2.2c	4.3	0.0001
Grain Aroma	16.9 <mark>b</mark>	24.8 <mark>a</mark>	23.6 <mark>a</mark>	3.5	0.0007
Ethanol Aroma	18.1c	38.7 <mark>b</mark>	51.3 <mark>a</mark>	4.7	0.0001

^{*}Within an attribute, products labeled with different letters are significantly different at the 95% confidence as determined by Anova followed by Fisher's LSD.

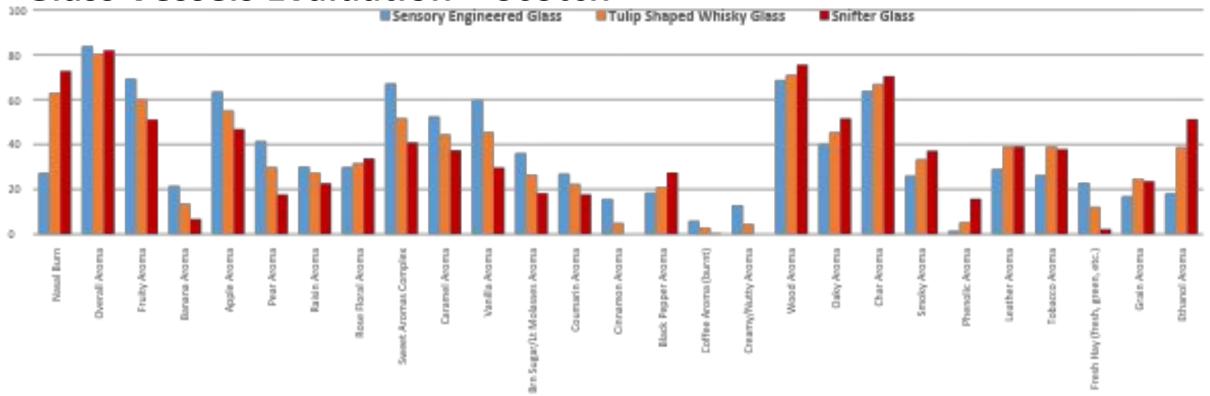
***Sensation Research**

For the evaluation of Scotch, the Sensory Engineered Glass was significantly highest in aromas of fruity, banana, apple, pear, raisin, sweet aromas complex, caramel, vanilla, brown sugar/light molasses, coumarin, cinnamon, creamy/nutty and fresh hay but lowest in nasal burn, fresh oak, charred oak, smoky, leather, tobacco, grain and ethanol.

The Tulip Shaped Whisky Glass is in the middle of the aroma profiles, and significantly lower than the Sensory Engineered Glass in overall aroma. It is high in leather, tobacco, and grain along with the Snifter Glass.

The Snifter Glass is significantly highest in nasal burn, black pepper, wood complex, fresh oak, charred oak, smoky, phenolic, and ethanol. The Snifter Glass is lowest in fruity complex, banana, apple, pear, raisin, sweet complex, caramel, vanilla, brown sugar/light molasses, coumarin, cinnamon and fresh hay. It is higher than the Sensory Engineered Glass in rose floral and lower than the Sensory Engineered Glass in coffee.

