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Identifying Drivers for Consumer Acceptance and Purchase Intent of a Novel Low-Fat Sugar-Free Sherbet Containing Soy Protein

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Abstract: Consumer interest in healthy eating and self-medication is exponentially growing. Soy-based products have become increasingly popular and gradually moved into the mainstream market. In this study 12 low-fat sugar-free orange sherbets were formulated with soy protein, SP (3.25, 4.25, 5.25 or 6.25%) and maltodextrin, MD (10, 11 or 12%) in addition to a control (0% SP and 12%MD). Acceptance and purchase intent of these products were evaluated by consumers. Sensory drivers of acceptance and purchase intent of these products were identified. Appearance, texture and overall liking had a significant influence on overall acceptance, while sourness and overall liking significantly affected purchase intent. After the consumer had been informed of the health benefits of soy ingredients in the products, the only significant predictor for purchase intent was overall liking, with the odd ratio (2.134) much lower than that (6.945) obtained before the consumers were informed of the health benefit information. One reason could be the compromise some consumers were willing to make because of the nutritional benefits of soy protein. This compromise resulted in a lower odds ratio for overall liking.

Key words: Acceptance, purchase intent, sherbet, soy protein

INTRODUCTION

Ice creams and sherbets had the largest share of the frozen dessert market at about 90.9% in 2004 (Milk Facts, 2005). Sherbets, particularly, have had a consistent consumption pattern of 1.2-1.3 Lbs. per capita between 2000 and 2004 (Milk Facts, 2004).

Fruit-containing frozen desserts are available in many forms including variations of sorbet or water ices. In general, they contain the same traditional ingredients such as sweeteners and stabilizers, but the primary difference is the amount of added fruit pieces and/or fruit juice. Common store brands have a fruit content ranging from 30-55% with some as low as 10-15% and others as high as 80%. Some fruit-based novelties claim to contain as much as 90% fruit juice (Hegenbart, 2002). Fruit pieces in many forms and sizes may also be added. Some frozen novelties products require a smooth texture and for these fruit juice concentrates or juice (usually reconstituted from a concentrate) will make a good choice. Fruit juice contributes sweetness and may be used to replace some or even all of the sweeteners in a frozen dessert formula (Hegenbart, 2002).

An increase in the growth of frozen novelties is allowing smaller companies to explore new product concepts that may not be of interest to larger companies due to small profit. In 1992, Marigold Foods launched Yo-J, a fruit juice blended with fat-free yogurt and skim milk, in 1994, Kemps Duos, a layered mixture of gelatin and yogurt and, in 1995, Sherbets, a creamy, fat free sherbet with contemporary flavors (Fusaro, 1996). Consumer interest in healthy eating and self-medication is not just a passing fad. Soy based products have become increasingly popular and gradually moved into the mainstream market. Many consumers associate soy with a healthy consumption pattern. Development of frozen desserts that indulge consumers' eating desire, yet provide potential health benefits, is a challenge. Product appraisal to identify specific sensory attributes driving product acceptance is vital to the introduction of this new product.

The objectives of this research were to evaluate acceptance and purchase intent of low-fat sugar-free orange sherbet products containing soy protein and to identify drivers for consumer acceptance and purchase intent of these products.

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MATERIALS AND METHODS

Soy protein isolate: Isolated soy protein (PRO-FAM® 873, Archers Daniel Midland Co., Decatur, Illinois) was used for this consumer study. It was a very bland, low viscosity, readily dispersible, highly soluble and functional soy protein. It contained isoflavones at a minimum level of 2 mg g^{-1} of product. It contained 6.0% moisture, 90% protein and 1% fat and 90% granulation passing through #100 U.S. Standard Screen. Microbial tests showed 10,000 CFU gm^{-1} (max) for Standard Plate Count and non-detectable for Salmonella (class 1) and negative for *E. coli*.

