

## Effect of Color and Flavor on the Perceived Intensity of Stevia (*Stevia rebaudiana*) in Sweetened Beverage Products

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One of the main health concerns today is diabetes and it causes by many reasons, one of them is sweeten beverage consumption. Stevia is a great candidate of natural sweetener that can be used in beverage products. It is 250 times sweeter than sugar, contains zero calories, can decrease blood sugars and etc. This study was aimed to investigate perceived intensity of sweetness (product still in the mouth), aftertaste as well as overall liking in beverage preparing with Stevia extract powder (Stevioside) and sucrose in four different flavored beverages (strawberry, green tea, orange, and lime/lemon). There were 120 consumers participated in the study, most of them were 18-25 years old students with monthly income about 10,000-20,000 Baht. Food Neophobia Scale (FNS), Food Involvement Scale (FIS), and Health and Taste Attitude scale (HTAS) were used in order to obtained the consumer attitude and behavior towards food products. It was found that Thai consumers in the study were considered as food neophobic. Both finding from FIS and HTAS indicated that Thai consumers were neutral in term of food involvement activities and attitude toward health perspectives and taste of food products. When comparing between male and female in all three psychographic scales, there was a significantly different found in "Preparation and Eating" subscale in FIS. According to the product testing, there were main effects of flavor and sweetener on perceived sweet intensity and overall liking, but not with the aftertaste intensity. There is no interaction effect between flavor and sweetener. When comparing within the same sweetener, strawberry flavored beverage was perceived as the sweetest product for both sucrose and stevia sample. Consumer perceived sweet intensity of sample containing sucrose with orange, lime/lemon, and strawberry flavor the same. All stevioside samples were perceived as having the same sweet intensity. Consumer perceived strawberry flavor with stevioside sample as having the same sweet intensity as green tea sample preparing with sucrose. The samples contained stevioside were less preferred than samples prepared with sucrose. However, the green tea sample with sucrose was not significantly different from lime, orange, and strawberry sample containing stevioside in overall liking.

**Keywords:** Sugar replacers; Stevia; Human's health; Beverage products; Sensory test

### Introduction

Nowadays, people are turning towards nature and seek food or food ingredients that not only healthy, but also have a good taste. According to the World Health Statistics report in 2012 which contains a WHO's annual compilation of data from 194 countries claims that today 12% of the world's population is considered obese, with women more likely to be obese than men and thus, exposed to a greater risk of diabetes, cardiovascular disease and



certain cancers. According to EPHA.org (2012), one in 10 adults worldwide has diabetes and if it is left untreated, diabetes can lead to cardiovascular disease, blindness and kidney failure.

There is one natural plant-derived sweetener known as Stevia, which is now widely available and rapidly replacing artificial sweeteners in consumer products. Its level of sweetness which is 250 times sweeter than sucrose. Mitchell (2006) wrote that stevia as sugar alternatives may have some important physiological effects and subsequent health benefits such as improved glycaemic control, dental health, digestive health and calorie reduction. Stevia has become an alternative to calorie conscious consumers who want to enjoy sweet taste with no added calories or glycemic response. Moreover, Curry and others (2008) stated that Stevia is considered generally recognized as safe or GRAS by FDA. Brandle and Telmer (2007) found out that sweeteners derived from *Stevia rebaudiana* show great potential as zero-calorie sweeteners in the snack and quick-meal foods including more specifically in food products based on dried fruits, cakes, and beverages.

One concern about Stevioside is the bitter aftertaste produced mostly attributed to a compound found in the Stevia plant called Stevioside (Tanaka 1997). Neely and Borg (1999) described aftertaste as the taste intensity of a food or beverage that is perceived immediately after that food or beverage is removed from the mouth. Although sweeteners have been found out to have more health benefits than sugar, most of them have an unpleasant aftertaste. This health factor can impact consumer decision to purchase them instead of sugar (Goyal and others 2010). Some people experience bitter aftertaste when consuming products with Stevia sweetener which due to the presence of essential oils, tannins and flavonoids. It limits its acceptability as a sugar substitute for the sensory conscious consumer. There seems to be limited research on how flavor together with color can affect the aftertaste, but the general idea seems to be that some flavors and colors can disguise or enhance aftertaste more than others. Another concern about Stevia is consumer acceptance of beverages when they are sweetened with it instead of sugar. Elkins (1997) suggests that although Stevia has a characteristic aftertaste, it is more likely to be accepted by consumers due to the fact that it is more natural than other sweeteners such as Saccharin or Aspartame.

These days consumer acceptance is influenced by health information and risk evaluation. Many consumers are willing to eat something that does not have a good taste if they believe it will give them health benefits. Not a lot of research has been done about

acceptance of stevia astringent aftertaste however many journals are available on acceptance of unpleasant taste and health information availability. (Carson and Hassel 1994)

The effect of flavor and color on the consumer's perceived aftertaste intensity of Stevia in sweetened beverage products with four different flavors: Strawberry, Orange, Lime/Lemon and Green Tea was investigated in this study.