Glass Vessels Evaluation - Scotch

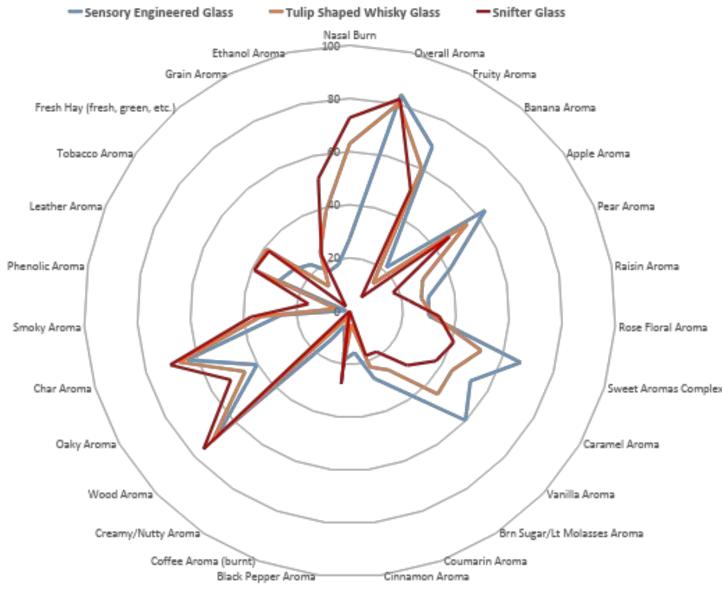


For the evaluation of Scotch, the Sensory Engineered Glass was significantly highest in aromas of fruity, banana, apple, pear, raisin, sweet aromas complex, caramel, vanilla, brown sugar/light molasses, coumarin, cinnamon, creamy/nutty and fresh hay but lowest in nasal burn, fresh oak, charred oak, smoky, leather, tobacco, grain and ethanol.

The Tulip Shaped Whisky Glass is in the middle of the aroma profiles, and significantly lower than the Sensory Engineered Glass in overall aroma. It is high in leather, tobacco, and grain along with the Snifter Glass.

The Snifter Glass is significantly highest in nasal burn, black pepper, wood complex, fresh oak, charred oak, smoky, phenolic, and ethanol. The Snifter Glass is lowest in fruity complex, banana, apple, pear, raisin, sweet complex, caramel, vanilla, brown sugar/light molasses, coumarin, cinnamon and fresh hay. It is higher than the Sensory Engineered Glass in rose floral and lower than the Sensory Engineered Glass in coffee.

Glass Vessels Evaluation - Scotch



For the evaluation of Scotch, the Sensory Engineered Glass was significantly highest in aromas of fruity, banana, apple, pear, raisin, sweet aromas complex, caramel, vanilla, brown sugar/light molasses, coumarin, cinnamon, creamy/nutty and fresh hay but lowest in nasal burn, fresh oak, charred oak, smoky, leather, tobacco, grain and ethanol.

The Tulip Shaped Whisky Glass is in the middle of the aroma profiles, and significantly lower than the Sensory Engineered Glass in overall aroma. It is high in leather, tobacco, and grain along with the Snifter Glass.

The Snifter Glass is significantly highest in nasal burn, black pepper, wood complex, fresh oak, charred oak, smoky, phenolic and ethanol. The Snifter Glass is lowest in fruity complex, banana, apple, pear, raisin, sweet complex, caramel, vanilla, brown sugar/light molasses, coumarin, cinnamon and fresh hay. It is higher than the Sensory Engineered Glass in rose floral and lower than the Sensory Engineered Glass in coffee.



Glass Vessels Evaluation - Cognac

Highest in attribute

Lowest in attribute

Glass Vessel Evaluation; Cognac: n=21 responses	Sensory Engineered Glass	Tulip Shaped Whisky Glass	Snifter Glass	LSD	Prob
Nasal Burn	31.4 ^b	62.3 ^a	65.9 ^a	4.3	0.0001
Overall Aroma	86.8 ^a	75.8 ^b	68.2 ^c	1.9	0.0001
Sweet Aromas Complex	68.2 ^a	62.3 ^b	58.5 ^c	2.0	0.0001
Vanilla Aroma	48.4 ^a	42.9 ^b	37.8 ^c	2.1	0.0001
Caramelized/Maple Aroma	64.0 ^a	58.6 ^b	54.6 ^c	1.4	0.0001
Cinnamon Aroma	37.3 ^a	30.9 ^b	24.3 ^c	2.2	0.0001
Fruit Aromas Complex	76.9 ^a	60.7 ^b	49.8 ^c	3.0	0.0001
Fresh Pressed Cider Aroma (red/green apples)	72.6 ^a	56.0 ^b	44.1 ^c	2.6	0.0001
Baked Apple Aroma	62.3 ^a	53.0 ^b	43.6 ^c	2.5	0.0001
Dried Fruit Aroma	40.3 ^a	30.0 ^b	24.8 ^c	2.3	0.0001
Pineapple Esters Aroma	22.2 ^a	18.1 ^b	19.1 ^b	2.1	0.0027
Cooked Cherries/Berries Aroma	45.1 ^a	33.4 ^b	25.7 ^c	2.9	0.0001
Rose Floral Aroma	33.2 ^a	32.6 ^a	27.0 ^b	1.6	0.0001
Wood Aromas Complex	70.1 ^a	69.8 ^a	66.2 ^b	2.5	0.0088
Wood Shavings Aroma	36.5 ^a	34.0 ^a	29.3 ^b	2.8	0.0003
Toasted Aroma	67.4 ^a	67.0 ^a	62.9 ^b	2.4	0.0030
Smoky Aroma	35.4 ^a	27.7 ^b	26.0 ^b	2.7	0.0001
Tar Aroma	16.1	13.0	14.5	3.7	0.2243
Crayon Aroma	13.0 ^a	3.7 ^b	2.8 ^b	3.6	0.0001
Ethanol Aroma	14.0 ^c	34.7 ^b	48.2 ^a	3.4	0.0001

