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Sensory and Marketing Characteristics of a Hibiscus Beverage

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The global beverage market comprises four sectors: 1) hot drinks, 2) milk drinks, 3) soft drinks, and 4) alcoholic drinks (Roethenbaugh 2005). The focus of this research is on soft drinks, specifically ready-to-drink non-carbonated beverages. Soft drinks are normally defined as sweetened water-based beverages, usually having a balanced acidity. There are two basic types of soft drinks: ready-to-drink (RTD) products and concentrates or dilute-to-taste products. The RTD sector is divided into carbonated and non-carbonated products (Ashurst 2005).

The two biggest market trends are health/wellness and convenience. Consumers are demanding more from their beverages. Drinks not only should be thirst-quenchers but also should provide added benefits. Health and wellness increasingly play an influential role in consumer choices on the beverage aisle. (Mintel International Group 2008).

Hispanics and blacks are important growth-driving demographics, not only because these groups are projected to exhibit an above-average population growth but also because they display an above-average incidence of juice consumption. Additionally, both groups are the key consumers in high-growth sports and energy drinks markets (Mintel 2008). Current market trends and changes in U.S. demographics have created the opportunity for the development of new products that would target these market segments.

Hibiscus sabdiriffa, commonly known as hibiscus or roselle, grows in many tropical and subtropical countries and is one of the highest volume specialty botanical products in international commerce (Plotto 1999). It is an annual herbaceous shrub and is a member of the Malvaceae family. The leaves are used extensively for animal fodder, fiber production, and in salads, while the seeds are a source of protein and lipids. Of commercial interest are the swollen calyces from the hibiscus plant. As the flowers fall apart, the bright red calyces swell they are then harvested by hand, dried, and sold for use in the herbal tea and beverage industry. In addition to international markets, there are extensive local and regional markets where hibiscus is processed into hot and cold beverages, jellies, confectionaries, and other products. Hibiscus flavor is a combination of sweet and tart, similar to cranberry (Morton 1987; El-Adawy and Khalil 1994; Sáyago-Ayerdi et al. 2007).

Demand for hibiscus has steadily increased over the past decades. Approximately 15,000 metric tons of dried hibiscus enter international trade each year. China and Thailand are the largest producers and control much of the world supply. Mexico, Egypt, Senegal, Tanzania, Mali, Sudan, and Jamaica are also important suppliers but production is mostly used domestically (Plotto 1999).

Hibiscus' attractive red color, refreshing properties, and associated health benefits have drawn the interest of several entrepreneurs to start a business of manufacturing hibiscus-based beverages. Some of the RTD commercial products that use hibiscus as main ingredient include Hibiscus Lemon Bissap (Adina for Life Inc.) Cañita Aguas Frescas (jamaica (hibiscus) flavor) (Eat Inc.), Squish Hibiscus Pressé (Squish Hibiscus Pressé), and Simply Hibi (Ibis Organica) (*New Nutrition Business* 2006).

Commercial products have different sensory and marketing characteristics and there is no available information on consumers' taste preferences of a hibiscus beverage. This study determined flavor and sweetness/acidity balance preferences of consumers in the development of a hibiscus beverage and determined possible market consumption patterns for a hibiscus beverage.

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Materials and Methods

Three sensory tests were performed at the University of Florida's Taste Panel Facility using 75 untrained panelists in each test (different panelists for each test). In the first two tests, flavor and sweetness/acidity balance preferences were determined. In the third test, a hibiscus beverage developed based on the information obtained from the previous two tests was evaluated and possible consumption patterns were explored through a market survey.

Beverage Preparation

For all sensory tests commercial sun-dried *Hibiscus sabdariffa* (cv."Criollo") was crushed and mixed with distilled water in the desired ratio (w/v) and maintained at room temperature (~22°C) for 1 hour. Extraction was conducted with constant stirring at low speed. The extracts obtained were filtered using four layers of cheesecloth. Sucrose was added to obtain a specific sweetness/acidity balance.

For Sensory Test 1 (ST 1) three hibiscus beverages containing different ratios of hibiscus and water were tested. The ratios were: 1:30, 1:50, and 1:70 (w/v), the latter being the least concentrated. All three extracts were adjusted to a sugar-to-acid ratio of 25[1] in order to maintain a constant sweetness/acidity balance in the beverages. For Sensory Test 2 (ST 2) four hibiscus beverages having a constant ratio of hibiscus and water of 1:40 (w/v) and different sugar-to-acid ratios (15, 20, 25, and 30) were tested. For sensory Test 3 (ST 3) one hibiscus beverage having a hibiscus to water ratio of 1:40 (w/v) and a sugar-to-acid ratio of 25 was tested. Codes and preparation ratios for all three sensory tests are presented in Table 1.

