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Acceptability of a Fruit Slush Product by Individuals that Participate in a Wellness Center

Keri Dyann Connelly

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ACCEPTABILITY OF A FRUIT SLUSH PRODUCT BY INDIVIDUALS THAT
PARTICIPATE IN A WELLNESS CENTER

By

Keri Dyann Connelly

A Thesis
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Master of Science
in Food Science, Nutrition, and Health Promotion
in the Department of Food Science, Nutrition, and Health Promotion

Mississippi State, Mississippi

May 2007

ACCEPTABILITY OF A FRUIT SLUSH PRODUCT BY INDIVIDUALS THAT
PARTICIPATE IN A WELLNESS CENTER

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INDIVIDUALS THAT PARTICIPATE IN A WELLNESS CENTER

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The objective of this study was to determine the consumer acceptability of fruit slushes prepared with either sucralose or sugar. Subjects (n=105) were given samples of fruit slushes and asked to complete an acceptability test and survey. The sensory characteristics measured included the overall liking of the product, flavor, texture, and color using a scale of 1=dislike extremely to 5=like extremely. Subjects' daily fruit consumption patterns and knowledge of nutrition were also solicited and analyzed. There were no differences ($P>0.05$) in sensory characteristics between the two products. Overall, participants moderately liked both products. Flavor scores of the sucralose and sugar products were 4.5 and 4.4, respectively. Twenty-nine percent of panelists extremely liked both fruit products. Twenty-three percent of panelists liked both products, but preferred ($P<0.05$) the slush prepared with sucralose. Enhancing the nutritional content of a fruit slush product with sucralose will still provide an acceptable product.

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CHAPTER 1

INTRODUCTION

The prevalence of overweight and obesity in the United States (U.S.) has increased significantly over the past several decades. Currently, 66.3% of adults in the U.S. are overweight, 32.2% are obese and 4.8% are extremely obese (Ogden et al., 2006). Being overweight increases a person's risk for developing many chronic diseases such as hypertension, dyslipidemia, Type 2 diabetes mellitus, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea and respiratory problems, and certain cancers (endometrial, colon, and breast) (Centers for Disease Control, 2007).

It is an accepted fact that diet and exercise play a major role in the obesity epidemic. Eating unhealthy foods and being physically inactive contributes to obesity and numerous chronic diseases including cancer, cardiovascular disease, and Type 2 Diabetes Mellitus. Regular physically activity has many proven benefits. It can reduce the risk of chronic disease; help control weight; contribute to healthy bones, muscles, and joints; help relieve arthritis pain; reduce symptoms of anxiety and depression; and is associated with fewer hospital visits. Physical activity does not need to be strenuous to be beneficial. People of all ages benefit from moderately-intense physical activity, such as 30 minutes of brisk walking most days of the week (Centers for Disease Control, 2006). Despite these benefits, currently 51% of U.S. adults are not physically active (BRFSS, 2005b).

Adequate physical activity is less common among women than men, and those with lower incomes and less education (BRFSS, 2005a). Good nutrition also plays a role in reducing chronic diseases and obesity rates. Currently, 77% of U.S. adults do not consume the recommended five or more servings of fruits and vegetables per day. Only 19% of men and 28% of women consume the recommended servings of fruits and vegetables per day (BRFSS, 2005a).

The increasing rates of obesity and associated health concerns have many consumers seeking new ways to reduce the consumption of calories. Few consumers find it easy to abandon sweet foods and beverages. Many consumers have discovered that low calorie, and non-caloric sweeteners offer a means to manage caloric intake. The use of non-caloric sweeteners can reduce the amount of calories in products such as colas, candies, chewing gum, and many desserts. In addition, several non-caloric sweeteners are available for tabletop use so that consumers can add to foods such as coffee, tea, fruits, and cereals.

Sucralose is a non-caloric sweetener and marketed as Splenda® brand sweetener. Sucralose is approximately 600 times sweeter than sugar. It has a disaccharide structure in which three chlorine molecules replace three hydroxyl groups. Sucralose provides no energy and is poorly absorbed. Sucralose is highly stable and can be used in foods and beverages as well as cooking and baking (American Dietetic Association, 2004). More than 100 studies have been conducted over a 20 year period to demonstrate that sucralose is a safe product and is suitable for consumption. Sucralose is safe for use by the general

population, including children, women who are pregnant or breast-feeding, and diabetics, because it does not affect blood glucose or insulin levels (Calorie Control Council, 2006).

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CHAPTER II
ACCEPTABILITY OF A FRUIT SLUSH PRODUCT BY INDIVIDUALS THAT
PARTICIPATE IN A WELLNESS CENTER

Abstract

The objective of this study was to determine the consumer acceptability of fruit slushes prepared with either sucralose or sugar. Subjects (n=105) were given samples of fruit slushes and asked to complete an acceptability test and survey. The sensory characteristics measured included the overall liking of the product, flavor, texture, and color using a scale of 1=dislike extremely to 5=like extremely. Subjects' daily fruit consumption patterns and knowledge of nutrition were also solicited and analyzed. There were no differences ($P>0.05$) in sensory characteristics between the two products. Overall, participants moderately liked both products. Flavor scores of the sucralose and sugar products were 4.5 and 4.4, respectively. Twenty-nine percent of panelists extremely liked both fruit products. Twenty-three percent of panelists liked both products, but preferred ($P<0.05$) the slush prepared with sucralose. Enhancing the nutritional content of a fruit slush product with sucralose will still provide an acceptable product.

Review of Literature

The Importance of Diet and Exercise

Diet and exercise are beneficial in reducing the risk of chronic diseases such as cardiovascular disease, hypertension, dyslipidemia, Type 2 diabetes mellitus, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea and respiratory problems, and certain cancers (endometrial, colon, and breast) (Centers for Disease Control, 2007). The prevalence of physical inactivity in the United States (U.S.) is 50.9%. Forty-nine percent of U.S. adults exercise 30 minutes or more five or more days per week (BRFSS, 2005a). In Mississippi, only 40% of adults exercise for 30 minutes or more five or more days a week (BRFSS, 2005c). Diet and exercise can increase energy needs and nutrient intake while maintaining weight and improving cardiovascular fitness (National Research Council, 1989). If individuals consume more energy than they expend, weight gain will follow, and if individuals expend more energy than they consume, weight loss follows. There is evidence to suggest that people who exercise regularly are more likely to adopt healthy eating habits. They are more likely to eat low-fat foods and consume adequate amounts of fruits and vegetables (Miller et al., 1990).

Georgiou et al. (1996) studied the attitudes about foods, recent dietary changes and food choices of 319 18-24 year olds that were classified as either exercisers or nonexercisers. The majority of the participants were full-time college students. The researchers reported that exercisers thought it was more important to eat healthy, more nutrient-dense, low-fat foods. The exercisers were more likely than nonexercisers to meet the dietary recommendations for grains, fruits and vegetables. Male and female exercisers

ate breakfast more frequently than nonexercisers. Ninety percent of female exercisers rated their ability to read food labels adequately (Georgoiu et al., 1996).

Fruit and Vegetable Consumption in the United States

A diet that is high in fruits and vegetables can lower the risks for developing numerous chronic diseases, including cancer and cardiovascular disease (Ness & Fowles, 1997). Fruits and vegetables are high in water and fiber and low in energy, therefore, playing a major role in weight management by helping to promote satiety and decrease energy intake (Rolls et al., 2004). The *Dietary Guidelines for Americans* (2005) recommends five or more servings (2½ cups) of vegetables and two or more servings (2 cups) of fruits each day. The *Dietary Guidelines* are published to provide advice to Americans on their health and to reduce the risk for chronic disease through diet and physical activity (Dietary Guidelines for Americans, 2005).

Lin and Morrison (2002) studied body mass index (BMI) in relation to fruit intake. Their study reported that people who ate more servings of fruit each day may have a lower BMI. The BMI is a screening tool used to identify possible weight problems in adults and children. The BMI is calculated using a person's height and weight ($BMI = \text{kg}/\text{m}^2$). The standard weight categories are listed in Table 2.1. Lin and Morrison (2002) examined data from the USDA's 1994-1996 Continuing Survey of Food Intakes by Individuals food consumption data. They reported significant differences in the amounts of fruit eaten by people of a healthy weight, overweight people, and obese people. Vegetable consumption was also evaluated, but there was no correlation that vegetable

consumption lowered BMI. The overweight children and obese adults (males and females) consumed less fruit than people of a healthy weight. Healthy weight men consumed more fruit than overweight and obese men. Obese men consumed 39% of the recommended servings of fruit, compared to men of a healthy weight who consumed 51%. Obese women consumed 51% of the recommended daily servings of fruit, while other women consumed 57%.