^{*}Within an attribute, products labeled with different letters are significantly different at the 95% confidence as determined by Anova followed by Fisher's LSD.

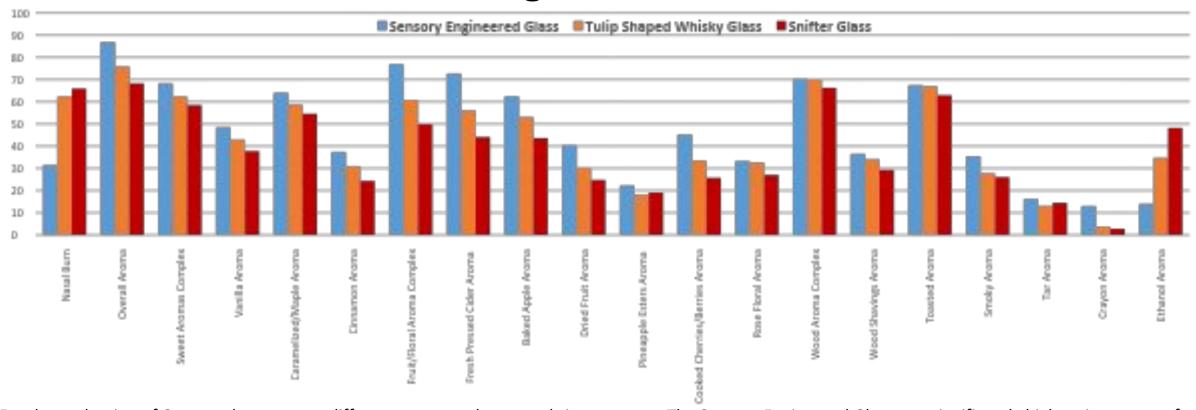
For the evaluation of Cognac, there was no difference among glass vessels in tar aroma. The Sensory Engineered Glass was significantly highest in aromas of overall, sweet aromas complex, vanilla, caramelized/maple, cinnamon, fruit aromas complex, fresh pressed cider, baked apple, dried fruit, pineapple esters, cooked cherries/berries, smoky and crayon and lowest in nasal burn and ethanol aroma.

The Tulip Shaped Whisky Glass is in the middle of the aroma profiles but it scores high in rose floral, wood aromas complex, wood shavings, and toasted with the Sensory Engineered Glass. It is also high in nasal burn along with the Snifter Glass.

The Snifter Glass is significantly highest in ethanol and lowest in overall, sweet aromas complex, vanilla, caramelized/maple, cinnamon, fruit aromas complex, fresh pressed cider, baked apple, dried fruit, cooked cherries/berries, rose floral, wood aromas complex, wood shavings and toasted.