Physicochemical Analyses

In order to characterize the beverages the following physicochemical analyses were performed: pH, °Brix, titratable acidity (TA), and color. pH and TA were measured using an automatic titrator (Brinkmann Instruments Co., Westbury, NY). TA was determined by titration of 10 mL of sample with NaOH 0.1N until a pH of 8.1 was reached, and is expressed as g of malic acid per 100 mL of beverage. °Brix were measured using a Leica Abbe Mark II bench top refractometer (Leica Inc., Buffalo, NY). Color was measured using Machine

[1] The sugar-to-acid ratio refers to a number by which the acidity of a sample (percent w/v) is multiplied by to give a percent sugar (w/v) that will be added to the sample to maintain a constant sweetness/acidity balance.

Table 1. Codes and Preparation Ratios of Hibiscus-to-Water and Sugar-to-Acid Used In the Three Sensory Tests Conducted.

Sensory test code	Sample code	Hibiscus-to-water ratio (w/v)	Sugar-to-acid ratio
ST 1[a]	A	1/30	25
ST 1	B	1/50	25
ST 1	C	1/70	25
ST 2[b]	D	1/40	15
ST 2	E	1/40	20
ST 2	F	1/40	25
ST 2	G	1/40	30
ST 3[c]	H	1/40	25

[a] Sensory Test 1
[b] Sensory Test 2
[c] Sensory Test 3

Vision (Balaban et al. 2008) by placing 20 mL of sample in a 60 mL white plastic cup and analyzed using Lens Eye software (Engineering & Cybersolutions Inc., Gainesville, FL). Color was expressed in L^*, a^*, and b^* parameters.[2]

Sensory Tests

All samples were chilled and kept in ice at a temperature of ~4°C before serving. They were then served on a tray in numbered plastic cups containing ~30 mL of sample. A cup of deionized water and non-salted crackers were also provided to the panelists to cleanse their palate between evaluations.

For ST 1 overall likeability was measured using a nine-point hedonic scale. Flavor strength, tartness, and sweetness were measured using a five-point "just right" scale.[3] Samples were ranked from the most preferred to the least preferred at the end of the test.[4]

Overall likeability and sweetness were measured for ST 2 using the same scales as described for ST 1. Samples were also ranked at the end of the test. Color, aroma, flavor, and overall likeability were measured using a nine-point hedonic scale while flavor strength, tartness, and sweetness were measured using a five-point "just right" scale for ST 3.

To determine possible market consumption patterns, the marketing survey contained single-answer and more-than-one-answer multiple-choice questions related to the hibiscus beverage characteristics, package, and buying habits and intent.

Statistical Analysis

A randomized complete block design was used for ST 1 and ST 2. The panelists are the blocks and the beverages they evaluate are the treatments. The treatments were randomized such that all orders of presentation were presented to panelists approximately an equal number of times. For all three tests sensory data were recorded and analyzed using Compusense five (Compusense, Guelph, Ontario, Canada) and STATA data analysis and statistical software (STATACorp LP, College Station, TX). Analysis of variance (ANOVA) and mean comparisons using t-test and Tukey's test were conducted at the five percent significance level.

Results and Discussion

Physicochemical Analysis

A summary of physicochemical properties measured for the eight samples tested along the three sensory tests are presented in Table 2.

As expected, pH and TA were lower and higher, respectively, for the more concentrated samples. °Brix were adjusted in relation to TA to obtain the desired sweetness/acidity balance. L^*, a^*, and b^* values increased (the color became lighter) as samples concentration decreased. Samples color was described as "vivid red" by the software used to analyze it.

Demographic Data

The number of males and females in all the sensory tests was balanced, with females accounting for 49.3 percent, 50.7 percent, and 51.4 percent of total panelists for ST 1, 2, and 3, respectively. The highest frequency of panelist age was found in the range of 18–24 years, which was 74.7 percent, 69.3 percent, and 73.0 percent of total participants for ST 1, 2, and 3, respectively. For ST 3 we sought to obtain a higher percentage of younger panelists to have a representative sample of the existing com-

[2] L^* stands for lightness and is measured on a scale of 0 to 100, where 0 is black and 100 is white. a^* stands for redness and is measured on a scale from – to +, where – values indicate a green color and + values a red color. b^* stands for yellowness and is measured in a scale from – to + where – values indicate a blue color and + values a yellow color.

[3] The nine-point hedonic scale is used in acceptance tests and uses nine points that are associated with a degree of liking of a product: 1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much, and 9 = like extremely. The five-point "just right" scale is used to measure the desirability of a specific attribute and is often used to determine the optimum level of attributes in a product. In our case we used the following scale points to measure flavor strength, tartness, and sweetness: 1 = not "attribute (strong, tart ,or sweet)" at all, 2 = somewhat not "attribute" enough, 3 = just right, 4 = somewhat too "attribute,", and 5 = much too "attribute" (Lawless and Heymann 1998).