## Materials and Methods

### Materials

Stevioside (Wang Chemical Company Ltd.), Sugar, Water, Flavors-lime, orange, strawberry and orange (Givaudan (Thailand) Ltd., SAS<sup>®</sup> (Statistic Analysis System for Windows, Version 9.2, 2010, SAS Institute Inc., Cary, NC).

### Methods

#### 1. Consumer Test

##### a. Recruiting consumers

Within screening questionnaire consisted of personal information, convenient time, health information (food allergies and diabetes), general information and consumers' decision whether participated in consumer test. Consumers were screened more than 120 consumers at Assumption University and nearby. Each consumer would be done the screening questionnaire for recruiting who were most appropriate for this test. The appropriate consumers would be replied back to appoint in convenient date and time for participating in this consumer test.

##### b. Sample Testing

There were two main tested samples, sucrose and stevia sample. The concentration of sucrose samples and Stevioside samples are shown in table 1.

**Table 1 The composition of the tested samples**

Sample	Sweetener	Sucrose (% w/v)	Stevioside (% w/v)	Colorant (% v/v)	Flavor (% v/v)
Orange 1	Sucrose	10	-	0.04	0.025
Orange 2	Stevioside	-	0.04	0.04	0.025
Lime 1	Sucrose	10	-	0.04	0.025
Lime 2	Stevioside	-	0.04	0.04	0.025
Strawberry 1	Sucrose	10	-	0.04	0.025
Strawberry 2	Stevioside	-	0.04	0.04	0.025
Green Tea 1	Sucrose	10	-	0.04	0.025
Green Tea 2	Stevioside	-	0.04	0.04	0.025



The consumers were presented to 2 set of samples; sucrose and Stevioside sample. Within each set different flavor of sample were randomly served by using William's Square Design. Each sample was presented with 3-digit code. 20 ml of each sample were given to the consumers to evaluate and rate the sweetness, flavor, overall aftertaste intensity using 15-point scale as well as 9-point hedonic scale on overall liking, sweetness, flavor, and overall aftertaste. The samples were at 8 ° - 10 ° C. After consumer were finished with the sample testing, they responded to the psychographic questions; Food Neophobia Scale (FNS), Food Involvement Scale (FIS), and Health and Taste Attitude Scale (HTAS) as well as demographic section in order to obtain the consumer characteristics. The data were analyzed using SAS<sup>®</sup>

## Results and Discussion

### 3.1. Consumer's perceived intensity and preferences.

Comparing within the same sweetener which is showed in Table 2, consumers still preferred sucrose than Stevia in all the flavors. Strawberry flavored beverage was perceived as the sweetest product for both sucrose and Stevioside sample products although all the flavored beverages were prepared with the same formula with the exactly same amount of sweetener. Strawberry with sucrose treatment is the most preferred by consumers and is followed by Orange, Lemon and Green Tea flavors with all the sucrose treatments and subsequently followed by the same order of flavors with Stevia treatments.

**Table 2 Means of perceived intensity and preferences**

Flavor	Sweetener	Sweet Intensity	Aftertaste Intensity	Overall Liking
Green Tea	Stevia	6.1	6.3	4.5
Green Tea	Sucrose	7.9	6.1	5.6
Lemon	Stevia	5.7	5.7	4.8
Lemon	Sucrose	9.0	6.3	6.1
Orange	Stevia	5.9	6.2	5.1
Orange	Sucrose	8.8	6.2	6.1
Strawberry	Stevia	6.7	5.9	5.2
Strawberry	Sucrose	10.1	6.3	6.2

Consumer perceived sweet intensity of sample containing sucrose with orange, lime/lemon, and strawberry flavor the same. All stevioside samples were perceived as having the same sweet intensity. Strawberry with sucrose treatment was the most significant different when compared with all the treatments in terms of sweet intensity. While the aftertaste intensity, all the flavors with sucrose treatments was significantly different with the stevia treatments. It was occurred in all flavors. Consumer perceived strawberry flavor with stevioside sample as having the same sweet intensity as green tea sample preparing with

sucrose. The samples contained stevioside were less preferred than samples prepared with sucrose. However, the green tea sample with sucrose was not significantly different from lime, orange, and strawberry sample containing stevioside in overall liking.

The consumers were asked to identify what aftertaste they perceived from each sample. There were more consumers perceived aftertaste than from sucrose samples. It was found that aftertaste from sucrose samples mostly identified as astringency; and the perceived intensity of Stevioside samples were identified as bitter and astringent which this bitter taste is due to the presence of essential oils, tannins and flavonoids found in Stevia. The consumer identified other perceived aftertaste as sweet.