Table 2.1 BMI Categories

| BMI | WEIGHT STATUS |
|----------------|---------------|
| Below 18.5 | Underweight |
| 18.5 - 24.9 | Normal Weight |
| 25.0- 29.9 | Overweight |
| 30.0 and above | Obese |

Source: Centers for Disease Control, 2006

National food supply data indicated a slight increase in fruit consumption from 1.30 to 1.36 servings per day from 1990, 1994, and 1998. Vegetable intake increased from 3.66 to 3.93 servings per day (Krebs-Smith & Kantor, 2001). Serdula et al. (2004) researched trends in fruit and vegetable consumption among adults in the U.S. using the Behavioral Risk Factor Surveillance System (BRFSS), 1994-2000. The mean frequency of fruit and vegetable consumption declined slightly during these years, from 3.44 times a day in 1994 to 3.37 times a day in 2000. Fruit juice was one category that showed a small decline from 0.32 in 1994 to 0.28 in 2000. Research showed that the prevalence of consuming fruits and vegetables five or more times a day was about 25% in 1994 to

2000. During these years, the 18-24 year old group showed an increase of 3.3% in fruit and vegetable consumption (Serdula et al., 2004).

In 1999-2000, 40% of Americans consumed the then-current recommendations of fruit and vegetables per day (Guenther et al., 2006). In the U.S., the mean intake of fruits and vegetables was estimated to be 4.7 servings per day (1.5=servings of fruits, 3.2=servings of vegetables). Research suggests that Americans should increase their fruit and vegetable intake to meet the current recommendations. It is important to note that this research is based on the assumption of a sedentary lifestyle (Guenther et al., 2006).

Although fruit consumption has been declining over the past 14 years, fresh fruit consumption actually rose 4% from 2002. Fresh vegetable consumption fell to 2% (PBH, 2005). Young adults and families with children under the age of six were the groups with the largest increase in fruit intake in 2004. (Sloan, 2005).

Georgiou et al. (1997) studied health-related habits and food choices of young women (n=758) and young men (n=580) 18-24 years old. The participants were divided into three groups: college students, college graduates, and nonstudents. The researchers reported that vegetable consumption was low for all groups. Women nonstudents consumed more potatoes, including french fries, than college students and college graduates. Male college graduates consumed more vegetables overall than male nonstudents. Male college students also consumed more fruits than nonstudents. Male students and college graduates drank twice as much 100% orange juice than nonstudents. The most popular fruit drinks were Kool-Aid, lemonade, and Tang among female students and nonstudents. The study concluded that college students and college

graduates came closer to meeting the current dietary recommendations than nonstudents (Georgiou et al., 1997).

Dietary Trends in the United States

Many studies have been conducted to determine what adults in the U.S. are eating and drinking. Sloan (2006) reported in “What, When, and Where American Eats” that the number of meals eaten at home declined from 64% in 2003 to 58% in 2005. Sloan (2006) stated that in 2005, Americans consumed about 80 meals per person at restaurants. Entrees and side dishes were the most frequently ordered take-out items on the menu. Pizza, hamburgers and Chinese food were the top choices for take-out. For young adults, hamburgers and French fries topped the “10 most popular foods ordered in restaurants” in 2004. Fruit was listed as the tenth most popular food for children under the age of six. Side salads made the list for men and women as well, topping fifth for men and fourth for women in the “Top 10 Most Popular Foods ordered in restaurants” (NPD, 2005).

Glanz et al. (1998) examined the importance of taste, nutrition, cost, convenience, and weight control on personal dietary choices and whether these factors vary among demographic groups. The researchers determined that taste was the most important consideration for participants, followed by cost, nutrition, convenience and weight control concerns. The study also examined the impact of demographics on responses. Younger adults and women, and people with a low economic status indicated that cost was a more important factor when choosing what to eat. Also, the importance of convenience was greater in younger adults and people with lower incomes. Convenience

was not gender related. The study concluded that nutrition and weight control concerns were more important to older persons and cost and convenience were more important to younger persons (Glanz et al., 1998).

Glanz et al. (1998), also examined the importance of the five factors (taste, cost, nutrition, convenience, and weight control concerns) in relation to eating behaviors. They determined that taste, nutrition, cost, convenience, and weight control concerns had a positive correlation with individual's fruit and vegetable intake. Older people and health-oriented people were more likely to eat fruits and vegetables. The study concluded that convenience should be emphasized to encourage consumers to eat fruits and vegetables (Glanz et al., 1998).

Snacking in America

Many restaurants are now finding new opportunities for snacking options on their menus. They are providing grab-and-go and sit-down-and-share snacks and regular meals during the afternoon and late-nights. "Soft drinks, ice cream, chips/pretzels/crackers, yogurt, candy bars, cheese, gelatin, donuts, fruit juice, pudding, salted nuts, salads, and cottage cheese are America's most ordered snacks at restaurants" (NPD, 2005). A 1992 study examined the snacking behavior, including frequency, time of day, location, and qualities found in snack choices among 1,800 adults and children (Cross et al., 1994). The majority of participants reported eating 2-3 snacks per day. The most common time of day to snack was the afternoon, followed by evenings.

Fruit was reported as the preferred morning snack of choice for senior citizens (36%) and K-6 children (40%). The fifth and sixth grade students preferred sweets (28.4%) and meal-type snacks (21.4%) over fruits (20.5%). Adults preferred baked goods (30.4%) over fruits (24.4%) in the morning. Fruits, chips, cookies, and candies were the top afternoon snacks. Only senior citizens and kindergarten-sixth grade children preferred fruits. Only 18.6% of adults preferred fruit as an afternoon snack over soft and crunchy snacks (40%). Ice cream was the preferred evening snack for fifth and sixth grade students and K-6 children. Salty and crunchy snack foods were preferred by seniors and adults. The study concluded that salty and crunchy foods dominated snacking preferences. Fruits were only preferred by one third of participants (Cross et al., 1994).

Beverage Consumption

Beverages are considered to be a significant source of energy in the U.S. Beverage consumption varies among different demographic groups. For example, African Americans drink less milk and more fruit drinks and Kool-Aid than Caucasian and Hispanics (Storey et al., 2006). Research suggests that Caucasians consume more carbonated soft drinks and tea/coffee with sugar than African Americans. Storey et al. (2006) evaluated beverage consumption across sex, age, and ethnicity using the National Health and Nutrition Examination Survey (NHANES) 1999-2002. Males had higher intakes from beverage sources than females. The energy level peaked between the ages of 20-39 for both males and females and declined with age. The consumption of fruit juice increased from childhood and then remained fixed through adulthood. The African

American population consumed more fruit juice than Caucasians and Hispanics. The differences were only significant among 6-11 year old girls, 20-39 year old men, 20-39 year old, and women and women greater than 60 years old. For regular carbonated beverages, Caucasians adolescent and young adult males consumed about 1.8 355 mL cans a day. Caucasian adolescent and young adult women consumed 1.1 and 1.2 355 mL cans, respectively (Storey et al., 2006).

A recent study by West et al. (2006) examined sugar-sweetened beverage consumption among college students. Two hundred and sixty five undergraduates were surveyed. Ninety-five percent reported that they had at least one sugary beverage in the past month. Sixty-five percent reported daily intakes of sugar beverages. Males had a higher intake than females. African American students reported a higher sugary beverage intake than Caucasians. Ninety-one percent of African Americans reported drinking a fruit drink in the past month and 50% reported daily consumption (West et al., 2006).

The Benefits of Non-Caloric Sweeteners

Diets that are high in sugars have been associated with dental caries, dyslipidemias, obesity, bone loss and fracture, and poor diet quality (Johnson & Frary, 2001). From a nutritional standpoint, there are nonnutritive and nutritive sweeteners on the market today. They are recognized as safe by the Food and Drug Administration (FDA). Nine in ten consumers in the U.S. purchase or use low calorie or non-caloric products, including sugar-free and reduced-fat foods and beverages (American Dietetic Association, 2004). The quality of the American diet is suffering from excessive nutritive

sweeteners. Twenty-five percent of total energy comes from nutritive sweeteners such as sucrose, fructose maltose, lactose, dextrose, honey, syrup, corn syrup, high fructose corn syrup, molasses, and fruit juice concentrate.