[4] The sample that was most preferred was given a rating of 1 followed by the intermediate sample which was given a rating of 2, and so on. To determine the ranking the given rates for each sample were added. The sample with the lowest added value is the sample that was most preferred.

Table 2. Measured pH, Titratable Acidity (TA) Expressed as G of Malic Acid per 100 ml of Beverage, °Brix, and Color (L^*, A^*, and B^*) for All Samples Tested.

Sample code	pH	TA	°Brix	L^*	a^*	b^*
A	2.40 ± 0.01	0.49 ± 0.01	13.8 ± 0.01	33.91 ± 0.07	56.19 ± 0.19	37.65 ± 0.27
B	2.42 ± 0.01	0.35 ± 0.01	9.0 ± 0.01	41.74 ± 0.27	65.94 ± 0.81	46.92 ± 0.94
C	2.52 ± 0.01	0.25 ± 0.01	7.0 ± 0.01	45.50 ± 0.35	69.57 ± 0.90	50.18 ± 0.98
D	2.40 ± 0.01	0.42 ± 0.01	7.2 ± 0.01	38.05 ± 0.02	62.48 ± 0.21	44.29 ± 0.22
E	2.40 ± 0.01	0.41 ± 0.01	9.1 ± 0.01	38.01 ± 0.02	63.09 ± 0.11	44.59 ± 0.08
F	2.39 ± 0.01	0.39 ± 0.01	11.2 ± 0.01	38.24 ± 0.07	63.11 ± 0.20	44.61 ± 0.24
G	2.39 ± 0.01	0.39 ± 0.01	13.1 ± 0.01	37.81 ± 0.09	62.67 ± 0.14	44.32 ± 0.10
H	2.40 ± 0.01	0.39 ± 0.01	10.6 ± 0.01	37.56 ± 0.03	63.09 ± 0.15	44.83 ± 0.18

mercial products targeted market segment. This market segment has shown to be more willingly to try new flavors as well as to have a greater interest for healthy and natural products. Panelists under 30, who represented 84.0 percent of the panelists, were grouped and their answers were compared with those over 30, who represented 16.0 percent.

Ethnicity distribution of panelists for Sensory Test 3 included white[5] (52.7 percent of the total), Hispanic or Latino[6] (10.8 percent), black or African-American[7] (20.3 percent), and Asian/Pacific Islander (16.2 percent). These values are different from the national population distribution, which is 68, 15, 12, and five percent for white, Hispanic, black, and Asian, respectively (U.S. Census Bureau 2009). For the ethnicity category the analysis performed compared responses from white and non-white panelists, 52.7 and 47.3 percent of the total, respectively. This division was made as an attempt to distinguish differences between possible target markets. Existing literature suggests non-whites are being targeted already as niche markets while whites represent potential new consumers.

[5] White does not include Hispanic or Latino.

[6] Hispanic or Latino include all races/multiple races.

[7] Black does not include Hispanic or Latino.

Sensory Test 1

The degrees of liking with the highest frequency were 6 and 7 ("like slightly" and "like moderately") for Sample A and 4 and 6 ("dislike slightly" and "like slightly") for Samples B and C. There was a significant difference ($p < 0.05$) among samples since mean values for overall likeability for Samples A and C (5.44 and 4.75, respectively) were significantly different (Tukey's test, $\alpha = 0.05$).

For flavor strength, the highest frequencies of ratings for Samples A and B were between 3 and 4 ("just right" and "somewhat too strong"); for Sample C they were between 2 and 3 ("somewhat not too strong" and "just right"). There was a significant difference ($p < 0.05$) among samples. Mean values for flavor strength for Samples A, B, and C were significantly different (3.48, 3.09, and 2.59, respectively) (Tukey's test, $\alpha = 0.05$).

For tartness, the highest frequencies of responses for Samples A and B were between 3 and 4 and for Sample C between 2 and 3. There was a significant difference between samples. Sample A mean value for tartness was significantly different from that of Sample C (3.29 and 2.83, respectively). For sweetness the highest frequencies of responses was between 3 and 4 for Sample A and between 2 and 3 for Samples B and C. There was a significant difference between samples. Sample A, B, and C mean

values for sweetness were significantly different (3.24, 2.68, and 2.21, respectively).

Sample A was ranked the best among the three samples followed by Sample B and Sample C. Samples A and C ranking values were significantly different. No significant differences ($p > 0.05$) were found between males and females for the mean values of all the measured characteristics (overall likeability, flavor strength, tartness, and sweetness). A summary of the mean values and ranking for all the attributes measured in ST 1 is presented in Table 3.