**Table 3. Frequency of Aftertaste Found Character Note of Each Sample**

Sweetener	Flavor	Number of Respondent (120)	Frequency		
			Bitterness	Astringent	Other
Sucrose	Green Tea	70	32	48	10
	Lemon	74	28	54	7
	Orange	61	27	31	13
	Strawberry	55	20	34	12
Stevia	Green Tea	97	68	60	6
	Lemon	92	49	69	6
	Orange	90	57	60	6
	Strawberry	84	51	58	3

### 3.2. Consumption Attitude and Behavior towards Food Products

Most of the consumers participated in this study were students in Assumption University with the age between 18-25 (72.5%) years old. There were 67 male (55.8%) and 53 female (44.2%) consumers. Their income 10,000 – 20,000 Bath per months (43.3 %) then followed by below 10,000 Bath per month (35.8%).

#### 3.2.1. Food Neophobia Scale

Food neophobia is a naturally occurring reaction in humans that protect individuals from the risk of being poisoned by consuming potentially harmful foods (Stallberg-White and Pliner 1999). Food neophobia is measured on a scale called the food neophobia scale or FNS that was developed in the early 1990s by Pliner and Hobden.

**Table 4. Percentage of consumer whom identified by Food Neophobia Scales (FNS)**

Consumer (Number)	No. of Consumer (percentage)		
	Neophilic (<25)	Neutral (25 - 35)	Neophobic (>35)
Overall (120)	5.8	35.8	58.3
Male (67)	6.0	35.8	58.2
Female (53)	5.7	35.8	58.5

According to Table 4, it was found that Thai consumers in this study were considered as food neophobic with average percentage 58.3%, with female has a higher percentage average than male.

### 3.2.2. Food Involvement Scale (FIS)

Food involvement refers to how much an individual is engaged with food and this influences brand loyalty, purchasing and view of food as nutritional objects not only as mere culinary objects (Bell and Marshall 2003). According to the study, it was found that Thai consumers were neutral interm of the FIS since the Likert mean average was  $4.4 \pm 0.5$ . When comparing between male ( $4.4 \pm 0.5$ ) and female ( $4.5 \pm 0.5$ ), there was no significantly difference found. When comparing male and female consumer in term of 2 subscale of FIS; Set and Disposal (S&D) and Preparation and Eating (P&E). the results showed us that there were no significantly different between female ( $4.7 \pm 1.1$ ) and male ( $4.7 \pm 1.0$ ) in Set and Disposal (S&D) scales, but there was a significantly different between male and female in Preparation and Eating (P&E) scales with scale of  $4.3 \pm 0.6$  for male and  $3.9 \pm 0.5$  for female.

### 3.2.3. Health and Taste Attitude Scales

The health and taste attitude scale (HTAS) developed by Roininen and published in 2001 determines the importance of health and taste characteristics of foods in the food choice process. He stated that these multi-item scales is made of sets of statements, ranging from “strongly disagree” to “strongly agree” in Likert scales, which further divide into three Health related statements (General health interest, Light product interest and Natural product interest) and three Taste related statements (Craving for sweet foods, Using food as a reward and Pleasure) sub-scales. According to table 5, When all of this six subscales compared between male and female, there were not significantly different in all the subscales, so we can conclude that both male and female has the same opinion about this six subscale in Health related and Taste related statements.



**Table 5. Likert score obtained from subscales of Health and Taste Attitude Scale (HTAS)**

Subscales	Consumers	Likert Score $\pm$ SD
General Health Interest	Overall	4.4 $\pm$ 0.8
	Male	4.4 $\pm$ 0.8
	Female	4.4 $\pm$ 0.8
Light Product Interest	Overall	4.0 $\pm$ 0.5
	Male	4.0 $\pm$ 0.5
	Female	4.0 $\pm$ 0.4
Natural Product Interest	Overall	3.9 $\pm$ 0.6
	Male	3.8 $\pm$ 0.7
	Female	4.0 $\pm$ 0.6
Craving for Sweet foods	Overall	3.7 $\pm$ 0.8
	Male	3.7 $\pm$ 0.8
	Female	3.6 $\pm$ 0.9
Using Food as a Reward	Overall	4.4 $\pm$ 0.8
	Male	4.4 $\pm$ 0.8
	Female	4.3 $\pm$ 0.7
Pleasure	Overall	4.0 $\pm$ 0.4
	Male	4.0 $\pm$ 0.4
	Female	4.1 $\pm$ 0.4

**Conclusion**

According to the sample tasting, it was found that consumers preferred sample containing sucrose over Stevioside. Strawberry samples were perceived as having highest sweet intensity, while green tea samples were perceived as the lowest. The aftertaste characteristic of sucrose sample was mostly indicating as astringent but Stevioside samples were perceived as having both bitter and astringent as the aftertaste. Food Neophobia Scale (FNS), Food Involvement Scale (FIS), and Health and Taste Attitude scale (HTAS) were used in order to obtain the consumer attitude and behavior towards food products. It was found that gender has no effect on the food related attitudes and behavior except for the Preparation and Eating subscale of FIS.

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