There are five nonnutritive sweeteners on the market (acesulfame-K, aspartame, neotame, saccharin, sucralose). The nonnutritive sweeteners offer no energy and can decrease the risk of dental caries, and also decrease the risk for obesity. Nonnutritive sweeteners are usually safe for consumption at moderate levels without any health risk (American Dietetic Association, 2004). There are many products on the market that target individuals with diabetes. Over the past several years there has been an increased growth in these products due to the increased availability and acceptance of the sugar substitute sucralose which is marketed as Splend®.

Non-caloric sweeteners have been available in the U.S. since 1903. They have helped people for years to reduce sugar and caloric intake. Healthcare providers must consider strategies to help consumers reduce sugar intake. Beverages with caloric sweeteners, sugar and sweets that provide little to no nutrients can contribute to excessive energy intakes. Non-caloric sweeteners can be useful in weight management and carbohydrate management for people with diabetes. They can also be useful in dental health to prevent tooth decay (American Diabetes Association, 2006).

Sucralose

Sucralose was discovered in 1976 by researchers at Queen Elizabeth College, University of London, during a research program with the sugar producer, Tate and Lyle, PLC (Calorie Control Council, 2006). Sucralose is a non-caloric sweetener used worldwide in more than 4,000 nutritional products. Sucralose is the sweetening ingredient used in the Splenda Brand Sweetener. More than 100 studies have been conducted to determine the safety of this product. Health and food safety authorities worldwide have concluded that sucralose is a safe sweetener. The Health Protection Branch of Health and Welfare in Canada was the first regulatory agency to authorize the use of sucralose in 1991. Over 80 countries now permit the use of sucralose. Sucralose was approved for use in the U.S. in 1998 as a food additive under the brand name Splenda. In 1999, the FDA expanded the uses for sucralose approving it for use as a “general purpose” sweetener (Meister, 2006).

There have been no safety concerns since the introduction of this product. Sucralose is not recognized as a carbohydrate by the body and is not broken down in the body for energy. It may also be a useful tool in the prevention of tooth decay (American Dietetic Association, 2006). Although sucralose is produced from sugar, it is not used as a nutrient source by the oral bacteria that cause tooth decay. Sucralose tastes identical to sugar since it is produced from sugar (sucrose). Sucralose does not contain the bitter aftertaste like its counterparts, saccharin and acesulfame-K (Beyts & Wilet, 1992). Conn et al. (2005) indicated in a recent study that sucralose interacts with sweet taste receptors similarly to natural sugars by interaction with the same two sweet taste receptors with

which sugar interacts with (Conn et al., 2005). Sucralose is like no other non-caloric sweetener, it is intensively sweet. It is about 600 times sweeter than sugar. Intense sweetness means that consumption will be substantially less on a weight-for-weight basis compared to sugar (Beyts & Wilet, 1992).

Sucralose is a white crystalline solid. It is made from sugar by selective chlorination at three hydroxyl groups, involving inversions of the configuration at carbon -4 from the gluco- to the galacto- analogue. (Figure 2.1) The resulting molecule becomes 1, 6 dichloro-1,6-dideoxy β -D-fructofuranosyl-4-chloro-4-deoxy- α -D-galactopyranoside. This molecule is highly water soluble and is not lipophilic (Jenner, 1996). Deriving energy from sugar and other disaccharides begins in the gastrointestinal tract. Disaccharides hydrolyze the central oxygen bond that links the two monosaccharides. This bond is called glycoside linkage. After hydrolysis, the resulting monosaccharides are rapidly taken up into the bloodstream by active transport. With the presence of chlorine at specific sites on the sucralose molecule stabilizes the glycoside linkage to such hydrolysis. Any sucralose that is absorbed is absorbed by passive diffusion. About 85% of consumed sucralose is excreted in the feces, unchanged without any gastrointestinal effects. Of the small amount of sucralose that passively crosses into the bloodstream, which is secreted unchanged, all is eliminated by urine. This is consistent with sucralose's hydrophilicity. Sucralose is not broken down for energy in the body and is therefore, non-caloric (Tso, 2003). Sucralose has an excellent source of heat stability in cooking and baking. Foods and beverages prepared with sucralose do not lose their sweetness. Consumers can use sucralose in granular form. It measures identical to table

sugar. Sucralose also comes in packets in powder form. (American Dietetic Association, 2004).

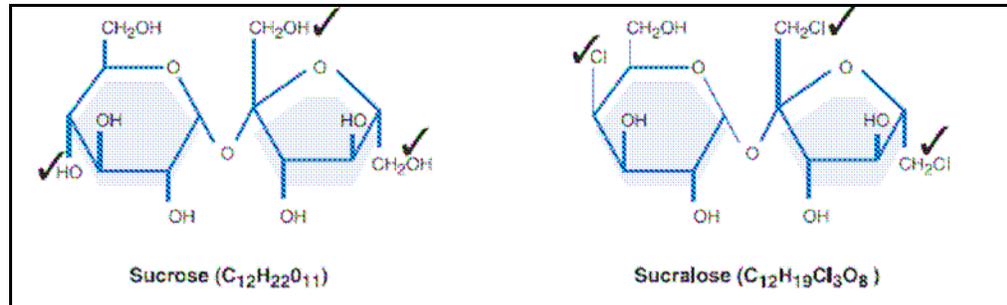


Figure 2.1 Structure of Sucrose and Sucralose (Source: splendaprofessional.com)

Mendonca et al. (2001) examined the partial substitution of sugar by a non-caloric sweetener sucralose in peach compote. Physical, chemical, and sensory characteristics were elaborated and analyzed in four syrup formulations of the fruit compote. The first formulation was used as the control. It was formulated with sucrose and glucose mixed with water. The three other formulations were prepared by substituting 30% of the sucrose with acesulfame-K, sucralose, or sucralose + acesulfame-K in a proportion of 1:1. Consumer preference was also examined. The sensory results showed no significant difference in appearance, color, shine, and softness amongst the formulations. The formulations of the control and of sucralose presented the highest values for flavor, being considered as very good. Statistically, the four peach compote formulations were equally favorable to consumers, although the best results were for the product formulated with sucralose. The study concluded that the use of the non-caloric sweetener sucralose provided the peach compote with sensory characteristic's similar to those of the peach compote prepared with sucrose and glucose (Mendonca, et al., 2001).

Materials and Methods

Study Sample

Participants in this study were adults (18 years or older) that were active members of the Sanderson Center at Mississippi State University. The Sanderson Center is a recreational facility that is located on the campus of Mississippi State University, and the majority of the participants were students from the university. The study was approved by the Institutional Review Board at Mississippi State University for the Protection of Human Subjects (Appendix A). Each participant signed an informed consent form that described the testing procedures and the possible allergy risks (Appendix B).

Survey Design

Panelists completed a product acceptability score sheet. It contained two columns comparing the product formulated with sucralose and the product formulated with sugar. A five point hedonic scale (1 = dislike extremely, 3 = neither like nor dislike, 5 = like extremely) was used to score the fruit slushes (Appendix C). A 16-item survey instrument was developed specifically for this study. Participants were asked questions regarding beverage consumption, likeability of the fruit slush product, nutritional knowledge concerning the fruit slush, fruit consumption, and exercise frequency (Appendix C).

Product Formulation

Ingredients listed in Table 2.2 and Table 2.3 were mixed together in two large containers. Two separate batches were made. One batch was prepared with sugar and the other with sucralose. Bananas were peeled and sliced and folded into the mixtures. The samples were then placed in 5.5 oz Sweetheart cups (Owings Mills, MD) filled with about two ounces of the slush from each batch to total 210 cups. The cups were then placed in a freezer overnight with a temperature of -10° F so the slush could freeze. Samples were taken out of the freezer to sit for about 60 minutes prior to serving them to the panelists.

Nutritional content are presented in Table 2.4. Nutritional content is based on one ounce serving of the fruit slush. Note the participants in this study received about two ounces. The calorie content is lower in the product prepared with sucralose.