According to the results obtained in ST 1, Samples A and B had the highest rating for overall likeability and were ranked in first and second place. According to the mean values, Sample A was "somewhat too strong" in flavor, tartness, and sweetness. Sample B was almost "just right" in flavor, "somewhat too tart," and "somewhat not too sweet." Sample C was "somewhat not too strong" in flavor, tartness and sweetness. Since the most preferred samples were A and B, and considering all the other results, we decided to use a concentration between that of Samples A and B to appeal to the preferences of a wider range of consumers. Bolade, Oluwalana, and Oja (2009) found in a previous study that the optimum ratio for the hot-water (100"C) extraction of Nigerian hibiscus was 1:62 (w/v). That study, while related, dealt with hot-water extraction, whereas our study deals with cold-water extraction, with different hibiscus varieties being used. Our experiment studies a broader range of concentrations and expands this research by including sensory tests with 75 panelists each.

Sensory Test 2

The concentration used for ST 2 was between that of Samples A and B (1:40 w/v). The degrees of liking with the highest frequency were 3 and 4 ("dislike slightly" and "dislike moderately") for Sample D; 4, 6, and 7 ("dislike slightly," "like slightly," and "like moderately") for Sample E; and 6 and 7 ("like slightly" and "like moderately") for samples F and G. There was a significant difference ($p < 0.05$) between samples. Sample F and G mean values (5.77 and 5.68, respectively) for overall likeability were not significantly different (Tukey's test, $\alpha = 0.05$) between each other but were significantly different from those of Samples D and E (5.15 and 4.03, respectively).

The highest frequencies for sweetness were between 1 and 2 for Sample D, between 2 and 3 for Samples E and F, and between 3 and 4 for Sample G. There was a significant difference between samples. Sample F and G mean values for sweetness were not significantly different (3.27 and 2.99, respectively) but were significantly different from those of Samples D and E (2.53 and 1.89, respectively).

Sample F was ranked the best among the four samples, followed by Sample G, E, and D. Samples E, F, and G ranking values were not significantly different. No significant differences ($p > 0.05$) were found between males and females for the mean

Table 3. Mean Values for Overall Likeability, Flavor Strength, Tartness, and Sweetness, and Ranking Values for All Samples Evaluated In ST 1.

	Overall likeability[b]	Flavor strength[c]	Tartness[c]	Sweetness[c]	Rank total[d]
Sample A	5.44 a[a]	3.48 a	3.29 a	3.24 a	138.00 b
Sample B	5.01 ab	3.09 b	3.12 ab	2.68 b	142.00 ab
Sample C	4.75 b	2.59 c	2.83 b	2.21 c	170.00 a

[a] Values with similar letters within columns are not significantly different (Tukey's HSD, $p > 0.05$).
[b] 1 = dislike extremely, 5 = neither like nor dislike, 9 = like extremely.
[c] 1 = not "attribute (strong, tart or sweet)" at all, 3 = just right, and 5 = much too "attribute."
[d] The sample with the lowest rank total is the sample that was most preferred.

values of all the measured characteristics (overall likeability and sweetness).

The obtained results from ST 2 showed that samples F and G were the most preferred by panelists. Since Sample F was ranked the highest and was considered to have the best sweetness level we decided to use this formulation for ST 3. A summary of the mean values and ranking for all the attributes measured in ST 2 is presented in Table 4.

Sensory Test 3

For this sensory test the concentration and sugar to acid ratio were 1:40 (w/v) and 25, respectively. Frequency distribution for panelists' responses for color, aroma, flavor, and overall likeability for Sample H are shown in Figure 1. The highest frequency ratings were 7 and 8 for color; 5 and 7 for aroma; 6 and 8 for flavor; and 6, 7, and 8 for overall likeability. Color had the highest mean value of all attributes (7.35) followed by flavor (5.93) and aroma (5.65). Overall likeability had a mean of 6.28. No significant differences ($p > 0.05$) were found between males and females for aroma, flavor, and overall likeability. Color means for males and females were significantly different (6.94 and 7.74, respectively). This result may suggest that females are more attracted to bright, bold colors than are males. There was no significant difference between whites and non-whites for any of the four attributes measured, and age also was found to have no significance

Figure 2 shows the frequency distribution for panelists' responses for flavor strength, tartness, and sweetness measured for Sample H. The highest frequencies of responses were between 3 and 4 for flavor strength and tartness and between 2 and 3 for sweetness. Mean values were 3.22, 3.19, and 2.77 for flavor strength, tartness, and sweetness, respectively. No significant differences were found between males and females for any of the three attributes measured. Whites and non-whites showed no significant differences ($p > 0.05$) for flavor strength and tartness but showed a significant difference in sweetness (2.95 for whites and 2.57 for non-whites), showing that whites prefer a sweeter product. It was found that flavor strength and tartness were significantly different between age groups. Panelists over 30 found the product to be not so tart and required more flavor strength. This means that age might play an important role determining the optimum concentration ratio of the hibiscus beverage preparation. A summary of the mean values for all the attributes measured in ST 3 is presented in Table 5.