Sherbet preparation: Thirteen sherbet formulations were prepared according to Table 1. Each formulation was prepared twice. Natural orange flavoring (WONF) (Flavors of North America, Carol Stream, Illinois), annatto color (Food Ingredient Solutions, New York, New York), Splenda® Brand sucralose as liquid concentrate 25% aqueous solution (McNeil Specialty Products Co., McIntosh, Alabama) and Sunnet® Brand acesulfame-K (Nutrinova Inc., Somerset, New Jersey) were combined before mixing with other ingredients. Water was heated to about 48.5°C, then weighed and transferred into a blender (Vita-Mix model VM0100A, Cleveland, Ohio). Maltodextrin (Malta*Gran® 10, Primera Foods, Faribault, Minnesota), soy protein (PRO-FAM® 873 Isolated Soy Protein, Archers Daniel Midland Co., Decatur, Illinois), citric acid (ADM, Southport, North Carolina) and locust bean gum (Gum Technology Corporation, Tucson, Arizona) were added to the blender. These ingredients were mixed in a blender for 5 min using 20 sec cycles consecutively. Grade-A Ultra-Pasteurized Heavy Whipping Cream (Kleinpeter Farms Dairy, Baton Rouge, Louisiana), Grade-A Pasteurized Homogenized Skim Milk (Kleinpeter Farms Dairy, Baton Rouge, Louisiana), Golden Churn Cultured Reduced-Fat Buttermilk (Milk Products LLC, Dallas, Texas), Pure Premium Original-No Pulp orange juice (Tropicana, Bradenton, Florida) were added.

Table 1: Sherbet formulations with ingredients varied[1]

Formulation	Soy Protein (SP) (%)	Maltodextrin (MD) (%)	Water (%)
1	3.25	10	50.95
2	4.25	10	49.95
3	5.25	10	49.00
4	6.25	10	48.00
5	3.25	11	50.00
6	4.25	11	49.00
7	5.25	11	48.00
8	6.25	11	47.00
9	3.25	12	49.00
10	4.25	12	48.00
11	5.25	12	47.00
12	6.25	12	46.00
13	0	12	52.25

[1]Fixed ingredients which make up a total of 100% for each formulation

Heavy cream	3.89%
Skim milk	10.79%
Buttermilk	2.71%
Orange juice	12.58%
Orange flavoring	0.14%
Citric acid	0.36%
Sucralose	0.11%
Acesulfame-K	0.02%
Annatto color	0.15%
Locust bean gum	0.05% (formulations 1-3 only)

The mixture of sweeteners, orange flavoring and annatto coloring solution was added to the blended mixture and thoroughly blended for 1 min. One gallon of the mix was transferred to a smoothie machine (Taylor model 430-12, Rockton, Illinois). The machine was operated for about 15 min and the smooth mixture was transferred to a 5 gallon container. The sherbet product was then proportioned into 2 oz plastic cups and sealed with lids; this was done inside the walk-in cooler (38°F) to prevent products from quickly melting. These samples were labeled with 3 digit numbers corresponding to the formulation numbers and stored in the blast freezer (-25°F). On the day of the consumer test, the samples were allowed to soften in the walk-in cooler (38°F) approximately 1-1.5 h before the actual taste test.

Experimental design and consumer tests: The experimental consumer test protocol was approved by the LSU AgCenter Institutional Review Board. Untrained consumers (n = 130) were randomly recruited from Baton Rouge, Louisiana State University. A day or two before the consumer test, the consumers were reminded through a phone call to attend a particular session. Criteria for recruitment were: at least 18 years of age, not allergic to soy or milk products and available and willing to participate on particular testing dates. Since not every consumer had participated in consumer acceptance tests, the testing procedures were briefly discussed, particularly about sample handling and evaluation. Consumers were told that each sample had a 3 digit code corresponding to each page of the questionnaire. Consumers were asked to complete the socioeconomic and demographic questionnaires regarding age, gender, race, marital status, educational level, employment status and household income. Consumers also provided information on consumption of low-fat and sugar-free desserts, frequency of purchase, the most important quality attribute of these desserts, the most preferred fruit flavor for frozen sherbets, history of purchasing low-fat sugar-free sherbets and willingness to purchase these sherbets if they contained a health promoting ingredient such as soy protein. A total of 19 central location test sessions were conducted during a 3-day period, in a conference room, illuminated with cool, natural, fluorescent lights.

Samples were evaluated using a balanced incomplete block design (Plan 11.21, t = 13, k = 3, r = 6, b = 26, λ = 1, E = 0.72, Type 3) described by Cochran and Cox (1957) because an individual consumer finds it increasingly difficult to evaluate a product as the number increases. This design allowed each consumer to evaluate three out of thirteen samples. With a total of 130 consumers, each of the 13 formulations was evaluated 30 times. All 30 responses for each formulation were used to generate predictive models relating sensory qualities and acceptability, purchase intent and purchase intent after acknowledgement of the products containing soy protein.

