

Exploring the Use of *Stevia rebaudiana* as a Sweetener in Comparison with Other Sweeteners

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ABSTRACT Stevia extract was prepared by boiling stevia leaf powder in water. Sweetness equivalence was tested by comparing sweetness of extract with sugar and other sweeteners like sugar free, equals, natura, sugar free natura and saccharine. Eleven recipes viz milk, coffee, tea, *gajar halwa*, milk shake, *kheer*, curd, lemon water, custard, *halwa* and *lapsi* were prepared using stevia extract and other sweeteners for sensory evaluation. Results revealed that 5g of sugar, 500mg of sugar free, 500mg of natura, 40mg of saccharine, 650mg of equals and 1.50ml of stevia extract in 100ml of water were equal in sweetness. Recipes prepared by using stevia extract were superior than the other sweeteners while saccharine as a sweetener recorded significantly minimum acceptability scores comparatively and was not preferred by the panel members.

INTRODUCTION

Stevia, the sweetest gift from mother nature belongs to the family asteraccae, genus *stevia* and species *rebaudiana*. It is an amazing plant from the rain forest of Amazone. The other names of stevia are sweet leaf, honey leaf, sweet herb, honey yerba. *Stevia* is extensively grown in places like Brazil, Paraguay, Central America, Israel, but is a native to Paraguay (Sharma et al. 2006). Stevioside, a white crystalline compound isolated from *stevia* is 100 to 300 times sweeter than table sugar. *S. rebaudiana* is used for the treatment of various conditions such as cancer (Yasukawa et al. 2002), diabetes (Lailerd et al. 2004), obesity, cavities, hypertension (Dyrskog et al. 2005), fatigue, depression, and yeast infection. It possesses hypoglycemic, hypotensive, vasodilating, taste improving, sweetening, anti-fungal, anti viral, anti inflammatory, anti bacterial properties and increases urination function of the body. It has been found to be non toxic, non addictive, non carcinogenic, non mutagenic, non teratogenic and is devoid of genotoxic effect. It does not affect blood sugar level hence safe for diabetics (Alan 2002).

Keeping in mind the sweetening property and other medicinal uses of *Stevia rebaudiana*, an attempt has been made to explore the use of *stevia rebaudiana* as a sweetener in comparison with the other sweetener available in the market, so that the diabetic and calorie conscious people can add variety to the diet and relish the food.

Objectives of the study were:

- (i) To assess the sweetness equivalence of stevia
- (ii) To compare the acceptability of food preparations with stevia and other sweeteners.

MATERIALS AND METHOS

Market Survey and Sample Selection: Study was conducted in the year 2006-2007. Ten popular medical shops of Udaipur city were surveyed for the availability of sweetener in the local market. Four most common sweeteners as revealed by the order of maximum sale and preference given by the consumers were selected for study. Stevia leaf powder was procured from ARS Herbals, ARS Nursery, Bangalore.

Development of Stevia Extract: Stevia extract was prepared by boiling 25g of stevia leaf powder in 500ml water for one and a half hour till reduced to 150 ml and used as a sweetener under the study. According to literature, *stevia* leaf powder contains 5-10percent of stevioside and the maximum safe limit of stevioside for human consumption has been suggested as 7938mg per kg body weight or 476.28mg per day (Xilli et al. 1992). Through experiment it was observed that 20ml of extract was maximum acceptable limit in a glass of water (200ml) at the same time, it contained 250mg of stevioside which is lower than the maximum safe limit. This amount was kept in mind before sweetening any recipe.

Sweetness Equivalence of Stevia Extract: Sweetness equivalence of stevia extract in comparison with the sugar and other sweeteners was judged through sensory evaluation by selected panel of judges using rank order test (Swaminathan 1995). Sugar solution was used as control and sweetness of other solutions prepared by using different sweeteners and stevia extract was compared for their equivalence with sugar solution.

Development of Sweet Preparations: Eleven commonly consumed sweet preparations namely milk, milk shakes, tea, coffee, lemon water, curd, *halwa*, *lapsi*, *kheer*, custard and *gajar halwa* were selected. These recipes were standardized with stevia extract, sugar and other sweeteners and tested for organoleptic characteristics by a panel of 10 judges using 9 point hedonic scale.