Glass Vessels Evaluation - Cognac



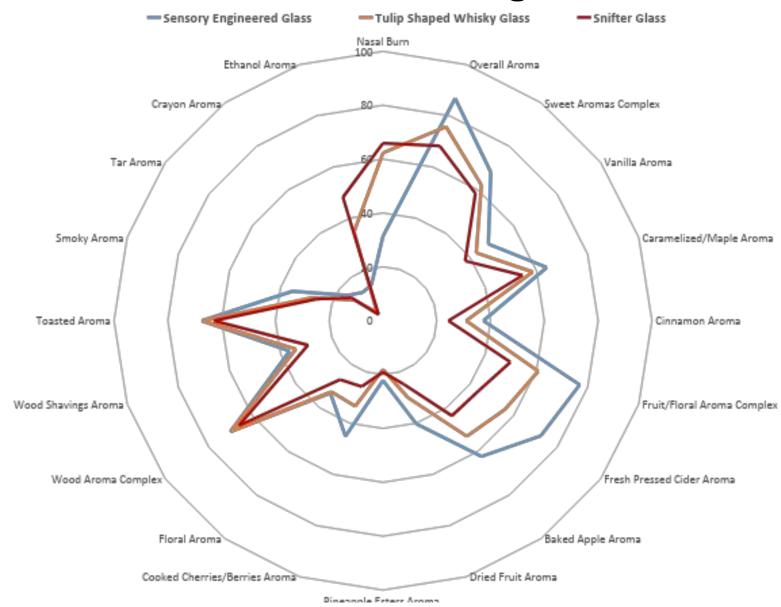
For the evaluation of Cognac, there was no difference among glass vessels in tar aroma. The Sensory Engineered Glass was significantly highest in aromas of overall, sweet aromas complex, vanilla, caramelized/maple, cinnamon, fruit aromas complex, fresh pressed cider, baked apple, dried fruit, pineapple esters, cooked cherries/berries, smoky and crayon and lowest in nasal burn and ethanol aroma.

The Tulip Shaped Whisky Glass is in the middle of the aroma profiles but it scores high in rose floral, wood aromas complex, wood shavings, and toasted with the Sensory Engineered Glass. It is also high in nasal burn along with the Snifter Glass.

The Snifter Glass is significantly highest in ethanol and lowest in overall, sweet aromas complex, vanilla, caramelized/maple, cinnamon, fruit aromas complex, fresh pressed cider, baked apple, dried fruit, cooked cherries/berries, rose floral, wood aromas complex, wood shavings and toasted.



Glass Vessels Evaluation - Cognac



For the evaluation of Cognac, there was no difference among glass vessels in tar aroma. The Sensory Engineered Glass was significantly highest in aromas of overall, sweet aromas complex, vanilla, caramelized/maple, cinnamon, fruit aromas complex, fresh pressed cider, baked apple, dried fruit, pineapple esters, cooked cherries/berries, smoky and crayon and lowest in nasal burn and ethanol aroma.

The Tulip Shaped Whisky Glass is in the middle of the aroma profiles but it scores high in rose floral, wood aromas complex, wood shavings, and toasted with the Sensory Engineered Glass. It is also high in nasal burn along with the Snifter Glass.

The Snifter Glass is significantly highest in ethanol and lowest in overall, sweet aromas complex, vanilla, caramelized/maple, cinnamon, fruit aromas complex, fresh pressed cider, baked apple, dried fruit, cooked cherries/berries, rose floral, wood aromas complex, wood shavings and toasted.

Glass Vessels Evaluation - Tequila Lowest in attribute

Highest in attribute

Glass Vessel Evaluation; Tequila: n=21 responses	Sensory Engineered Glass	Tulip Shaped Whisky Glass	Snifter Glass	LSD	Prob
Nasal Burn	25.3 ^b	73.1 ^a	70.0 ^a	3.7	0.0001
Overall Aroma	80.5 ^a	68.4 ^b	61.9 ^c	2.1	0.0001
Salty Aroma	22.4 ^a	21.6 ^a	18.9 ^b	2.6	0.0297
Marshmallow Aroma	23.0 ^a	11.4 ^b	0.0 ^c	2.9	0.0001
Smoky Aroma (ashtray)	53.1 ^b	59.8 ^a	54.2 ^b	2.8	0.0004
Black Pepper Aroma	43.1 ^a	38.1 ^b	35.2 ^c	2.1	0.0001
Overall Fruit Aromas Complex	68.7 ^a	54.0 ^b	33.3 ^c	2.5	0.0001
Grapefruit Citrus Aroma	44.0 ^b	47.4 ^a	29.7 ^c	3.3	0.0001
Lime Citrus Aroma	62.7 ^a	44.1 ^b	28.4 ^c	2.5	0.0001
Banana Aroma	21.8 ^a	1.0 ^b	0.0	2.8	0.0001
Floral Aroma	33.8 ^a	31.8 ^a	22.3 ^b	3.1	0.0001
Grass/Bell Pepper Aroma	37.8 ^b	46.7 ^a	41.3 ^b	3.6	0.0006
Cactus Aroma	48.8 ^a	34.4 ^b	16.6 ^c	4.7	0.0001
Mint Aroma	42.4 ^a	32.6 ^b	19.4 ^c	2.4	0.0001
Yellow Aromas (Squash/Sweet Potato)	32.4 ^a	12.8 ^b	5.2 ^c	4.4	0.0001
Ethanol Aroma	21.0 ^c	47.7 ^b	59.0 ^a	3.2	0.0001