To determine the market consumption patterns for the hibiscus beverage, questions measuring the general perception of the product were asked in the ST 3 survey. Panelists found the characteristic that best described the hibiscus beverage was "exotic

Table 4. Mean Values for Overall Likeability, Sweetness, and Ranking Values for All Samples Evaluated in ST 2.

	Overall likeability[b]	Sweetness[c]	Rank total[d]
Sample D	4.03 c[a]	1.89 c	254.00 a
Sample E	5.15 b	2.53 b	182.00 b
Sample F	5.68 a	2.99 a	155.00 b
Sample G	5.77 a	3.27 a	159.00 b

[a] Values with similar letters within columns are not significantly different (Tukey's HSD, $p > 0.05$).
[b] 1 = dislike extremely, 5 = neither like nor dislike, 9 = like extremely.
[c] 1 = not "attribute (strong, tart or sweet)" at all, 3 = just right, and 5 = much too "attribute."
[d] The sample with the lowest rank total is the sample that was most preferred.

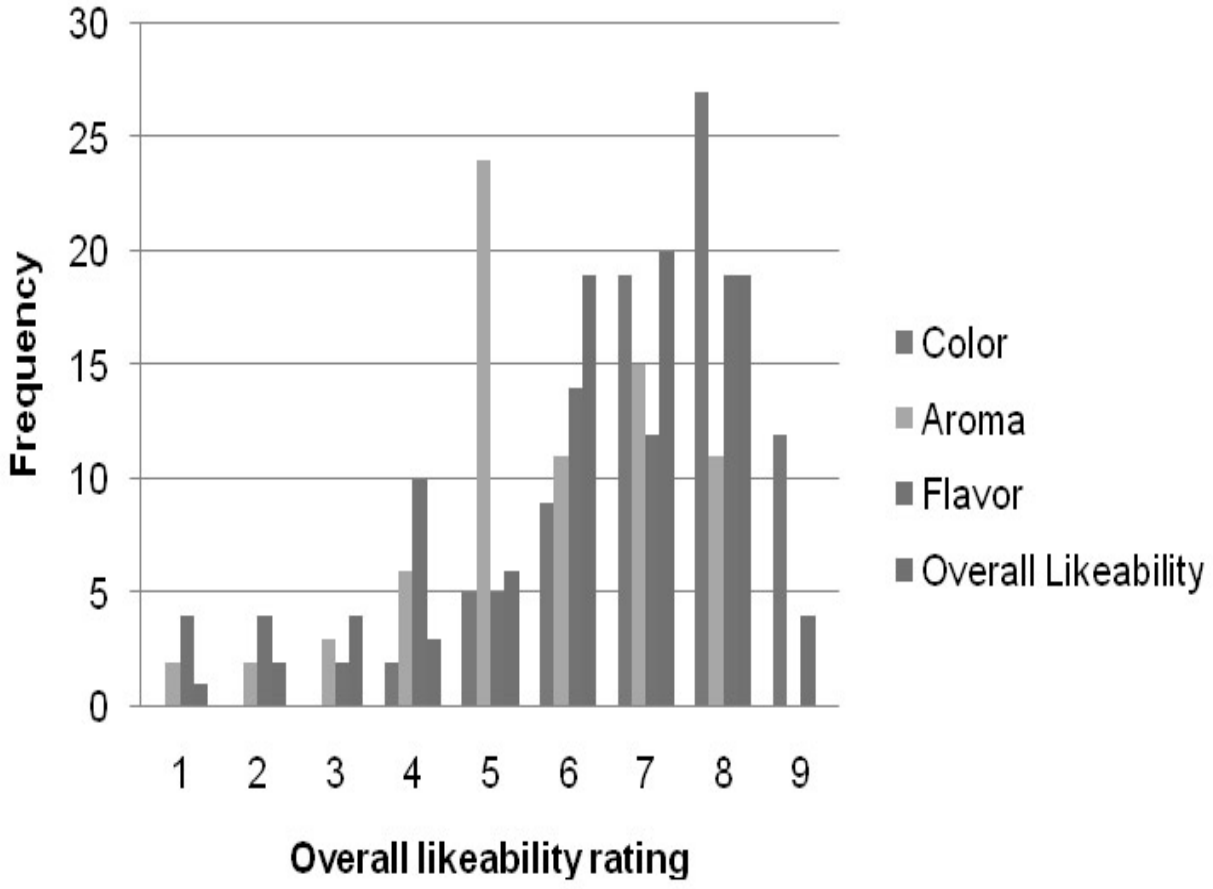

Figure 1. Color, Aroma, Flavor, and Overall Likeability Ratings Frequency for Sample H Evaluated in ST 3.