RESULTS AND DISCUSSION

Type of Sweeteners Available: Through market survey it was known that four types of sweeteners were available in the market namely Sugar free, Equals, Sugar free natura and saccharin as a sugar substitute. On the basis of their sale, preference for these sweeteners was determined and found that 70% patients preferred Sugar free followed by 25% for Equals, 10% for Sugar free natura and 5% were using Saccharin as revealed by the shop keepers. As far as cost is concerned, Saccharin was lowest (Rs.20 per 100g) among all other sweeteners.

Sweetness Equivalence: Sweetness equivalence of *stevia* in comparison to sugar and other sweetener is shown in Table 1 which reveals that majority of the panel members (80-90%) were of the opinion that acceptable levels of various sweeteners were 5000mg for sugar, 500mg for Sugar free and Natura each, 40mg for saccharine, 650mg for Equals and 1.5ml liquid extract per 100ml of water. According to Sharma et al. (2003), stevioside extract have been found to be 100-300 times sweeter than sugar. Savita et al. (2003)

reported that crude stevia leaves and herbal green powder is 10-15 times sweeter than sucrose while Horwitz and Bauer (1983) stated that aspartame is the main component of artificial sweeteners and is approximately 180 times sweeter than sugar. According to Crammer and Ikan (1986) the crude stevia leaves and herbal green powder is 10-15 times sweeter than sucrose.

Standardization of Recipes with Stevia and Other Sweeteners: Table 2 depicts the method of preparation of selected eleven recipes with stevia extract. The amount of stevia extract used to sweeten one serving of milk shake, coffee, curd custard was 2ml while it was 2.5-3.0ml for tea, *kheer*, lemon water and 4ml for milk, *halwa*, *lapsi* and carrot *halwa*. The amount of sugar in various preparations ranged from 5-10g while it was 1-2g for other sweeteners like Natura, Equals and Sugar free.

Sensory Evaluation: The mean scores of sensory evaluation for appearance, color, flavour, texture, taste, overall acceptability (Table3) showed perceivable variation between the products. All the products with stevia extract were well accepted by the panel members (7.67-7.90) and ranked first when compared with other artificial sweeteners (6.27-7.03) and found statistically at par ($p > 0.001$) with sugar (7.47-8.47) in coffee, *halwa*, milk shake, *kheer* and *lapsi* while superior over the rest of recipes. These results were significant at 1 percent level and no bitter taste or after taste was reported by the judges in the products developed with stevia extract. The recipes prepared by using Sugar free as a sweetener were better liked among all the artificial sweeteners and saccharine scored lowest (4.17-6.37). Sekihashi et al. (2002) expressed that steviol is not toxic to human beings and does not damage brain, liver or kidney but use of saccharin caused bladder tumor in rats (Arnold 1984).

CONCLUSION

Stevia rebaudiana is a natural herb, having enormous sweetening power and is safe for consumption. Various food preparations like milk, milk shake, curd, lemon water, *lapsi* (sweet *dalia*), custard, *halwa*, *kheer*, carrot *halwa*, tea, coffee prepared by using stevia extract were found at par or even superior for some characteristics than table sugar. Among the artificial sweeteners Sugar free natura was better liked among all and products with saccharin were least preferred by the panel

Table 1: Sweetness equivalence of stevia extract and other sweeteners

Sweetener	Amount (mg)	Water (ml)
Sugar	5000	100
Sugar free	500	100
Natura	500	100
Saccharin	40	100
Equals	650	100
Stevia extract (ml)	1.50	100

Table 2: Method of preparation of recipes with stevia extract (per serving)

S.No.	Recipes	Raw Ingredients	Amount (g/ml)	Method	Cooked wt./vol. (g/ml)
1.	Milk	Milk	200	Boil milk	200
		Stevia extract	4	Add stevia extract	
2.	Milk shake	Milk	100	Take chilled milk	150
		Banana	50	Peel and cut banana, churn with milk	
		Stevia extract	2	Add to shake	
3.	Tea	Water	70	Boil water	100
		Tea leaves	2.5	Add tea leaves	
		Milk	50	Add milk	
		Stevia extract	2.5	Add stevia extract	
4.	Coffee	Milk	100	Boil milk	100
		Stevia extract	2	Add stevia extract	
		Coffee powder	1	Add coffee	
5.	Lemon water	Lemon juice	10	Take lemon juice	210
		Water	200	Add water	
		Stevia extract	3	Add Stevia extract	
		Salt	Pinch	Add salt	
6.	Curd	Curd	100	Churn curd	100
		Stevia extract	2	Add Stevia extract	
7.	Halwa	Ghee	20	Heat ghee	130
		Wheat flour	30	Roast flour	
		Water	100	Add water	
		Stevia extract	4	Add Stevia extract	
8.	Lapsi	Ghee	10	Heat ghee	140
		Dalia	30	Roast dalia	
		Water	120	Add water	
		Stevia extract	2.5	Add Stevia extract	
9.	Kheer	Milk	100	Boil milk	125
		Rice	5	Cook rice in milk	
		Stevia extract	2.5	Add Stevia extract	
10	Custard	Milk	100	Boil milk	130
		Custard powder	5	Add custard powder	
		Stevia extract	2	Add Stevia extract	
		Fruits	25	Add chopped fruits	
11	Gajar halwa	Ghee	10	Heat ghee	125
		Carrot	100	Fry carrot	
		Milk	200	Add boil milk	
		Stevia extract	4	Add Stevia extract	