The samples were presented to consumers in 2-oz opaque white plastic cups labeled with a 3 digit number on the lids. Water, unsalted crackers and expectoration cups were provided for consumers to use to minimize any sensory carryover effect that may have occurred between samples. Consumers were instructed to evaluate each sample for acceptability of appearance, color, flavor, texture/mouthfeel and overall liking using a 9-point hedonic scale (1 = dislike extremely, 5 = neither dislike nor like and 9 = like extremely) (Peryam and Pilgrim, 1957). Consumers were also asked to evaluate each sample as "acceptable" or "unacceptable" as suggested by Moskowitz (1994). Purchase intent (buy/not buy) and purchase intent, after additional information about soy protein in the samples had been provided to consumers, were also asked. The process of asking consumers to make judgments regarding how much they like or dislike products is frequently performed (Schutz, 1983). In this study the paper ballot was used.

Statistical analysis: The analysis of variance (Proc Mixed, SAS version 8.2, 2001) was performed to determine differences in acceptability for each sensory attribute and overall liking. Paired-wise comparisons were performed to compare the acceptability of each formulation with the control (no soy protein). Group differences, expressed in terms of mean vectors of acceptability (appearance, color, flavor, sweetness, sourness, texture/mouthfeel and overall liking), were determined using multivariate analysis of variance (MANOVA) (Bray and Maxwell, 1982). Descriptive discriminate analysis (DDA) (Huberty, 1994) (PROC CANDISC, SAS version 8.2, 2001) was performed to identify sensory acceptability attributes that largely contributed to the group differences among 13 sherbet formulations. Predictive discriminate analysis (PDA) (Huberty, 1994) (PROC DISCRIM, SAS version 8.2, 2001) and logistic regression analysis were performed to identify sensory attributes critical to overall product acceptance and purchase intent (Saw-Eaw *et al*., 2007). For PDA, the test of homogeneity of within covariance matrices was conducted (POOL = TEST) using the chi-square test (Betz, 1987; Brown and Tinsley, 1983). The logistic regression models, both full and single-variable models, were generated to predict acceptability and purchase intent before and after additional information about soy protein in the samples had been provided to the consumers.

RESULTS AND DISCUSSION

Consumer characteristics: Demographic and socio-economic characteristics of the 130 participating consumers (69.2% females and 30.8% males) showed the majority (70.8%) was distributed between the ages of 18-44. The remainder were in the 45-54 (14.6%) and over 54 (14.6%) year groups. Most were white (65.4%) followed by Asian (19.2%), African-American (6.9%), Other (4.6%) and Hispanic/Spanish (3.4%). Their household status was single adult (42.3%) couple with children in home (28.5%) and couple without children in home (22.3%), single parent with children in home (5.4%) and other (1.5%). Most had a graduate degree (43.8%) with the remainders having completed college (20.8%), some college (30.8%) and high school degrees (4.6%). Fourty eight point one percent of the consumers were employed fulltime while 44.2% of the consumers were students. The remaining 7.7% were employed part-time, homemaker and retired. The majority of consumers (65.6%) had annual incomes of less than $50,000 and 34.4% of the consumers having an annual income in excess of $50,000. Note that although consumers were not representative of the U.S. population, they did represent regular consumers of sherbet products.

From the product information survey, the vast majority (74.6%) said they normally eat frozen desserts low in fat and 56.2% said they eat frozen desserts that are sugar-free. When questioned about purchase frequency regarding frozen desserts, most of the consumers (60%) indicated they buy frozen desserts once a month. Other reported purchase frequencies included more than once a week (4.6%), once a week (14.6%) and twice a month (20.8%). Taste (73.8%) was the most important quality attribute while texture/mouth feel (10.8%) and nutrition (7.7%) were less important for sherbets. Color/appearance and aroma/odor were not listed as important attributes to these groups of consumers.

The most preferred fruit flavor was strawberry (29.4%), then orange (24.4%), pineapple (12.6%), lemon/lime (12.6%), peach (11.8%), cherry (5%), grape (2.5%) and other (1.7%). Most of the consumers (54.3%) preferred sherbet products which were sweeter and less sour, some (35.5%) preferred sweet and sour equally and others (10.2%) preferred more sour and less sweet.