1 = Dislike Extremely, 5 = Neither Like Nor Dislike, 9 = Like Extremely.

flavor," followed by "tart taste," "unusual taste," and then "floral flavor." These answers were expected since this is a new flavor to which consumers are not accustomed, and it might take some time for consumers to get used to it. According to some panelists' comments, at first they were not familiar with the flavor but as they tasted it several times they started liking it. Differences among panelists by gender and ethnicity were not found. Panelists over 30, however, were more likely to relate the hibiscus beverage with weak taste than were panelists under this age, as discussed in the previous paragraph.

The majority of panelists included this product in the category "juice drink," followed by "ready-to-drink tea." This implies that they saw the product more as a juice drink than as a tea. Hibiscus is marketed as both; a juice drink mixed with fruit juices and is also used in tea blends in commercial products. The hibiscus beverage was not associated with a sport drink and is not currently sold in this category. Differences among panelists by gender, age, and ethnicity were not found in this area.

Package preferences among panelists were equally divided between plastic and glass bottles. Aluminum cans were only selected by 5.4 percent of the panelists. This result gives some insights about

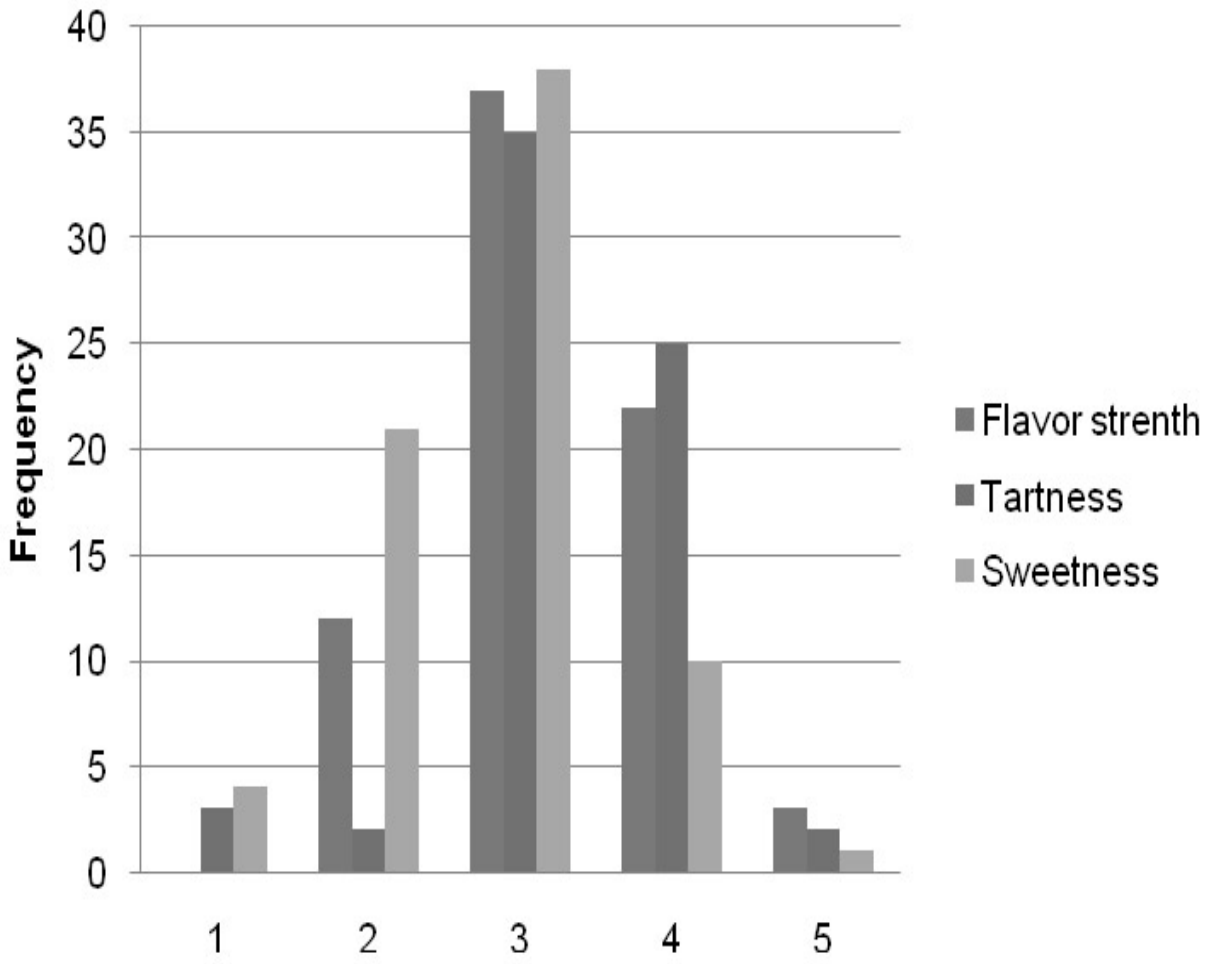

Figure 2. Flavor Strength, Tartness, and Sweetness Ratings Frequency for Sample H Evaluated in ST 3.