Table 2.2 Product formulation for fruit slush prepared with sugar.

| Product Containing Sugar | |
|---------------------------------|---------------|
| <i>Item</i> | <i>Amount</i> |
| Frozen Strawberries | 2839 ml |
| Canned Pineapple Tidbits | 1183 ml |
| Frozen Orange Juice Concentrate | 1065 ml |
| Sugar | 400 g |
| Water | 710 ml |
| Bananas | 1770 g |

Table 2.3 Product formulation for fruit slush prepared with sucralose.

| Product Containing Sucralose | |
|---------------------------------|---------------|
| <i>Item</i> | <i>Amount</i> |
| Frozen Strawberries | 2839 ml |
| Canned Pineapple Tidbits | 1183 ml |
| Frozen Orange Juice Concentrate | 1065 ml |
| Sucralose | 50 g |
| Water | 710 ml |
| Bananas | 1770 g |

Table 2.4 Nutritional content of fruit slush products

| Nutritional content (based on 1 oz serving) | | | |
|---|----------|--------------|-----------|
| Product | Calories | Carbohydrate | Potassium |
| Sugar | 22 kcal | 5 g | 45 mg |
| Sucralose | 19 kcal | 5 g | 45 mg |

Data Collection

Participants were verbally recruited for this study in the front lobby of the Sanderson Center at Mississippi State University. Each participant read and signed an informed consent form before participation in the experiment. One-hundred and five participants tasted and scored the samples using a five point hedonic scale (1 = dislike extremely, 3 = neither like nor dislike, 5 = like extremely). Participants evaluated the overall liking, color, flavor, and texture.

Statistical Analysis

A randomized complete block design with three replications was used to determine if differences ($P < 0.05$) existed in acceptability among fruit slush formulated with sucralose and sugar treatments. Replications were conducted on three different days and included 35 participants. The treatments included the fruit slush formulated with sugar and the fruit slush formulated with sucralose. Tukey's Honestly Significant Differences Test was used to separate treatment means when significant differences ($P < 0.05$) occurred among treatments. All data within each demographic group were analyzed. Data analysis was conducted using SAS version 9.1.3 (SAS Institute., 2002-2003, Cary, NC).

Results and Discussion

This study investigated the consumer preference and consumer acceptability of a fruit slush product formulated with sugar and a fruit slush product formulated with sucralose. A total of 105 panelists participated in the study of which 53.3% were males and 46.7% were females. The ethnicity of the panelists included 68.6% Caucasians, 26.7% African Americans, 1.9% Hispanics, 1.9% Asian/Pacific Islanders, and 0.95% indicated other. When looking at the preferences according to gender, there was no significant difference in the overall acceptability of the products (Appendix D.1). The scores for the overall liking and flavor were similar. Overall, the males and females extremely to moderately liked both fruit products and their flavor. The scores for the color and texture of the fruit slush products were also very similar. Males and females moderately liked the color and texture of the fruit slush products. There were no differences in the acceptability of the fruit slush products in accordance to gender.

When looking at preferences according to race (Table 2.5), there were no differences ($P>0.05$) between the fruit slush formulated with sucralose and the fruit slush formulated with sugar. All races moderately to extremely liked both fruit products. Acceptability scores were similar for sensory characteristics. Flavor of both products was moderately to extremely liked by the Caucasians, African Americans, Hispanics, and Asian/Island Pacificers. The one panelist in the other racial group neither liked nor disliked the flavor of the products. Hispanic panelists scored the texture slightly higher than the other races, although this is not statistically different. Hispanics are accustomed to consuming foods of different textures. Overall, scores were similar for all

characteristics between the fruit slush products. It is feasible to substitute the sugar in a fruit slush product with a non-caloric sweetener such as sucralose and still have an acceptable product for all races.

Table 2.5 Mean consumer acceptability scores using a five point hedonic scale to determine the consumer acceptability of fruit slush formulated with either sucralose or sugar according to race¹.

| Treatment | Sensory Evaluation Scores ² (Standard Error) | | | |
|----------------------------|---|-------------------------|-------------------------|-------------------------|
| | Overall Liking | Flavor | Color | Texture |
| Caucasian (n=72) | | | | |
| Sucralose | 4.4 ^a (0.07) | 4.5 ^a (0.07) | 4.1 ^a (0.06) | 4.1 ^a (0.06) |
| Sugar | 4.4 ^a (0.07) | 4.4 ^a (0.07) | 4.1 ^a (0.06) | 4.1 ^a (0.06) |
| African American (n=28) | | | | |
| Sucralose | 4.4 ^a (0.14) | 4.4 ^a (0.15) | 4.0 ^a (0.08) | 4.1 ^a (0.15) |
| Sugar | 4.4 ^a (0.14) | 4.4 ^a (0.15) | 4.1 ^a (0.08) | 4.0 ^a (0.15) |
| Hispanic (n=2) | | | | |
| Sucralose | 5.0 ^a (0) | 4.5 ^a (0.35) | 4.0 ^a (0) | 4.5 ^a (0) |
| Sugar | 5.0 ^a (0) | 5.0 ^a (0.35) | 4.0 ^a (0) | 4.5 ^a (0) |
| Asian/Island Pacific (n=2) | | | | |
| Sucralose | 3.5 ^a (0.35) | 4.0 ^a (0.35) | 4.0 ^a (0.71) | 3.5 ^a (0.35) |
| Sugar | 4.0 ^a (0.35) | 3.5 ^a (0.35) | 4.0 ^a (0.71) | 4.0 ^a (0.35) |
| Other ³ (n=1) | | | | |
| Sucralose | 4.0 ^a (NA) | 3.0 ^a (NA) | 4.0 ^a (NA) | 2.0 ^a (NA) |
| Sugar | 4.0 ^a (NA) | 3.0 ^a (NA) | 4.0 ^a (NA) | 2.0 ^a (NA) |

^a For each demographic group (Caucasian, African American, Hispanic, Asian/Island Pacific, Other), means with the same letter within each column are not significantly different (P>0.05).

¹ Native American was also a choice on the survey but none of the participants chose it. Therefore, no data were available.

² Hedonic Scale was based on a 5-point scale (1= dislike extremely, 3= neither like nor dislike, 5= like extremely): each participant tasted one cup of fruit slush prepared with sucralose and one cup of fruit slush prepared with sugar.

³ Since there was only one participant in this demographic group, no statistical analysis could be performed. Standard error was not applicable (NA).

When looking at consumer preferences according to age there were no differences ($P>0.05$) in the overall acceptability of the fruit slush products, except in the 25-29 age group (Table 2.6). The majority (92.4%) of panelists were in the 18-24 age group. The 25-29 age group consisted of 6.7% of panelists and one panelist was in the 30-34 age group.

The panelists in the 25-29 age group significantly preferred ($P<0.05$) the fruit slush formulated with sugar over the slush formulated with sucralose. These panelists also statistically preferred the flavor of the sugar product over the sucralose product. The color and texture was moderately liked by the 25-29 age group. Note the sample size for this group was only seven participants. The younger age group extremely liked both products. The flavor was moderately to extremely liked. Color and texture was moderately liked by the younger panelists. The younger age group may be more aware of products prepared with sucralose than the older panelists. They may also be aware of the health benefits associated with non-caloric sweeteners.

There were no differences ($P>0.05$) observed in the overall liking, flavor, color, and texture of the fruit slushes. (Table 2.7) Participants moderately liked the both fruit products and their characteristics. Scores for overall liking were 4.4 for both fruit slushes. The color and texture received slightly lower scores, but were not significant ($P>0.05$). The slightly lower scores in these categories may have been due to the chunks of fruit that appeared in the products and the color was not very appealing, although the scores were still acceptable. This demonstrates that products made with sucralose are as

acceptable as products made with sugar. One can substitute a sugar based product with sucralose and have acceptable results.

Table 2.6 Mean consumer acceptability scores using a five point hedonic scale to determine the consumer acceptability of fruit slush formulated with either sucralose or sugar according to age¹.

| Treatment | Sensory Evaluation Scores ² (Standard Error) | | | |
|--------------------------|---|-------------------------|-------------------------|-------------------------|
| | Overall Liking | Flavor | Color | Texture |
| 18-24 (n=97) | | | | |
| Sucralose | 4.5 ^a (0.06) | 4.5 ^a (0.06) | 4.1 ^a (0.05) | 4.1 ^a (0.06) |
| Sugar | 4.5 ^a (0.06) | 4.4 ^a (0.06) | 4.1 ^a (0.05) | 4.1 ^a (0.06) |
| 25-29 (n=7) | | | | |
| Sucralose | 3.7 ^a (0.24) | 3.9 ^a (0.20) | 4.3 ^a (0.15) | 3.8 ^a (0.15) |
| Sugar | 4.6 ^b (0.24) | 4.6 ^b (0.20) | 4.3 ^a (0.15) | 3.8 ^a (0.15) |
| 30-34 ³ (n=1) | | | | |
| Sucralose | 4.0 ^a (NA) | 4.0 ^a (NA) | 3.0 ^a (NA) | 4.0 ^a (NA) |
| Sugar | 2.0 ^a (NA) | 2.0 ^a (NA) | 3.0 ^a (NA) | 4.0 ^a (NA) |

^{a-b} For each demographic group (18-24, 25-29, 30-34), means with the same letter within each column are not significantly different (P>0.05).