Table 2: Mean consumer scores for acceptability of appearance, color, flavor, sweetness, sourness, texture/mouthfeel, and overall liking of orange sherbet formulations[1]

Formulation[2]	Soy (SP) %	MD %	Appearance		Color		Flavor		Sweetness		Sourness		Texture		Overall liking	
1	3.25	10	6.07	(1.62)	6.70	(1.62)	5.33*	(2.19)	5.87	(2.11)	5.37*	(1.52)	4.33*	(2.28)	5.03*	(2.01)
2	4.25	10	6.10	(1.65)	6.40	(1.63)	4.77*	(2.08)	5.63	(1.73)	5.13*	(1.89)	3.77*	(2.28)	4.30*	(1.82)
3	5.25	10	5.83*	(1.53)	6.30*	(1.58)	4.17*	(1.93)	5.40*	(1.65)	5.47*	(1.70)	3.00*	(1.58)	3.87*	(1.74)
4	6.25	10	5.87*	(1.68)	6.13*	(1.55)	4.37*	(2.09)	4.97*	(1.83)	5.20*	(1.69)	3.93*	(2.12)	4.30*	(2.15)
5	3.25	11	6.37	(1.54)	6.47	(1.74)	5.13*	(1.93)	5.87	(1.87)	5.97	(1.47)	4.17*	(2.18)	5.17*	(1.93)
6	4.25	11	6.27	(1.78)	6.50	(1.48)	5.07*	(2.20)	5.38*	(2.23)	5.70	(1.95)	3.93*	(2.02)	4.77*	(2.21)
7	5.25	11	5.83*	(1.70)	6.30*	(1.58)	4.97*	(1.75)	5.62*	(1.80)	5.50*	(1.55)	3.67*	(1.63)	4.48*	(1.74)
8	6.25	11	6.30*	(2.10)	6.53*	(1.78)	4.53*	(2.06)	5.17*	(2.00)	5.07*	(1.76)	3.70*	(2.37)	4.17*	(2.25)
9	3.25	12	5.83*	(2.00)	6.40*	(1.65)	5.47*	(1.98)	5.87	(1.87)	5.87	(1.48)	4.67*	(2.25)	4.97*	(2.28)
10	4.25	12	6.50	(1.50)	6.57	(1.36)	5.47*	(1.85)	5.70	(1.73)	5.43*	(1.79)	4.57*	(1.83)	5.20*	(1.99)
11	5.25	12	5.77*	(1.89)	5.93*	(1.86)	4.90*	(2.12)	4.90*	(2.04)	5.00*	(1.82)	3.97*	(2.17)	4.40*	(2.09)
12	6.25	12	5.37*	(1.27)	5.50*	(1.83)	4.79*	(1.93)	5.28*	(1.77)	5.10*	(1.84)	4.23*	(2.05)	4.53*	(1.89)
13 (control)	0.00	12	6.77	(1.25)	7.00	(1.20)	6.97	(1.22)	6.50	(1.66)	6.43	(1.10)	6.97	(1.33)	6.93	(1.23)
P-Value*			0.03		0.02		0.05		0.19		0.19		0.02		0.01	

[1]Numbers in parentheses refer to standard deviation of 30 consumer responses. A 9-point hedonic scale was used (1 = dislike extremely, 5 = neither like nor dislike and 9 = like extremely), [2]Refer to Table 1 for detailed product formulations, * Indicates a significant difference between each formulation and the control at $p \leq 0.05$

Table 3a: Purchase intent if the sherbet contains a health-promoting ingredient such as soy protein[1]

	Male	Percentage	Female	Percentage	Total	Percentage
Yes	31	77.50	74	82.20	105	80.80
No	9	22.50	16	17.80	25	19.20

[1]Questions asked before the taste test

Table 3b: The positive (yes) responses for product acceptability and purchase intent of orange sherbet formulations[1]

Formulation[2]	Acceptability (%)	Purchase intent (%)	Purchase intent with soy3(%)
1	53.3	23.3	43.3
2	30	16.7	36.7
3	26.7	13.3	30
4	40	20.7	30
5	50	36.7	50
6	60	33.3	40
7	43.3	6.7	23.3
8	26.7	16.7	16.7
9	53.3	26.7	40
10	53.3	33.3	43.3
11	40	16.7	26.7
12	36.7	20	23.3
13	90	63.3	80
Overall	46.4	25.2	37.2

[1]Each product was evaluated 30 times; questions asked after taste test, using a 2-point scale (acceptable vs. unacceptable; buy vs. not-buy), [2]Refer to Table 1 for detailed product formulations, [3]When consumers were informed of the health benefits of sherbets containing soy

Almost half (45.4%) have purchased/consumed low-fat sugar-free sherbet products before. When asked about purchase intent if the sherbet product contained a health-promoting ingredient such as soy protein, 80.8% gave positive responses and 19.2% gave negative responses.

