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Sensory and Nutritional Evaluation of Sweet Milk Products Prepared Using Stevia Powder for Diabetics

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ABSRACT Sweet milk products namely custard, *kulfi* and *sandesh* were prepared using stevia powder. Stevia was added at three different levels in the experimental products while sugar was added in the control product. The organoleptic evaluation of the products was done by a panel of judges to select the most acceptable level of stevia in all the products. The products with most acceptable level of stevia and with sugar were analyzed for their proximate composition. It was found that custard, *kulfi* and *sandesh* were acceptable at 25mg stevia as compared to the control recipe. The modified recipe of custard had 81.92g of moisture, 3.91g of protein, 1.35g of fat, 11.55g of carbohydrates and provided 74Kcal of energy. The modified recipe of *kulfi* had 58.81g of moisture, 9.37g of protein, 13.1g of fat, 15.95g of carbohydrates and provided 219 Kcal of energy. The modified recipe of *sandesh* had 67.40g of moisture, 18.84g of protein, 1.77g of fat, 8.37g of carbohydrates and provided 125Kcal of energy. The percent decrease in calories provided by modified recipe compared to the basic recipe was custard 23.71%, *kulfi* 30.03% and *sandesh* 21.38%. Sweet milk products using stevia powder were highly acceptable upto 25mg and and are low in calories as compared to the basic recipe which makes them suitable for consumption by diabetics.

INTRODUCTION

Diabetes mellitus with its devastating consequences has assumed epidemic proportions as its prevalence is on a rise globally. According to International Diabetes Federation, Diabetes currently affects 246 million people worldwide and India has the largest number of people with diabetes i.e. 40.9 million (IDF 2007). Increasing incidence of diabetes mellitus is mainly due to modern lifestyle and changed diets with balance tilted towards refined foods especially sugar and fat. This sugar along with sweetening qualities have also been found to contribute calories, which can lead to obesity, a risk factor for some chronic diseases such as diabetes.

Some people switch to artificial sweeteners, but these man-made chemicals cause more health problems than they cure. These chemicals attack vital organs that could lead to serious complications after prolonged use.

In the wake of growing incidence of diabetes, there is an increasing patronage of natural foods and flavour enhancers. *Stevia rebaudiana* is perennial herb with claimed medicinal and culinary characteristics. It is a plant of daisy family that grows naturally in South America. It is not only a 'natural' calorie free product but is 300 times sweeter than sucrose (Kerzicnik et al. 1999). Stevioside and rebaudioside A are the main sweet glycosides in stevia that provide it a sweet taste. Stevioside (St) makes up 70-80% of the sweetener and 30-40% is Rebaudioside-A(R-A). The ratio R-A/St is the accepted measure of sweetness quality. More R-A better the sweetness quality (Maiti and Purohit 2008).The sweetening effect of these compounds is purely by taste, they are undigested and not absorbed by the body. Stevia helps to treat many ailments like high blood pressure, hyperlipidemia, obesity, skin diseases and digestive disorders (Gregersen 2004; Savita et al. 2004; Gisleine et al. 2006). It has no side effects and is safe for consumption (Ferri et al. 2006).

Stevia leaves have been traditionally used for hundreds of years in Paraguay and Brazil to sweeten local teas, medicines and as a "sweet treat". Quality of stevia's sweetness is preferable to that of aspartame or saccharin. It serves as a flavor enhancer and remains stable when combined with acidic foods. High temperature does not destroy its sweetening properties. It neither ferments, not does it discolour. This makes stevia suitable for hot dishes also (Sahelian and Gates 1999).

To add variety to the tasteless food and

satisfy taste buds of diabetics, a strategy was planned to develop sweet products using stevia, to evaluate organoleptically sweet products prepared using stevia powder for diabetics and to evaluate the acceptable products nutritionally.

MATERIALS AND METHODS

Stevia powder in the form of stevi0cal was procured from Indco Hitech Agro Rural Development Women Welfare Society, Ludhiana. Custard, *kulfi* and *sandesh* were standardized and developed in the laboratory for organoleptic evaluation. In the test recipe, stevia was added at three levels in 100g cooked product while in the control recipe, required amount of sugar was added in 100g cooked product.

Development of Products

Custard- *Ingredients:* Milk – 125ml, Custard powder – 6g, Cardamom powder – pinch, Stevi0cal at three different levels 12.5mg, 25mg, 50mg and 6g sugar in control recipe. Took 20ml milk in a cup and dissolved the custard powder in it. Boiled the rest of the milk in a heavy bottom pan. Slowly added the dissolved custard powder into the boiling milk while stirring continuously. Added cardamom powder and stevi0cal/sugar and refrigerated.

Kulfi- *Ingredients:* Milk – 550ml, Cardamom powder- pinch, Stevi0cal at three different levels 25mg, 37.5mg, 50mg and 25g sugar in control recipe. Boiled milk in a pan and reduced to one fourth volume. Added cardamom powder and stevi0cal/sugar. Heated for 2 minutes. Poured in moulds and refrigerated.