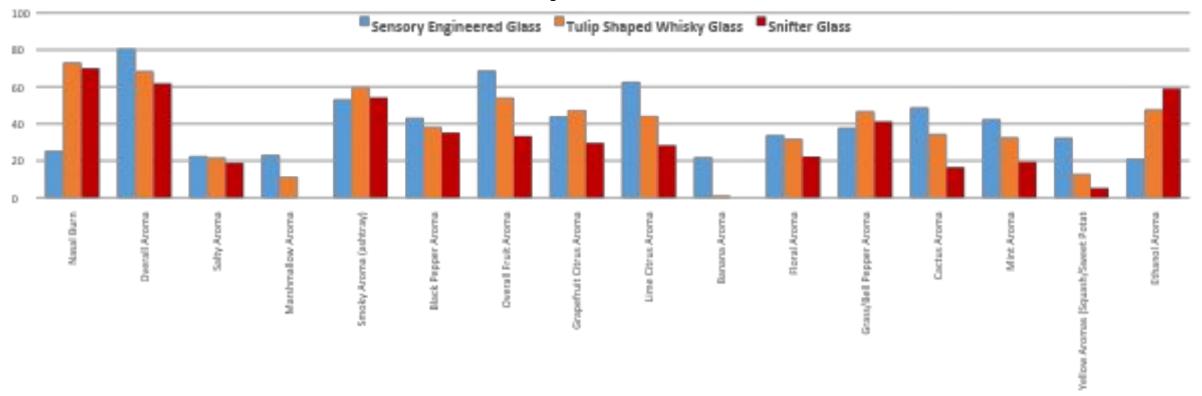
^{*}Within an attribute, products labeled with different letters are significantly different at the 95% confidence as determined by Anova followed by Fisher's LSD.

For the evaluation of tequila, the Sensory Engineered Glass was significantly highest in aromas of overall, marshmallow, black pepper, overall fruit complex, lime citrus, banana, cactus, mint and yellow squash/sweet potato and lowest in nasal burn and ethanol aroma.

The Tulip Shaped Whisky Glass is in the middle of most of the aroma profiles, however, it scores highest in smoky (ashtray), grapefruit and grass/bell pepper. It also scores high in salty and floral along with the Sensory Engineered Glass.

The Snifter Glass is significantly highest in ethanol and lowest in overall, salty, marshmallow, black pepper, overall fruit complex, grapefruit citrus, lime citrus, floral, cactus, mint and yellow squash/sweet potato.