Consumer acceptability: The control formulation (0% SP, 12% MD) had the highest mean score for all sensory attributes (Table 2). Excluding the control sample, formulation 10 (4.25% SP, 12% MD) had the highest mean acceptability score (6.50) for appearance while formulation 1 (3.25% SP, 10% MD) had the highest score (6.70) for color. The highest mean acceptability score for flavor was observed with formulation 9 (3.25% SP, 12% MD) and 10 (4.25% SP, 12% MD), both were scored at 5.47. The texture scores for formulations containing SP were lower than the control due to the sandy mouthfeel (Arbuckle, 1986). With respect to overall liking, formulation 10 was rated the highest with a mean score of 5.2 while formulation 3 was rated the lowest with a mean acceptance score of 3.87. For flavor, texture and overall liking, all products containing soy protein were significantly different from the control with p-values of 0.0484, 0.0194 and 0.0094, respectively. Excluding the control, there were no significant differences for sweetness and sourness among 12 products containing SP (the Tukey's Studentized range test not shown). A series of paired comparison tests, comparing each formulation to the control for each attribute, revealed significant differences between each formulation and the control for flavor, texture and overall liking. For appearance and color acceptability scores, the formulations 3, 4, 7, 8, 9, 11 and 12 were significantly lower than the control.

Product acceptance and purchase intent: Prior to the actual product taste test, consumers were asked if they would purchase the sherbet knowing it contains a health promoting soy ingredient. Although, the purchase intent percentages were lower than expected, 80% of the consumers would be willing to purchase sherbet products which contained SP as an ingredient (Table 3a). This is an interesting observation considering that SP was added to the sherbet formulations as a health promoting ingredient. The survey results indicated that 20% of the consumers from this study (Table 3a) would not buy the product containing SP. None of the consumers were allergic to SP though negative perception about soy protein and its sensory properties could underlie part of the reason for its unacceptability (Liu, 1999).

Each formulation was evaluated separately for consumer acceptance, purchase intent and purchase intent if the product contained SP as a health promoting ingredient (Table 3b). Note that the percent (%) used in Table 3a is referred to as percent frequency of positive responses for acceptability and purchase intent. Of the products containing SP, formulation 6 (4.25% SP, 11% MD) had the highest consumer acceptability (60.0%) while formulation 3 was (5.25% SP, 10% MD) rated lowest (26.7%). Formulation 13 (control) was rated highest for acceptability (90.0%) and purchase intent with soy (80.0%). Although, formulation 3 was rated lowest in acceptability, it was one of only 2 formulations (i.e., formulation 2 and 3) which had a higher percent purchase intent than acceptability after consumers had been informed that it contained SP. This may indicate that some consumers would purchase the product even though it was unacceptable, presumably for soy's health promoting benefits. When consumers were asked about purchase intent, formulation 5 was (3.25% SP, 11% MD) rated highest (36.7%) and formulation 7 (5.25% SP, 11% MD) scored the lowest (6.7%). Both formulation 1 (3.25% SP, 10% MD) and formulation 2 (4.25% SP, 10% MD) had a 20% increase in positive purchase intent after consumers had been informed that the products contained soy protein as a health promoting ingredient.

Overall product differences-pooled within canonical structure r's: MANOVA was performed to determine if overall difference existed among 13 products considering all sensory attributes simultaneously. Results of a Wilks' Lambda P-value of 0.0001 indicated that all thirteen sherbet formulations were overall different. We then determined which attributes largely accounted for the differences among thirteen formulations using descriptive discriminant analysis (DDA). The first dimension of the pooled within canonical structure (Can 1, Table 4) reveals that flavor (canonical correlation = 0.661), texture (0.919) and overall liking (0.726) significantly contributed to the overall difference among formulations 1-13.

