

# Chocolate Milk Sweetened With Stevia: Acceptance by Children

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## Abstract

We investigated children's acceptance of chocolate non-fat milk, sweetened with sucrose and stevia (Enliten®) with eighty-four children (11-14 years old) under four sweetness conditions. Samples were evaluated with a structured 7-point hedonic scale, ranging from "super bad" to "super good", for color, sweetness, flavor, texture and overall liking. The chocolate milk with 18g of sucrose with stevia was more accepted; chocolate milk with no sugar added (NSA) and with stevia had lower notes.

**Keywords:** Chocolate Milk; Stevia; Color; Flavor; Preference; Sweetness

## Introduction

Milk contributes substantially to nutrient intake. Those who consumed milk had higher intakes of several key nutrients. Milk provides more than 50 percent of the daily intake of vitamin D, over 30 percent of calcium, and over 20 percent of vitamin A, riboflavin, vitamin B<sub>12</sub>, and phosphorus for milk [1].

According to the 2010 USDA Dietary Guidelines for Americans a nutritious choice – unlike many soft drinks and fruit juices, flavored milk provides at least 8 grams of protein per serving and essential nutrients such as calcium, vitamin A, D, B<sub>12</sub>, potassium, phosphorus, riboflavin, and niacin. This unique nutrient profile along with small amounts of sugar added to nutrient-dense foods, such as reduced fat milk products, may encourage intake of such products by improving their palatability, fostering increased nutrient intake without excessive calories [2].

Due to these benefits, all Americans 9 and older are encouraged to consume three cups of fat-free or low fat fluid milk or equivalent milk products per day. The Institute of Medicine (2010) recommended children aged between 9-13 years consume 1,300 mg of calcium per day [3]. Sebastian (2010) said that young children (age 2-11 years) consumed significantly more milk than teens or adults; milk therefore provided a higher proportion of their total nutrient intake [1].

Chan et al. (1995) related that young girls whose dietary calcium intake was provided primarily by dairy products at or above the recommended dietary allowances had an increased rate of bone mineralization. Increased intake of dairy foods did not increase overall total or saturated fat intake and was not associated with excessive weight gain or increased body fat [4,5].

The overconsumption of added sugar by kids is debated by everyone from parents to policymakers around the world [6]. Conners and Bednar (2002) related that child nutrition programs are well positioned to promote its consumption and thus have a salutary effect on the nutritional status of school children [7].

Murphy et al. (2008) described that consumption of either flavored or plain milk is associated with a positive influence on nutrient intakes by children in the United States and According to Johnson et al. (2002), children who consume flavored milk have higher calcium intakes, but similar total fat and added sugar intakes as children who do not drink flavored milk. Boor (2001) described that chocolate is the most popular milk flavor and represents a popular option among children and adults [8-10].

Fayeta et al. (2013) related that children and adolescents evaluating the effects of flavored milk on improving total milk and nutrient intake along with important clinical end points such as bone health and body composition are recommended [11].

Tachdjian et al. (2013) related that sugar and calories are key components that can be limited to render a positive nutritional effect on health. High-intensity sweeteners can provide the sweetness of sugar, with various taste qualities. Because they are many times sweeter than sugar, much less of the sweetener is required to replace the sugar [12].

Approximately 16% of children and adolescents’ total caloric intakes came from added sugars [13]. Blackburn et al. (1997) indicated that flavored milk with artificial sweetener provides the desired sweetness and palatability without contributing to caloric intake [14].

Stevia rebaudiana (Bert.) Bertoni a herbaceous perennial plant native to subtropical and tropical rainforests of South America is an all-natural zero-calorie sweetener [15] used in a wide variety of food and beverages [16]. Stevia seems well-positioned to become a major high-potency sweetener [17] for the growing natural food market, especially given its lack of undesirable taste characteristics [18].

## Materials and Methods

### Milks

Treatments comprised four types of chocolate milk produced by Ingredion Incorporated™. The ingredients and nutritional information of chocolate milk samples are described in Table 1. Three samples contained high-intensity Enliten®, a naturally low-calorie sweetener obtained from Stevia rebaudiana; the remaining sample was sweetened with 28g of sucrose.

	Chocolate milk			
	Stevia and sucrose (20g) (A)	Stevia and sucrose (18g) (B)	NSA** with Stevia (C)	Control - with sucrose (28g) (D)
Enliten® Reb A Stevia Sweetener (%)	0.015	0.015	0.0247	0
Calories*	120	110	90	150
Protein (g)*	8	8	8	8
Calcium (g)*	300	300	300	300
Total fat (g)*	0.5	0.5	0.5	0.5

NSA = non-sugar-added  
 The Daily Value, the recommended daily intake of a nutrient, for calcium is 1,000mg

**Table 1:** Nutritional information of four chocolate milks - per serving 238mL

### Sensory test

Eighty-four students were recruited at random to take part in the study. Panels were female (n = 48) and male (n = 36), aged from 12 to 14 years (Table 2). For sensory evaluation, chocolate milk samples were removed from the refrigerator, placed in 2 ounce white cups coded with random 3-digit numbers and brought to 5 °C. Tasters were instructed to evaluate the chocolate milk with respect to color, flavor, sweetness, texture/feel and overall liking. Samples were rated on a 7-point hedonic scale, ranging from 1 (“super bad”) to 7 (“super good”). Between samples, the participants ate a cream cracker biscuit and drank water. The first-order and carry-over effects were balanced using a design based on [19]. Samples were presented monadically.