Glass Vessels Evaluation - Tequila



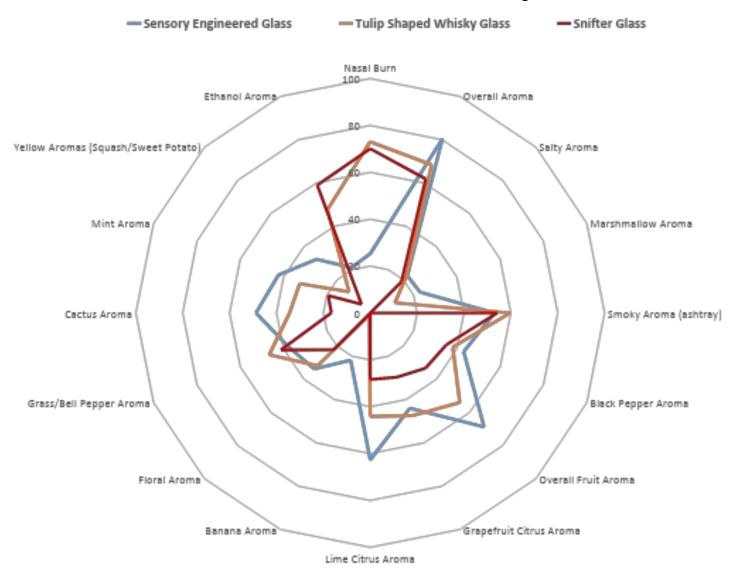
For the evaluation of tequila, the Sensory Engineered Glass was significantly highest in aromas of overall, marshmallow, black pepper, overall fruit complex, lime citrus, banana, cactus, mint and yellow squash/sweet potato and lowest in nasal burn and ethanol aroma.

The Tulip Shaped Whisky Glass is in the middle of most of the aroma profiles, however, it scores highest in smoky (ashtray), grapefruit and grass/bell pepper. It also scores high in salty and floral along with the Sensory Engineered Glass.

The Snifter Glass is significantly highest in ethanol and lowest in overall, salty, marshmallow, black pepper, overall fruit complex, grapefruit citrus, lime citrus, floral, cactus, mint and yellow squash/sweet potato.



Glass Vessels Evaluation - Tequila



For the evaluation of tequila, the Sensory Engineered Glass was significantly highest in aromas of overall, marshmallow, black pepper, overall fruit complex, lime citrus, banana, cactus, mint and yellow squash/sweet potato and lowest in nasal burn and ethanol aroma.

The Tulip Shaped Whisky Glass is in the middle of most of the aroma profiles, however, it scores highest in smoky (ashtray), grapefruit and grass/bell pepper. It also scores high in salty and floral along with the Sensory Engineered Glass.

The Snifter Glass is significantly highest in ethanol and lowest in overall, salty, marshmallow, black pepper, overall fruit complex, grapefruit citrus, lime citrus, floral, cactus, mint and yellow squash/sweet potato.



Appendix Aroma Language

Scotch Aroma Language – Glass Vessels Evaluation

Scotch Aroma Language
Nasal Burn
Overall Aroma
Fruity Aroma Complex
Banana Aroma
Apple Aroma
Pear Aroma
Raisin Aroma
Floral Aroma
Sweet Aroma Complex
Caramel Aroma
Vanilla Aroma
Brown Sugar/Light Molasses Aroma
Coumarin Aroma
Cinnamon Aroma
Black Pepper Aroma
Coffee Aroma (burnt)
Creamy/Nutty Aroma
Wood Aroma Complex
Wood Shavings Aroma
Toasted Aroma
Smoky Aroma
Phenolic Aroma
Leather Aroma
Tobacco Aroma
Fresh Hay
Grain Aroma
Ethanol Aroma



Cognac Aroma Language – Glass Vessels Evaluation

Cognac Aroma Language
Nasal Burn
Overall Aroma
Sweet Aromas Complex
Vanilla Aroma
Caramelized/Maple Aroma
Cinnamon Aroma
Fruit Aromas Complex
Fresh Pressed Cider Aroma (red and green apples)
Baked Apple Aroma
Raisin Aroma
Pineapple Esters Aroma
Cooked Cherries/Berries Aroma
Floral Aroma
Wood Aromas Complex
Fresh Oak Aroma
Charred Oak Aroma
Smoky Aroma
Tar Aroma
Crayon Aroma
Ethanol Aroma



Tequila Aroma Language – Glass Vessels Evaluation

Tequila Aroma Language
Nasal Burn
Overall Aroma
Salty Aroma
Marshmallow Aroma
Smoky Aroma (ashtray)
Black Pepper Aroma
Overall Fruit Aroma
Grapefruit Citrus Aroma
Lime Citrus Aroma
Banana Aroma
Floral Aroma
Grass/Bell Pepper Aroma
Cactus Aroma
Mint Aroma
Yellow Aromas (Squash/Sweet Potato)
Ethanol Aroma