Predictive discriminant analysis for acceptance and purchase intent: The results of predictive discriminant analysis showed that all seven attributes together as a predictor yielded a hit rate (correct classification for responses "acceptable" vs. "not-acceptable) of 89% for product acceptance (Table 5). The single attribute contributing the most to prediction of product acceptance was overall liking with a hit rate (correct prediction) of 88.7%, followed by flavor (83.8%) and texture (82.0%). The hit rates (correct classification for responses "buy" vs. "not-buy") (%) for purchase intent were slightly lower than acceptance. With all 7 attributes, we correctly predicted 83% of the time whether a consumer would purchase a particular formulation. This percentage dropped to 78.7% utilizing just texture, 77.5% for sweetness alone and 74.2% for flavor alone.

Table 4: Canonical structure r's describing group differences among sherbet formulations[1]

Variable	Can1	Can2
Appearance acceptability	0.210	0.578
Color acceptability	0.173	0.723
Flavor acceptability	0.661*	0.467
Sweet acceptability	0.286	0.653
Sour acceptability	0.309	0.711
Texture/mouthfeel acceptability	0.919*	0.253
Overall liking	0.726*	0.587
Cumulative variance explained (%)	58.39	71.61

[1]Based on a pool within-group variances, * Indicates sensory attributes which largely accounted for group differences in the first dimension

Table 5: Percentage Hit rate[1] for predicting acceptance and purchase intent by predictive discriminate analysis (PDA)

	Acceptance (%)	Purchase intent (%)
Appearance acceptability2	66.4	62.8
Color acceptability2	62.9	57.0
Flavor acceptability2	83.8	74.2
Sweet acceptability2	73.4	77.5
Sour acceptability2	74.6	69.2
Texture acceptability2	82.0	78.7
Overall liking2	88.7	82.5
All 7 attributes	89.0	83.0

[1]Hit rate (%) is the correct classification of an unknown sample into a group (either acceptable compared with unacceptable and/or buy compared with not-buy), [2]A single-variable model

Table 6: The R^2 and odds ratio estimates for the logistic regression models used to predict consumer acceptance

Independent	Variable	R-Square	Prob> X^2 (full)	Odds ratio estimate (single)[2]	Odds ratio estimate (full)[1]
Appearance	X_1	0.1717	0.0251	1.803	1.694
Color	X_2	0.1280	0.1962	1.657	0.751
Flavor	X_3	0.4465	0.3012	3.031	1.191
Sweetness	X_4	0.2926	0.9230	2.185	1.016
Sourness	X_5	0.2921	0.2146	2.513	1.269
Texture	X_6	0.4582	0.0009	2.933	1.667
Overall liking	X_7	0.5776	<0.0001	5.428	3.167
All attributes	X_1-X_7	0.6018			

[1]A full (all 7 variables) model. Significance of parameter estimates was based on the Wald X^2 value at $p<0.05$, [2]A single-variable model

Logistic regression analysis for acceptance: Logistic regression analysis was used to determine which attributes influence acceptance, purchase intent and purchase intent after the consumers had been informed of soy health benefits. Using all 7 attributes as a full model predictor, the analysis revealed that appearance, texture and overall liking had a significant influence on acceptance (prob>X^2<0.05) (Table 6). These attributes had corresponding odds ratio estimates {a ratio of probability of an event (i.e., acceptable) and a non-event (i.e., not acceptable)} of 1.694, 1.667 and 3.167, respectively (Table 6).

The odds ratio (Table 6) indicated that the overall product acceptance will be increased by 69.4, 66.7 and 216.7%, respectively, for every one point increase in the mean hedonic score of appearance, texture and overall liking on a 9-point hedonic scale. Although, overall liking is very significant with respect to overall acceptance it is important to remember that it is the sum total of other attributes the consumers experience. Therefore, increasing overall liking directly may not be feasible but increasing the acceptability of other attributes, such as appearance and texture, is certainly possible. Therefore, product improvement can have a very significant result in future studies and should be mainly focused on appearance and texture improvement.

The strength of association of logistic regression can be performed similar to that of the multiple regression. Unlike multiple regression which uses least squares estimation, logistic regression uses a maximum likelihood estimation procedure. Each variable that is added to the model gives a better prediction as to whether the product is acceptable or if the consumer would purchase it. If a variable is not significant (Ho: $\beta = 0$), then it can be dropped from the equation. The R^2 for the full model relating all attributes to consumer acceptance is 0.6018 with overall liking alone being just slightly lower at 0.5776 (Table 6).