¹ 35-39 and 40 or older were also choices on the survey but none of the participants chose them. Therefore, no data were available.

² Hedonic Scale was based on a 5-point scale (1= dislike extremely, 3= neither like nor dislike, 5= like extremely): each participant tasted one cup of fruit slush prepared with sucralose and one cup of fruit slush prepared with sugar.

³ Since there was only one participant in this demographic group, no statistical analysis could be performed. Standard error was not applicable (NA).

Table 2.7 Overall mean consumer acceptability scores using a five point hedonic scale to determine the consumer acceptability of fruit slush formulated with either sucralose or sugar.

| Sensory Evaluation Scores ¹ | | | | |
|--|------------------|------------------|------------------|------------------|
| Treatment | Overall Liking | Flavor | Color | Texture |
| Sucralose | 4.4 ^a | 4.5 ^a | 4.1 ^a | 4.1 ^a |
| Sugar | 4.4 ^a | 4.4 ^a | 4.1 ^a | 4.0 ^a |
| Standard Error | 0.06 | 0.06 | 0.05 | 0.06 |

^a Means with the same letter within each row are not significantly different (P>0.05).

¹ Hedonic Scale was based on a 5-point scale (1= dislike extremely, 3= neither like nor dislike, 5= like extremely): each participant tasted one cup of fruit slush prepared with sucralose and one cup of fruit slush prepared with sugar.

Nutritional knowledge of participants was examined by asking participants if they thought that the product was a healthy food item. Ninety-one percent of participants reported that they believed that the product was a healthy food item. Only one participant reported that the product was not healthy. Eight percent reported they were not sure if it was healthy. It may be assumed that these panelists were not sure if it was secondary the product formulated with sugar.

When looking at the mean acceptability scores according to participants' perception of the product as a healthy food (Table 2.8), no differences were detected (P>0.05). The panelists that believed the product was healthy scored overall liking and flavor 4.5. These panelists moderately liked the color and texture of the product. Panelists that were not sure of if the products were healthy moderately liked both products. Texture of the sucralose product was scored slightly lower but this was not statistically different.

Participants were also asked to rate their nutritional perception of the of the fruit slush products was excellent, good, fair, poor, or very poor. (Table D.2). The participants

were not given the nutritional content of either product. They did receive a list of ingredients. There were no difference ($P>0.05$) in the overall acceptability between the products. Only 32% of participants perceived the products as having an excellent nutritional content. These participants scored the products' characteristics slightly higher than the other participants, but there was no statistical difference ($P>0.05$). They extremely liked the products and their flavor. Fifty-four percent of panelists perceived the products as a good source of nutrition. These panelists moderately liked both products and their sensory characteristics. Thirteen percent of panelists perceived the products as a fair source of nutrition. These panelists moderately liked the products and their sensory characteristics. It is hypothesized that more panelists rated the nutritional perception as good or fair over excellent secondary to product formulated sugar.

Table 2.8 Mean consumer acceptability scores using a five point hedonic scale to determine the consumer acceptability of fruit slush formulated with either sucralose or sugar according to participants' perception of the product as a healthy food.

| Treatment | Sensory Evaluation Scores ¹ (Standard Error) | | | |
|-----------------------|---|-------------------------|-------------------------|-------------------------|
| | Overall Liking | Flavor | Color | Texture |
| Yes (n=96) | | | | |
| Sucralose | 4.5 ^a (0.06) | 4.5 ^a (0.06) | 4.1 ^a (0.05) | 4.2 ^a (0.06) |
| Sugar | 4.5 ^a (0.06) | 4.5 ^a (0.06) | 4.1 ^a (0.05) | 4.1 ^a (0.06) |
| No ² (n=1) | | | | |
| Sucralose | 4.0 ^a (NA) | 4.0 ^a (NA) | 3.0 ^a (NA) | 3.0 ^a (NA) |
| Sugar | 4.0 ^a (NA) | 4.0 ^a (NA) | 3.0 ^a (NA) | 3.0 ^a (NA) |
| Not Sure (n=8) | | | | |
| Sucralose | 3.5 ^a (0.38) | 3.6 ^a (0.41) | 3.5 ^a (0.09) | 3.4 ^a (0.13) |
| Sugar | 4.0 ^a (0.38) | 3.8 ^a (0.41) | 3.6 ^a (0.09) | 3.8 ^a (0.13) |

^a For each demographic group (Yes, No, Not Sure), means with the same letter within each column are not significantly different ($P > 0.05$).

¹ Hedonic Scale was based on a 5-point scale (1= dislike extremely, 3= neither like nor dislike, 5= like extremely): each participant tasted one cup of fruit slush prepared with sucralose and one cup of fruit slush prepared with sugar.

² Since there was only one participant in this demographic group, no statistical analysis could be performed. Standard error was not applicable (NA).

Throughout this research, the focus was on the preferences between the fruit slush prepared with sucralose and the fruit slush prepared with sugar. Consumer acceptability of both fruit products was measured. If the products were sold on stores, it is important to see how well they would sell. Therefore, we asked panelists if they would be willing to purchase these products (Table D.3). Seventy-nine percent of the panelists indicated that they would be willing to purchase these products. This is a very acceptable market share. Twelve percent of panelists indicated that they were not sure if they would purchase these products. These panelists scored the color of both products slightly lower, although not statistically different. Overall, these panelists extremely liked both products scoring them 4.6 and 4.5 respectively. Only seven percent of panelists indicated that they would not be

willing to purchase these products. These panelists moderately liked both fruit products, but neither liked nor disliked the texture of the products.

Participants were also asked if they would be willing to purchase these products over other products versus other products, such as colas, fruit juices, fruit smoothies, sport drinks, etc. Table 2.9 contains mean acceptability scores of the fruit slush products according to participants' willingness to purchase the products used in this research study versus other products. No differences were observed ($P < 0.05$) in the overall acceptability of the two fruit products. Twenty-eight percent of panelists indicated that they would "very likely" purchase the product used in this research study versus the other products. These panelists extremely liked the products and their flavor.

Fifty-two percent of panelists indicated that they would be "somewhat likely" to purchase these products versus other products. These panelists rated the products very similarly. They moderately to extremely liked both products and their characteristics.

Twelve percent of panelists indicated that they would be "neither likely nor unlikely" purchase the products used in this research study versus other products. These participants moderately liked the products and their characteristics. Only six percent of panelists indicated that they would be "somewhat unlikely" purchase the products used in this research study versus other products. These panelists moderately liked the sugar product and its characteristics. Overall, they neither liked nor disliked the sucralose product and its texture. Texture of the sucralose product was neither liked nor disliked by these panelists. Only two percent of panelists would be "very unlikely" to purchase this

product. Although the extremely liked both of the products scoring them a 4.5, they neither liked nor disliked the texture of the products.

Overall, the consumer acceptability scores according to whether the panelists' would be willing to purchase these products versus other products were outstanding. Color and texture received slightly lower scores, but these were still very acceptable scores.

With over half of Americans not consuming the recommended two to three servings of fruits per day, it became of interest to examine fruit consumption patterns in adults that participate in a wellness center. Mean consumer acceptability scores of the fruit products according to participants' fruit consumption are presented in Table D.4. There were no differences ($P>0.05$) in the overall acceptability of the fruit slush products. In this study, 33% of panelists indicated that they consumed the minimum number of recommended servings of fruits per day. This data correlated with the results from the 2005 Behavioral Risk Factor Surveillance System for Mississippi. Only 17% of Mississippians consumed the recommended servings of fruit and vegetables per day (BRFSS, 2005b). Fifty-one percent of panelists reported that they consumed one serving of fruit per day which does not meet the *Dietary Guidelines for Americans*. Fifteen percent indicated that they did not consume any fruit.