Table 3: Sensory scores of recipes using different sweetener (overall acceptability scores)

Sweetener	Milk	Coffee	Tea	Gajar halwa	Milk shake	Kheer	Curd	Lemon water	Custard	Halwa	Lapsi
Stevia extract	7.83	7.47	7.73	7.93	7.97	7.90	6.60	7.97	7.67	7.97	7.87
Sugar free	6.57	6.07	6.07	7.00	6.63	6.87	7.03	6.87	6.97	6.93	6.87
Sugar free natura	6.57	5.87	6.50	6.37	6.47	6.77	5.90	6.53	6.90	6.70	6.93
Equals	6.67	6.57	6.70	6.27	6.83	6.37	6.03	6.60	6.73	6.40	6.60
Saccharin	6.00	4.17	4.60	5.17	6.37	5.67	4.40	4.97	4.80	5.60	4.77
Sugar	8.07	7.90	8.27	8.23	7.07	7.90	7.97	8.47	8.07	7.67	7.87
SE	0.10	0.11	0.09	0.09	0.11	0.12	0.10	0.11	0.09	0.10	0.15
CD(1%)	0.37	0.41	0.35	0.32	0.39	0.43	0.42	0.32	0.35	0.54	0.35
CV	7.97	9.64	7.79	7.04	8.31	9.17	8.31	9.03	6.89	7.65	11.7

of judges and recorded significantly lower acceptability scores. This is concluded that stevia extract is acceptable and its use can be a boon to diabetics and weight looser.

REFERENCES

- Alan T 2002. Stevia, glycemic index and hypertension. *Phytomedicin*. 41: 9-14.
 Arnold DL 1984. Toxicology of saccharin. *Appl Toxicol*, 4: 674-685.

- Crammer I, Ikan R 1986. Sweet glycosides from the stevia plant. *Chem Brit*, 22: 915-917.
- Dyrskog SE, Jeppensen PB, Colombo M, Abudula R, Hermansen K 2005. Preventive effects of soy based diet supplemented with stevioside on development of type 2 diabetes. *Metabolism*, 54: 1181-1188.
- Horwitz DL, Bauer JK 1983. Can aspartame meet our expectations? *J Am Diet Assoc*, 83: 142-146.
- Lailerd N, Saengsirisuwan V, Slonigar JA 2004. Effect of stevioside on glucose transport activity in rat muscle. *Metabolism*, 53: 101-107.
- Savita SM, Sheela K, Sunanda S 2004. Health implications of *Stevia rebaudiana*. *J Hum Ecol*, 13: 191-194.
- Sekihashi K, Saitoh H, Sasaki Y 2002. Genotoxicity of stevia extract. *J Toxicol Sci*, 27: 1-8.
- Sharma N, Kaushal N, Chawla A, Mohan M 2006. *Stevia rebaudiana* – A review. *Agribios*, 5: 46-48.
- Sharma RD 1987. Diabetes mellitus and fenugreek seeds. *Nutrition News, NIN* 8: 1-3.
- Swaminathan M 1993. Sensory evaluation. *Food Science, Chemistry and Experimental Food*. Bangalore: The Bangalore Printing Press, pp. 273-286.
- Xilli L 1992. Chronic oral toxicity and carcinogenicity of stevioside. *Chem Toxic*, 31: 957-965.
- Yasukawa K, Kitanaka S, Seo S 2002. Inhibitory effect of stevioside on tumor promotion by 12-O-TCA in two stage carcinogenesis in mouse skin. *Biol Pharma Bull*, 25: 1488-1499.