Logistic regression analysis for purchase intent: Prediction of purchase intent revealed that consumers found that sourness and overall liking were significant (prob>X^2<0.05). This is not surprising since one of the distinctive characteristics of sherbet is its sourness which is normally more sour than ice cream (Marshall and Arbuckle, 2000). The odds ratio for overall liking was very high (6.945) compared to the other attributes and sourness (1.73) (Table 7). The higher odds ratio means that consumers feel overall liking is more important when it comes to purchasing the product. With an increase in overall liking score of 1, it is 6.9 times more likely that consumers will purchase the product. Based on the prob>X^2 and odds ratio estimates (Table 6 and 7), appearance, texture and sourness should be the focus for further product improvement as these attributes significantly affect acceptance and purchase intent.

For purchase intent the R^2 was 0.5271 with all the attributes in the model and 0.5104 when only with overall liking (Table 7). The R^2 for the purchase intent model after consumers had been notified that products contained soy drops even further to 0.4343 with all attributes and 0.4260 with only overall liking as a predictor (Table 8). Prediction of purchase intent of the product after the consumers had been informed of soy health benefits was less accurate (Table 8) than that of the acceptance (Table 6) and purchase intent (Table 7). The only significant predictor was overall liking (prob>X^2<0.05). The odd ratio for overall liking was 2.134 showing that although it is a significant predictor for purchase intent, it is not nearly as strong an indicator compared to the previous model (Table 7). One reason could be the compromise some consumers are willing to make because of the nutritional benefits of soy protein. This compromise results in a lower odds ratio for overall liking and this value would be expected to drop even further as the number of positive responses for purchase intent increases. It should be noted that the R2 dropped from 0.5271 in the previous model (Table 7) to 0.4343 in this one. Although overall liking is the only significant attribute affecting purchase intent, improving the other critical attributes based on the results of the previous models, will naturally increase purchase intent and thus purchase intent with soy.

Table 7: The R^2 and odds ratio estimates for the logistic regression models used to predict consumer purchase intent

Independent	Variable	R-Square	Prob> X^2 (full)	Odds ratio estimate (single)[2]	Odds ratio estimate (full)[1]
Appearance	X_1	0.1304	0.1343	1.852	1.476
Color	X_2	0.1041	0.1221	1.746	0.664
Flavor	X_3	0.3969	0.1752	4.362	1.438
Sweetness	X_4	0.3150	0.8671	3.305	1.036
Sourness	X_5	0.2833	0.0104	3.159	1.730
Texture	X_6	0.3197	0.8045	2.269	0.960
Overall liking	X_7	0.5104	<0.0001	10.016	6.945
All attributes	X_1-X_7	0.5271			

[1]A full (all 7 variables) model. Significance of parameter estimates was based on the Wald X^2 value at $p<0.05$, [2]A single-variable model

Table 8: The R^2 and odds ratio estimates for the logistic regression models used to predict consumer purchase intent after notification that the formulation contained soy protein

Independent	Variable	R-Square	Prob> X^2 (full)	Odds ratio estimate (single)[2]	Odds ratio estimate (full)[1]
Appearance	X_1	0.1330	0.3264	1.695	1.179
Color	X_2	0.1123	0.9439	1.641	0.988
Flavor	X_3	0.3548	0.2475	2.520	1.186
Sweetness	X_4	0.2587	0.2613	2.136	1.152
Sourness	X_5	0.2214	0.7942	2.158	1.038
Texture	X_6	0.2918	0.6105	1.937	1.057
Overall liking	X_7	0.4260	<.0001	2.947	2.134
All attributes	X_1-X_7	0.4343			

[1]A full (all 7 variables) model. Significance of parameter estimates was based on the Wald X^2 value at $p<0.05$, [2]A single-variable model

CONCLUSION

This study identified specific consumer sensory attributes driving acceptance and purchase intent of low-fat sugar-free sherbets containing soy protein. The addition of soy protein to sherbet formulations causes significant differences in consumer responses towards certain sensory attributes. Flavor, texture and overall

liking mainly contributed to overall product differences. Appearance, texture and overall liking significantly affected overall acceptance. Overall liking and sourness affected the purchase intent. Consumers would be more willing to compromise their preference and to purchase sherbet products with soy protein added as a health promoting ingredient. To validate the findings from this study, a larger scale consumer test with a target consumer population should be further conducted.

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