1 = Not "Attribute (Strong, Tart or Sweet)" At All, 3 = Just Right, And 5 = Much Too "Attribute."

consumer preferences regarding the presentation of the beverage. It seems that transparent containers would be ideal for consumers since color might play an important role in capturing consumer attention. Furthermore, glass is a better barrier to oxygen, which could prevent degradation of anthocyanins present in hibiscus. Most commercial hibiscus products are preferentially packaged in glass bottles. Differences in package preferences were found between males and females—63.9 percent of the male panelists preferred plastic bottles, while 63.2 percent of the female panelists preferred glass bottles. On the other hand, non-white panelists were found to like plastic bottles better than glass bottles, as opposed to white panelists. Package preferences also differed by age—75.0 percent of the panelists over 30 preferred glass bottles, compared to 41.9 percent of those under 30.

In terms of the time of day panelists would drink the hibiscus beverage, it was found that the product

Table 5. Mean Values and T-Test Comparison By Gender, Ethnicity, and Age of Tested Sensory Attributes for Sample H in ST 3.

	Gender			Ethnicity			Age			
Parameter	Male	Female	t	White	Non-white	t	Under 30	More than 30	t	Total[c]
Color[a]	7.74	6.94	2.87**	7.21	7.51	1.07	7.29	7.67	0.96	7.35
Overall likeability[a]	6.03	6.53	1.30	6.46	6.09	-0.97	6.21	6.67	0.87	6.28
Aroma[a]	5.53	5.76	0.60	5.72	5.57	-0.37	5.60	5.92	0.60	5.65
Flavor[a]	5.75	6.11	0.69	6.15	5.69	-0.92	5.79	6.67	1.27	5.93
Flavor strength[b]	3.33	3.11	-1.29	3.18	3.26	0.43	3.22	2.67	-2.85**	3.22
Tartness[b]	3.31	3.08	-1.16	3.10	3.29	0.94	3.27	2.75	-2.02**	3.19
Sweetness[b]	2.78	2.76	-0.08	2.95	2.57	-2.06**	2.79	2.67	-0.49	2.77

[a] Attributes tested using a nine-point hedonic scale.
[b] Attributes measured using a five-point "just to right" scale.
[c] Refers to the average of the total panelists' responses.
** Statistically significant ($\alpha = 0.05$).

could be consumed at almost any time of the day. Mid-morning snack, afternoon snack, and evening snack were the times of the day preferred by the panelists. In terms of the purchase place, panelists did not categorize the hibiscus beverage exclusively as an ethnic product. The most recurrent places they would buy this product were grocery store, ethnic market, and vending machine. Differences among panelists by gender, age, and ethnicity were not found in this area.

When asked about their purchase intent, the highest frequencies of answers were obtained for the categories "might or might not" and "probably would"; the mean value was 2.91. The purchase-intent mean increased to 3.45 after panelists were told that the product contained natural "antioxidants" that are associated with health benefits (Figure 3). This suggests that hibiscus-beverage marketing plans should focus specially on increasing consumers' awareness of the health benefits associated with the product as a strategic plan to increase consumers' purchase intent. Panelists who answered "definitely would not" and "probably would not" were asked to state the reason for which they were not willing to buy the product. "Unusual taste," "too tart," and "strong aftertaste" were the most frequent reasons for not buying the product. Panelists who answered "might or might not" to the question were asked to state what changes in the product would make them more willingly to buy it. "Mix it with other flavors" and "make it sweeter" were the most frequent responses.

No significant differences were found between males and females and between whites and non-whites in terms purchase intent. There also was no significant difference between purchase intent of males and females after they knew the product contained antioxidants. However, there was a significant difference between whites and non-whites. Non-whites' purchase intent increased more (3.77) than did that of whites (3.15) after they knew the product contained antioxidants.

At the end of the survey all panelists were asked in what other products they would like to see hibiscus flavor added. "Tea blends," "juice blends," and "smoothies" were the most frequent answers.