Table 2.9 Mean consumer acceptability scores using a five point hedonic scale to determine the consumer acceptability of fruit slush formulated with either sucralose or sugar according to participants' willingness to purchase this product versus other products such as colas, fruit juices, fruit smoothies, sport drinks, etc.

| Treatment | Sensory Evaluation Scores ¹ (Standard Error) | | | |
|-----------------------------------|---|-------------------------|-------------------------|-------------------------|
| | Overall Liking | Flavor | Color | Texture |
| Very Likely (n=29) | | | | |
| Sucralose | 4.6 ^a (0.09) | 4.5 ^a (0.13) | 4.2 ^a (0.07) | 4.3 ^a (0.08) |
| Sugar | 4.8 ^a (0.09) | 4.5 ^a (0.13) | 4.3 ^a (0.07) | 4.2 ^a (0.08) |
| Somewhat Likely (n=55) | | | | |
| Sucralose | 4.6 ^a (0.08) | 4.6 ^a (0.08) | 4.1 ^a (0.08) | 4.2 ^a (0.09) |
| Sugar | 4.4 ^a (0.08) | 4.4 ^a (0.08) | 4.1 ^a (0.08) | 4.1 ^a (0.09) |
| Neither Likely or Unlikely (n=13) | | | | |
| Sucralose | 4.1 ^a (0.18) | 4.2 ^a (0.19) | 3.9 ^a (0.11) | 3.8 ^a (0.11) |
| Sugar | 4.1 ^a (0.18) | 4.2 ^a (0.19) | 3.7 ^a (0.11) | 3.8 ^a (0.11) |
| Somewhat Unlikely (n=6) | | | | |
| Sucralose | 3.2 ^a (0.34) | 3.5 ^a (0.34) | 3.7 ^a (0.18) | 3.0 ^a (0.24) |
| Sugar | 4.3 ^a (0.34) | 4.3 ^a (0.34) | 3.7 ^a (0.18) | 3.7 ^a (0.24) |
| Very Unlikely (n=2) | | | | |
| Sucralose | 4.5 ^a (0) | 4.0 ^a (0) | 3.5 ^a (0) | 2.5 ^a (0) |
| Sugar | 4.5 ^a (0) | 4.0 ^a (0) | 3.5 ^a (0) | 2.5 ^a (0) |

^aFor each demographic group (Very Likely, Somewhat Likely, Neither Likely or Unlikely, Somewhat Unlikely, Very Unlikely), means with the same letter within each column are not significantly different (P>0.05).

¹Hedonic Scale was based on a 5-point scale (1= dislike extremely, 3= neither like nor dislike, 5= like extremely): each participant tasted one cup of fruit slush prepared with sucralose and one cup of fruit slush prepared with sugar.

Panelists that consumed none to two serving of fruit per day moderately to extremely liked both fruit slushes. Scores were similar between these two groups of panelists. Panelists consuming three or more fruits per day moderately liked both products overall, but neither liked nor disliked the color of both products and the texture of the product formulated with sugar.

Participants' frequency of physical activity was measured. Seventy-seven percent of participants indicated they met the minimum recommendations for physical activity of exercising three or more times a week for thirty minutes or more. Only nine percent of participants reported that they rarely exercised. Mean consumer acceptability scores of the two fruit slushes are shown in Table D.5. There was one difference ($P < 0.05$) observed in the flavor and texture of the fruit slush products indicated by participants that exercise three times a week for thirty minutes or more. These panelists significantly preferred the flavor and color of the product formulated with sucralose over the product formulated with sugar. No other differences ($P > 0.05$) were observed. Participants moderately to extremely liked both fruit products and its characteristics.

Agglomerate hierarchical clustering was performed using Ward's Method to cluster consumers together based on their preference and liking of fruit slush treatments (Table 2. 10). A dendrogram and a dissimilarity plot were used to determine how many clusters should be utilized to group together consumers. After this cluster analysis was performed, randomized complete block designs were utilized to determine differences ($P < 0.05$) among treatments within each cluster. When significant differences occurred for a response ($P < 0.05$) within each cluster, the Least Significant Distance Test was performed to separate treatment means.

For the fruit slush product, cluster 1 (7.6% of panelists) preferred ($P < 0.05$) the fruit slush prepared with sugar. Cluster 2 (3.8% of panelists) preferred ($P < 0.05$) the fruit slush prepared with sucralose. In cluster 3, (19.0% of panelists) moderately liked both fruit products. Cluster 4 (22.9% of panelists) liked both of the products but preferred

($P < 0.05$) the slush prepared with sucralose. Cluster 5 (18.1% of panelist) liked both products but preferred ($P < 0.05$) the slush prepared with sugar. In cluster 6 (28.6% of panelists) extremely liked both fruit products. These results reveal that substituting a fruit slush product originally prepared with sugar with a non-caloric sweetener such as sucralose, you can still have a very acceptable product. Clustering of consumers allowed for the determination of potential consumer groups that both did and did not like different combinations of the products that were tested.

Table 2.10 Mean consumer acceptability scores using a five point hedonic scale to determine the consumer acceptability of fruit slush formulated with either sucralose or sugar according to different clusters.

| Cluster | Sucralose | Sugar | Panelist Percentage |
|-----------|------------------|------------------|---------------------|
| Cluster 1 | 2.8 ^b | 4.3 ^a | 7.6% |
| Cluster 2 | 4.3 ^a | 2.5 ^b | 3.8% |
| Cluster 3 | 4.0 ^a | 4.0 ^a | 19.0% |
| Cluster 4 | 5.0 ^a | 4.0 ^b | 22.9% |
| Cluster 5 | 4.0 ^a | 5.0 ^a | 18.1% |
| Cluster 6 | 5.0 ^a | 5.0 ^a | 28.6% |

^{a-b} Means with the same letter within each row are not significantly different ($P > 0.05$).

Conclusion

This study examined the attitudes and acceptability of consumers to consume fruit slushes that was formulated with sucralose or sugar. Sucralose compared favorably with the fruit slush product prepared with sugar. Results of this study indicated that consumers who were active in a wellness center were willing to increase fruit consumption by purchasing this type of product. Seventy-nine percent of the participants reported that

they would be willing to purchase this product. Fifty-two percent of participants indicated that they would be somewhat likely to purchase this product versus other products such as colas, fruit juices, fruit smoothies, etc.

With the increasing overweight and obesity rates in Mississippi and throughout the U.S., it is important to encourage healthy eating habits. Recent concerns have been expressed regarding high intakes of sugar sweetened foods and beverages and their association with the increasing prevalence of overweight and obesity. The increase in consumption of high-sugar, low nutrient dense foods have raised particular interest. This is why the use of non-calorie sweeteners should be encouraged for many individuals. It is an accepted fact that diet and lack of exercise play a major role in the obesity epidemic. Regular physical activity plays an important role in weight loss. Seventy-seven percent of participants in this study met the recommendation. Fruit and vegetable consumption is not being met in Mississippi and throughout the U.S. Only 17% of participants in this study consumed the recommended servings for fruit. The fruit slush product used in this study contained four different fruits (strawberries, pineapple, orange juice, and bananas). Consuming this product could greatly increase fruit consumption. Preparing the product with sucralose made little difference in the overall liking, taste, texture and flavor of the product. This product is a healthy option for consumers versus other products such as colas, and other sugar-based products because it is nutritious and lower in sugar and calories.

Implications

The implication of this research is that sucralose-based fruit slushes are as acceptable as fruit slushes prepared with sugar. Enhancing the nutritional content of a fruit slush product by substituting sugar with the non-caloric sweetener, sucralose, one can produce an acceptable product. The product will maintain the same sensory characteristics. Therefore, it is feasible to develop an acceptable fruit slush product with a sugar substitute such as sucralose.

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APPENDIX A
INSTITUTIONAL REVIEW BOARD APPROVAL LETTER



August 3, 2006

Keri Connelly
Foos Science, Nutrition and Health Promotion
Mail Stop 9805

RE: IRB Study #06-192: Acceptability of a Fruit Slush Product by Individuals That Participate In a Wellness Program

Dear Ms. Connelly:

The above referenced project was reviewed and approved via administrative review on 8/3/2006 in accordance with 45 CFR 46.101(b)(6). Continuing review is not necessary for this project. However, any modification to the project must be reviewed and approved by the IRB prior to implementation. Any failure to adhere to the approved protocol could result in suspension or termination of your project. The IRB reserves the right, at anytime during the project period, to observe you and the additional researchers on this project.

Please refer to your IRB number (#06-192) when contacting our office regarding this application.

Thank you for your cooperation and good luck to you in conducting this research project. If you have questions or concerns, please contact me at jmiller@research.msstate.edu or 325-5220.

Sincerely,

A handwritten signature in black ink that reads "Jonathan E. Miller". The signature is written in a cursive style with a large initial "J".