Panelists were asked about: liking white milk (yes or no); liking chocolate milk (yes or no); frequency of milk consumption at lunch during the week, and choice of drink for school lunch (white milk, chocolate milk, both, or neither). Compusense Five (Compusense®), software was used to perform the sensory analysis. Analysis of variance (ANOVA) was used to compare mean scores of each chocolate milk [20]. This study was approved by the Institutional Review Board at a large Northeastern University.

Gender	Age n (%)		
	12	13	14
Male	7 (8.3)	26 (31.0)	3 (3.6)
Female	12 (14.3)	32 (38.1)	4 (4.8)
	19 (22.6%)	58 (69.1%)	7 (8.3%)

**Table 2:** Characteristics of children panels

## Materials and Methods

The majority of tasters liked both white and chocolate milk:

Answers	White milk % (n)	Chocolate milk % (n)
Yes	85.7 (72)	92.9 (78)
No	14.3 (12)	7.1 (6)

n=84

**Table 3:** Liking rate for white and chocolate milk

Children’s milk consumption frequency during lunch (Table 4) showed that 47.6% had milk 4 or more times per week; 23.8% had milk 3 times a week; while 14% did not consume milk.

Weekly school lunch milk consumption (servings)	n (%)
0	13 (14.0)
1	4 (4.8)
2	4 (4.8)
3	20 (23.8)
≥ 4	40 (47.6)

n=84

**Table 4:** Consumption frequency children of milk for school lunch during the week

Choice	Answers n (%)
White milk	6 (7.1)
Chocolate milk	53 (63.1)
Both the same	20 (23.8)
Neither	6 (7.1)

n=84

**Table 5:** School lunch milk type preference

Table 6 gives sensory preference (color, flavor, sweetness, texture, overall liking) for the four chocolate milks. Color of chocolate milk sample containing sucrose and stevia – 18g (B) and 20g (A) received 100% approval [21].

For sweetness, flavor and texture there was no significant difference ( $p \geq 0.05$ ), among the samples. The chocolate milk with 18g of sucrose with stevia was more accepted and sample with NSA and with stevia (C) had lower notes [22-25]. Panelists significantly prefer chocolate milk with 18g sucrose and stevia.

Liking	Chocolate milk			
	with stevia and sucrose – 20g (A)	with stevia and sucrose-18g (B)	NSA with stevia (C)	with sucrose-28g (D)
	<b>Color</b>			
Means <sup>1</sup>	6.02 <sup>ab</sup>	6.18 <sup>a</sup>	5.65 <sup>c</sup>	5.94 <sup>b</sup>
Approval (%) <sup>2</sup>	100	100	89.29	96.43
Indifferent (%) <sup>3</sup>	0	0	9.52	2.38
Rejection (%) <sup>4</sup>	0	0	1.19	1.19
	<b>Sweetness</b>			
Notes <sup>1</sup>	5.96 <sup>b</sup>	6.24 <sup>a</sup>	4.69 <sup>c</sup>	5.85 <sup>b</sup>
Approval (%) <sup>2</sup>	92.86	94.05	54.76	91.67
Indifferent (%) <sup>3</sup>	4.76	3.57	25.00	3.57
Rejection (%) <sup>4</sup>	2.38	2.38	20.24	4.76
	<b>Flavor</b>			
Notes <sup>1</sup>	5.90 <sup>b</sup>	6.29 <sup>a</sup>	4.86 <sup>c</sup>	6.06 <sup>b</sup>
Approval (%) <sup>2</sup>	100	96.43	55.95	2.38
Indifferent (%) <sup>3</sup>	0	1.19	29.76	8.33
Rejection (%) <sup>4</sup>	0	2.38	14.29	89.29
	<b>Texture</b>			
Notes <sup>1</sup>	5.74 <sup>b</sup>	6.14 <sup>a</sup>	5.18 <sup>c</sup>	5.75 <sup>b</sup>
Approval (%) <sup>2</sup>	90.48	96.43	80.95	89.29
Indifferent (%) <sup>3</sup>	5.95	3.57	7.34	7.14
Rejection (%) <sup>4</sup>	3.57	0	10.71	3.57
	<b>Overall liking</b>			
Notes <sup>1</sup>	6.06 <sup>b</sup>	6.38 <sup>a</sup>	5.02 <sup>d</sup>	5.93 <sup>c</sup>
Approval (%) <sup>2</sup>	97.62	98.81	67.86	91.67
Indifferent (%) <sup>3</sup>	2.38	0	22.62	3.57
Rejection (%) <sup>4</sup>	0	1.19	9.52	4.76

Means in the same row followed by the same superscript do not differ statistically at 5% Tukey

<sup>1</sup>Scale: 1 = super bad, 2 = really bad, 3 = bad, 4 = maybe good or bad, 5 = good, 6 = really good, 7 = super good;<sup>2</sup>Notes for approval = 5, 6, 7; <sup>3</sup>Notes for indifferent = 4; <sup>4</sup>Notes for rejection = 1, 2, 3**Table 6:** Preference test of the chocolate milk for color, sweetness, flavor, texture and overall liking

## Conclusion

The use of stevia and small amounts of sucrose increased taste acceptance of chocolate milk with school age children. Using stevia saved 40 calories per serving. Chocolate milk which used stevia alone was least preferred by the panel. A future study might look at optimizing sucrose levels to increase acceptance while minimizing added calories.

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