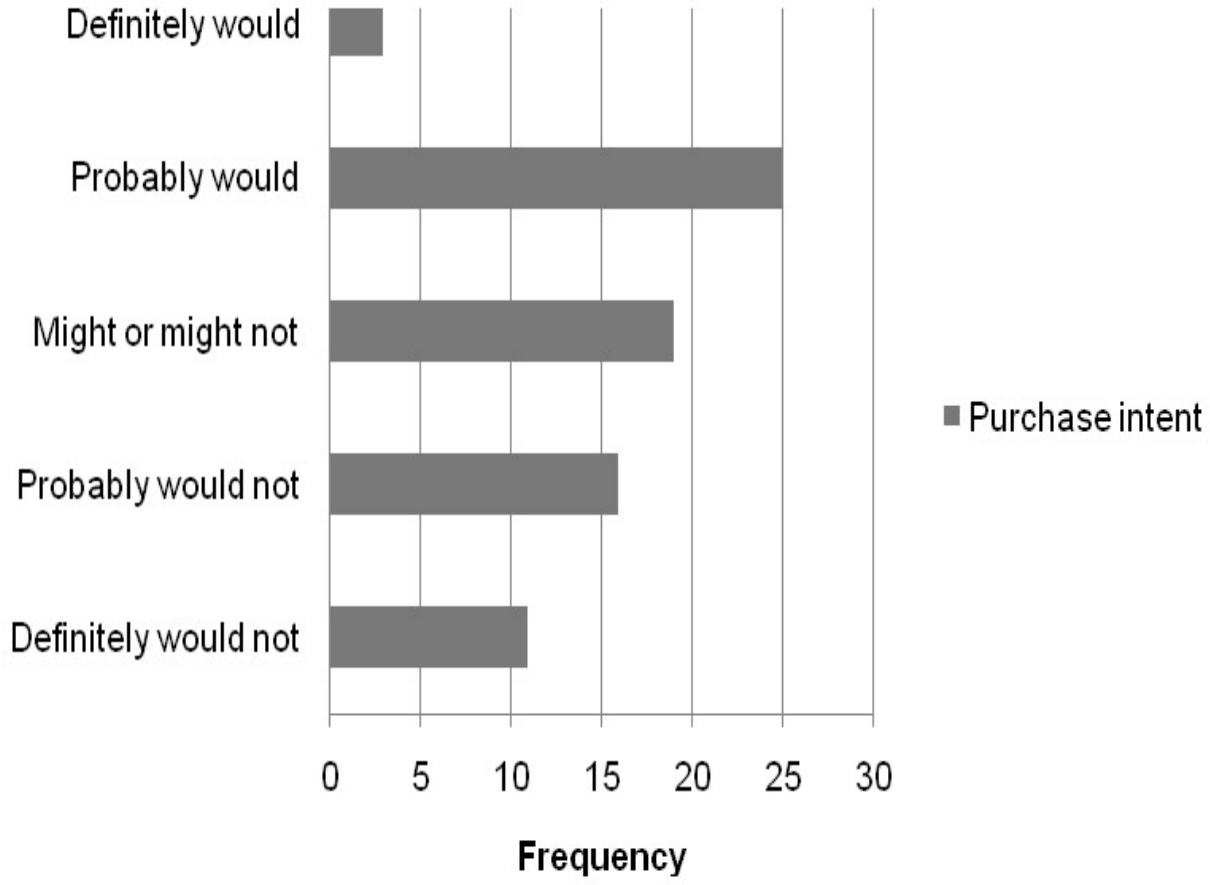

Figure 3. Distribution of Answers to the Questions "How Likely Would You Be to Purchase This Product?" and "If You Knew the Product Has Natural ANTIOXIDANTS That Are Associated With Health Benefits, How Likely Would You Be to Purchase It?"

Conclusions

Color was the attribute that panelists rated the highest, followed by flavor and aroma. Color was also the only attribute that was rated significantly different between males and female. There was a significant difference between whites' and non-whites' sweetness perception as well as purchase intent after knowing the product contained antioxidants. The analysis suggests age, gender, and ethnicity are important factors that play a role in determining the market consumption patterns for the hibiscus beverage. Package preferences and the hibiscus-beverage concentration, for instance, were found to change depending on the target market. Place and time of consumption were homogeneous among consumers. Finally, color and the health benefits associated with the product were two main factors that seemed to be appealing to consumers and should be included in any marketing plan.

Until now, ready-to-drink hibiscus beverages have been targeting niche and young segment markets. This project shows that there is a potential market for hibiscus beverages in the American market,

not only in niche markets but also as a specialty product in a larger market; this study therefore can be used as reference for future focus groups research. In the same way, the hibiscus formulation results of this project (extraction conditions and beverage sweetness level) could be used by the food industry in the development of new hibiscus beverages or blends of hibiscus with other ingredients such as juices or teas and in the selection of target markets for these products.

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