Jonathan E. Miller
IRB Administrator

cc: William Benjy Mikel

Office of Regulatory Compliance

P. O. Box 6223 • 8A Morgan Street • Mailstop 9563 • Mississippi State, MS 39762 • (662) 325-3294 • FAX (662) 325-8776

APPENDIX B
INFORMED CONSENT FORM

Acceptability of a Fruit Slush Product by Individuals that Participate in a Wellness Program Consent Form

YOU MUST BE 18 YEARS OR OLDER TO PARTICIPATE!

Title of Study: Acceptability of a Fruit Slush Product by Individuals That Participate In a Wellness Program

Study Site: Mississippi State University Department of Food Science, Nutrition, and Health Promotion Garrison Sensory Evaluation Food Laboratory and the Sanderson Center

Name of Researcher(s) & University affiliation: Keri D. Connelly, Graduate Student, Mississippi State University

What is the purpose of this research project?

The purpose of this project is to determine the acceptability of a newly developed fruit slush by individuals that are participating in a wellness center as well as provide nutritional information about the importance of fruit intake and benefits of potassium.

How will the research be conducted?

The research will be conducted in two parts:

1. A scoresheet will be administered to you. You will be instructed to read the ingredient list attached to the scoresheet to be sure you are not allergic to any of the ingredients. You will then be given samples of the frozen fruit slush and asked to record your preferences onto the scoresheet. Your name will not be recorded onto the scoresheet.
2. You will be asked to complete a survey. Your name will not be recorded on the survey.

Are there any risks or discomforts to me because of my participation? No

Does participation in this research provide any benefits to others or myself?

You will learn valuable nutrition information about fruit consumption and discover a new alternative to increase fruit consumption. You will also learn information about potassium and its benefits associated with muscle cramps and cramping.

What are alternative procedures or courses of treatment that might be advantageous to me? N/A

Will this information be kept confidential?

Yes, this information will be kept confidential. Names will only be attached to consent forms which will be stored in a locked file cabinet in the Department of Food Science, Nutrition, and Health Promotion. These files will be retained for three years and then destroyed. Also, please note that these records will be held by a state entity and therefore are subject to disclosure by law.

Who do I contact with research questions? If you should have any questions about this research project, please feel free to contact Keri Connelly at 601-218-4765. For additional information regarding your rights as a research subject, please feel free to contact the MSU Regulatory Compliance Office at 662-325-5220.

****If the study is physical in nature or is considered by the IRB to be more than minimal risk the following question must be included:**

What do I do if I am injured at a result of this research?

In addition to reporting an injury to Dr. Benjy Mikel at 662-325-5508 and to the Regulatory Compliance Office (662-325-5220), you may be able to obtain limited compensation from the State of Mississippi if the injury was caused by the negligent act of a state employee where the damage is a result of an act for which payment may be made under §11-46-1, et seq. Mississippi Code Annotated 1972. To obtain a claim form, contact the University Police Department at *MSU UNIVERSITY POLICE DEPARTMENT, Stone Building, Mississippi State, MS 39762, (662) 325-2121.*

What if I do not want to participate?

Please understand that your **participation is voluntary**, your **refusal to participate will involve no penalty or loss** of benefits to which you are otherwise entitled, and you **may discontinue your participation** at any time without penalty or loss of benefits.

You will be given a copy of this form for your records.

Thank you for your participation!

Participant Signature

Date

Investigator Signature

Date

APPENDIX C
SURVEY AND ACCEPTABILITY TEST

A list of ingredients is attached to this scoresheet. If you have ANY known allergies, please carefully read the attached list.

Department of Food Science, Nutrition & Health Promotion
Mississippi State University
Box 9805
Mississippi State, MS 39762

Product: Fruit Slush

Date:

Aug-Sep 2006

Please taste the frozen fruit product and check your preference:

SAMPLE A

OVERALL LIKING

- Like extremely
- Like moderately
- Neither like nor dislike
- Dislike moderately
- Dislike extremely

The Color of the Product

- Like extremely
- Like moderately
- Neither like nor dislike
- Dislike moderately
- Dislike extremely

Overall Flavor

- Like extremely
- Like moderately
- Neither like nor dislike
- Dislike moderately
- Dislike extremely

The Texture of the Product

- Like extremely
- Like moderately
- Neither like nor dislike
- Dislike moderately
- Dislike extremely

SAMPLE B

OVERALL LIKING

- Like extremely
- Like moderately
- Neither like nor dislike
- Dislike moderately
- Dislike extremely

The Color of the Product

- Like extremely
- Like moderately
- Neither like nor dislike
- Dislike moderately
- Dislike extremely

Overall Flavor

- Like extremely
- Like moderately
- Neither like nor dislike
- Dislike moderately
- Dislike extremely

The Texture of the Product

- Like extremely
- Like moderately
- Neither like nor dislike
- Dislike moderately
- Dislike extremely

Please provide us with ANY comments or suggestions you may have for this product:

**Acceptability of a Fruit Slush Product by Individuals that
Participate in a Wellness Program Survey**

**Please try to answer all of the following questions by placing a checkmark
by your chosen response.**

1. Overall, do you think the fruit slush is a healthy food item?
 Yes No Not Sure

2. Would you be willing to purchase this product?
 Yes No Not Sure

3. When would you most likely consume this product? (You may choose more than one.)
 Breakfast
 Morning Snack
 Lunch
 Afternoon Snack
 Dinner
 Bedtime Snack
 None of the Above

4. Please indicate your willingness to purchase this product over other products such as colas beverages, fruit juices, fruit smoothies, sport drinks, etc.
 Very Likely
 Somewhat Likely
 Neither Likely or Unlikely
 Somewhat Unlikely
 Very Unlikely

5. How would you rate the nutritional content of this product?

| | | | | |
|-----------|------|------|------|-----------|
| 1 | 2 | 3 | 4 | 5 |
| Excellent | Good | Fair | Poor | Very Poor |

6. Do you think that the product is high in potassium?
 Yes No Not Sure

7. If you were experiencing muscle cramps, would you consume this product?
 Yes No Not Sure

8. Which products do you usually consume? Check all that apply.

| | | |
|--|---------------------------------------|--|
| <input type="checkbox"/> Gatorade | <input type="checkbox"/> Propel | <input type="checkbox"/> Flavored Water |
| <input type="checkbox"/> Colas | <input type="checkbox"/> Fruit Juices | <input type="checkbox"/> Fruit Smoothies |
| <input type="checkbox"/> Fruit Slushes | <input type="checkbox"/> Milk | <input type="checkbox"/> None |
| <input type="checkbox"/> Other (please list) _____ | | |

9. How many servings of fruit do you usually consume in one day?

- None
- 1 Serving
- 2 Servings
- 3 Servings or More

10. About how often do you work out?

- Rarely
- 1 time a week for at least 30 minutes or more
- 3 times a week for at least 30 minutes or more
- 5 or more times a week for at least 30 minutes or more

11. Do you take supplements on a regular basis?

- Yes
- No

12. Please check your category for your weight status.

- I am underweight.
- I have a normal body weight.
- I am overweight.
- I am not sure.

13. Are you a college athlete?

- Yes
- No

If yes, which sport do you participate in? _____

The following questions are asked for categorical purposes only:

14. Check your age group.

- 18-24
- 25-29
- 30-34
- 35-39
- 40 or older

15. What is your gender?

- Male
- Female

16. Please check your ethnicity.

- Caucasian
- African-American
- Hispanic
- Asian/Island Pacific
- Native American
- Other

Thank you for your participation!

APPENDIX D
CONSUMER ACCEPTABILITY TABLES

Table D.1 Mean consumer acceptability scores using a five point hedonic scale to determine the consumer acceptability of fruit slush formulated with either sucralose or sugar according to gender.

| Treatment | Sensory Evaluation Scores ¹ (Standard Error) | | | |
|---------------|---|-------------------------|-------------------------|-------------------------|
| | Overall Liking | Flavor | Color | Texture |
| Male (n=56) | | | | |
| Sucralose | 4.4 ^a (0.07) | 4.4 ^a (0.08) | 4.0 ^a (0.08) | 4.0 ^a (0.07) |
| Sugar | 4.4 ^a (0.07) | 4.3 ^a (0.08) | 4.0 ^a (0.08) | 4.0 ^a (0.07) |
| Female (n=49) | | | | |
| Sucralose | 4.5 ^a (0.10) | 4.5 ^a (0.10) | 4.2 ^a (0.06) | 4.1 ^a (0.10) |
| Sugar | 4.5 ^a (0.10) | 4.5 ^a (0.10) | 4.2 ^a (0.06) | 4.1 ^a (0.10) |

^a For each demographic group (Male, Female), means within each column with the same letter are not significantly different (P>0.05)

¹ Hedonic Scale was based on a 5-point scale (1= dislike extremely, 3= neither like nor dislike, 5= like extremely): each participant tasted one cup of fruit slush prepared with sucralose and one cup of fruit slush prepared with sugar.

Table D.2 Mean consumer acceptability scores using a five point hedonic scale to determine the consumer acceptability of fruit slush formulated with either sucralose or sugar according to participants' nutritional perception¹ of the product.

| Treatment | Sensory Evaluation Scores ² (Standard Error) | | | |
|------------------|---|-------------------------|-------------------------|-------------------------|
| | Overall Liking | Flavor | Color | Texture |
| Excellent (n=34) | | | | |
| Sucralose | 4.6 ^a (0.08) | 4.7 ^a (0.08) | 4.2 ^a (0.07) | 4.3 ^a (0.08) |
| Sugar | 4.7 ^a (0.08) | 4.5 ^a (0.08) | 4.2 ^a (0.07) | 4.3 ^a (0.08) |
| Good (n=57) | | | | |
| Sucralose | 4.4 ^a (0.09) | 4.4 ^a (0.10) | 4.1 ^a (0.08) | 4.1 ^a (0.09) |
| Sugar | 4.3 ^a (0.09) | 4.4 ^a (0.10) | 4.1 ^a (0.08) | 4.0 ^a (0.09) |
| Fair (n=14) | | | | |
| Sucralose | 3.9 ^a (0.16) | 4.1 ^a (0.20) | 3.8 ^a (0.09) | 3.6 ^a (0.13) |
| Sugar | 4.3 ^a (0.16) | 4.1 ^a (0.20) | 3.7 ^a (0.09) | 3.6 ^a (0.13) |

^a For each demographic group (Excellent, Good, Fair), means with the same letter within each column are not significantly different (P>0.05).

¹ Poor and very poor were also choices on the survey but none of the participants chose them. Therefore, no data was available to go into the table.

² Hedonic Scale was based on a 5-point scale (1= dislike extremely, 3= neither like nor dislike, 5= like extremely): each participant tasted one cup of fruit slush prepared with sucralose and one cup of fruit slush prepared with sugar.

Table D.3 Mean consumer acceptability scores using a five point hedonic scale to determine the consumer acceptability of fruit slush formulated with either sucralose or sugar according to participants' willingness to purchase the product.

| Treatment | Sensory Evaluation Scores ¹ (Standard Error) | | | |
|-----------------|---|-------------------------|-------------------------|-------------------------|
| | Overall Liking | Flavor | Color | Texture |
| Yes (n=83) | | | | |
| Sucralose | 4.5 ^a (0.07) | 4.5 ^a (0.07) | 4.2 ^a (0.05) | 4.2 ^a (0.07) |
| Sugar | 4.5 ^a (0.07) | 4.5 ^a (0.07) | 4.1 ^a (0.05) | 4.1 ^a (0.07) |
| No (n=9) | | | | |
| Sucralose | 3.9 ^a (0.25) | 3.9 ^a (0.22) | 3.7 ^a (0.24) | 3.1 ^a (0.08) |
| Sugar | 4.0 ^a (0.25) | 4.0 ^a (0.22) | 4.0 ^a (0.24) | 3.2 ^a (0.08) |
| Not Sure (n=13) | | | | |
| Sucralose | 4.6 ^a (0.14) | 4.6 ^a (0.17) | 3.7 ^a (0.14) | 4.2 ^a (0.14) |
| Sugar | 4.5 ^a (0.14) | 4.3 ^a (0.17) | 3.9 ^a (0.14) | 4.1 ^a (0.14) |

^a For each demographic group (Yes, No, Not Sure), means with the same letter within each column are not significantly different (P>0.05).

¹ Hedonic Scale was based on a 5-point scale (1= dislike extremely, 3= neither like nor dislike, 5= like extremely): each participant tasted one cup of fruit slush prepared with sucralose and one cup of fruit slush prepared with sugar.

Table D.4 Mean consumer acceptability scores using a five point hedonic scale to determine the consumer acceptability of fruit slush formulated with either sucralose or sugar according participants' daily fruit consumption.

| Treatment | Sensory Evaluation Scores ¹ (Standard Error) | | | |
|-----------------------------|---|-------------------------|-------------------------|-------------------------|
| | Overall Liking | Flavor | Color | Texture |
| None (n=16) | | | | |
| Sucralose | 4.3 ^a (0.16) | 4.4 ^a (0.13) | 4.1 ^a (0.19) | 4.0 ^a (0.09) |
| Sugar | 4.4 ^a (0.16) | 4.6 ^a (0.13) | 3.9 ^a (0.19) | 4.3 ^a (0.09) |
| 1 Serving (n=54) | | | | |
| Sucralose | 4.5 ^a (0.09) | 4.5 ^a (0.10) | 4.1 ^a (0.06) | 4.0 ^a (0.08) |
| Sugar | 4.4 ^a (0.09) | 4.4 ^a (0.10) | 4.1 ^a (0.06) | 4.0 ^a (0.08) |
| 2 Servings (n=28) | | | | |
| Sucralose | 4.5 ^a (0.12) | 4.5 ^a (0.11) | 4.1 ^a (0.09) | 4.3 ^a (0.12) |
| Sugar | 4.6 ^a (0.12) | 4.4 ^a (0.11) | 4.4 ^a (0.09) | 4.2 ^a (0.12) |
| 3 or Servings or More (n=7) | | | | |
| Sucralose | 4.3 ^a (0.24) | 4.0 ^a (0.29) | 3.4 ^a (0.10) | 4.0 ^a (0.37) |
| Sugar | 4.1 ^a (0.24) | 4.1 ^a (0.29) | 3.3 ^a (0.10) | 3.3 ^a (0.37) |

^a For each demographic group (None, 1 Serving, 2 Servings, 3 Servings or More), means with the same letter within each column are not significantly different (P>0.05).

¹ Hedonic Scale was based on a 5-point scale (1= dislike extremely, 3= neither like nor dislike, 5= like extremely): each participant tasted one cup of fruit slush prepared with sucralose and one cup of fruit slush prepared with sugar.

Table D.5 Mean consumer acceptability scores using a five point hedonic scale to determine the consumer acceptability of fruit slush formulated with either sucralose or sugar according to participants' exercise frequency.

| Treatment | Sensory Evaluation Scores ¹ (Standard Error) | | | |
|---|---|-------------------------|-------------------------|-------------------------|
| | Overall Liking | Flavor | Color | Texture |
| Rarely (n=9) | | | | |
| Sucralose | 4.4 ^a (0.17) | 4.4 ^a (0.16) | 4.3 ^a (0.27) | 3.7 ^a (0.12) |
| Sugar | 4.4 ^a (0.17) | 4.7 ^a (0.16) | 4.2 ^a (0.27) | 4.0 ^a (0.12) |
| 1 time a week for at least 30 minutes or more (n=15) | | | | |
| Sucralose | 4.5 ^a (0.15) | 4.6 ^a (0.16) | 3.9 ^a (0.19) | 4.1 ^a (0.10) |
| Sugar | 4.6 ^a (0.15) | 4.5 ^a (0.16) | 4.1 ^a (0.19) | 4.3 ^a (0.10) |
| 3 times a week for at least 30 minutes or more (n=46) | | | | |
| Sucralose | 4.6 ^a (0.09) | 4.6 ^a (0.09) | 4.2 ^a (0.06) | 4.3 ^a (0.09) |
| Sugar | 4.4 ^a (0.09) | 4.4 ^b (0.09) | 4.2 ^a (0.06) | 4.0 ^b (0.09) |
| 5 or more times a week for at least 30 minutes or more (n=35) | | | | |
| Sucralose | 4.1 ^a (0.11) | 4.1 ^a (0.13) | 3.9 ^a (0.07) | 3.9 ^a (0.11) |
| Sugar | 4.4 ^a (0.11) | 4.3 ^a (0.13) | 3.9 ^a (0.07) | 4.0 ^a (0.11) |

^{a-b} For each demographic group (Rarely, 1 time a week for at least 30 minutes or more, 3 times a week for at least 30 minutes or more, 5 or more times a week for at least 30 minutes or more), means with the same letter within each column are not significantly different ($P > 0.05$).

¹ Hedonic Scale was based on a 5-point scale (1= dislike extremely, 3= neither like nor dislike, 5= like extremely): each participant tasted one cup of fruit slush prepared with sucralose and one cup of fruit slush prepared with sugar.