Sandesh- *Ingredients:* Fresh cottage cheese-100g, Rose essence – 1drop, Stevi0cal at three different levels 25mg, 50mg, 62.5mg and 10g sugar in control recipe. Mashed the cheese with hand till smooth. Added stevi0cal/sugar and rose essence. Put the mixture in muffin case. Cooled in refrigerator for 30 minutes and took out of the case.

Organoleptic Evaluation

The organoleptic evaluation was done to select the most acceptable level of stevia in all the recipes. The panel of judges including faculty of Department of Food and Nutrition and a few diabetics were provided with score card of Hedonic Rating Scale to score the test samples for their colour, appearance, flavor, texture feel, taste and overall acceptability, compared to the control recipe.

Nutritional Evaluation

Each recipe with sugar i.e. control and corresponding recipe with acceptable level of stevia was chemically analyzed for their proximate composition i.e. moisture, crude protein, total ash, crude fat, crude fiber, total carbohydrates and energy by standard procedures (AOAC 1990).

Statistical Analysis*:* The data on organoleptic evaluation and chemical analysis was analyzed statistically. The percentages, standard error, analysis of variance and their statistical significance was ascertained using a computer programme package (Cheema and Sidhu 2004).

RESULTS AND DISCUSSION

Organoleptic Evaluation

Custard - In the trained panel, the scores for flavour ranged from 7.0±0.29 to 7.9±0.13 with the highest for the basic recipe and modified recipe with 25mg stevi0cal which reveals that they liked it very much (Table 1). The taste score was highest for 25mg stevi0cal recipe which was liked very much and lowest for 12.5mg stevi0cal recipe. The overall acceptability ranged from 6.6±0.19 to 8.0±0.0. The most acceptable modified recipe according to the trained panel was recipe with 25mg stevi0cal. It had the overall acceptability score of 7.7±0.17.

According to the scores given by the diabetic panel, the highest score for flavour was for the modified recipe with 25mg stevi0cal i.e. 7.9±0.13. The taste scores ranged from 6.6±0.28 to 7.9±0.13, the highest for the recipe with 25mg stevi0cal after the basic recipe. The overall acceptability was highest for the same recipe and lowest for the recipe with 12.5mg stevi0cal. The table 1 reveals that there is a non-significant difference in the scores of flavor, taste and overall acceptability of custard with sugar and with stevia. Stevia is as good in taste as sugar in custard at a level of 25 mg.

Kulfi- In the trained panel, the scores for flavour ranged from 6.7±0.39 to 8.0±0.0, with 25mg recipe which had the highest score among the modified recipes (Table 2). The taste score was

Table 1: Organoleptic evaluation of custard

S. No.	*Colour*	*Appearance*	*Flavour*	*Texture*	*Taste*	*Overall acceptability*
Trained Panel						
S1	8.0 ± 0.0	8.0 ± 0.0	7.1 ± 0.32	8.0 ± 0.0	6.7 ± 0.17	6.6 ± 0.19
S2	8.0 ± 0.0	8.0 ± 0.0	7.9 ± 0.13	8.0 ± 0.0	7.6 ± 0.19	7.7 ± 0.17
S3	8.0 ± 0.0	8.0 ± 0.0	7.0 ± 0.29	7.4 ± 0.19	7.3 ± 0.27	6.9 ± 0.24
S4	8.0 ± 0.0	8.0 ± 0.0	7.9 ± 0.13	8.0 ± 0.0	7.9 ± 0.13	8.0 ± 0.0
F-Ratio	0.0^{NS}	0.0^{NS}	0.98^{NS}	0.75^{NS}	1.12^{NS}	1.01^{NS}
C.D. at 5%						
Diabetics						
S1	8.0 ± 0.0	8.0 ± 0.0	7.4 ± 0.28	7.8 ± 0.13	6.6 ± 0.28	6.6 ± 0.28
S2	8.0 ± 0.0	8.0 ± 0.0	7.9 ± 0.13	7.9 ± 0.13	7.7 ± 0.17	7.7 ± 0.17
S3	8.0 ± 0.0	8.0 ± 0.0	7.6 ± 0.19	7.9 ± 0.13	7.0 ± 0.20	6.9 ± 0.24
S4	8.0 ± 0.0	8.0 ± 0.0	8.0 ± 0.0	7.9 ± 0.13	7.9 ± 0.13	7.9 ± 0.13
F-Ratio	0.0^{NS}	0.0^{NS}	0.97^{NS}	0.55^{NS}	1.01^{NS}	0.99^{NS}
C.D. at 5%						

S1= modified recipe with 12.5mg stevi0cal, S2= modified recipe with 25mg stevi0cal, S3= modified recipe with 50mg stevi0cal, S4= basic recipe with 6 g sugar, Values are Mean ± S.E.

Table 2: Organoleptic evaluation of *kulfi*

S. No.	*Colour*	*Appearance*	*Flavour*	*Texture*	*Taste*	*Overall acceptability*
Trained Panel						
S1	7.9 ±0.13	8.0 ± 0.0	7.7 ± 0.17	7.9 ± 0.13	7.7 ± 0.17	7.7 ± 0.17
S2	8.0 ± 0.0	8.0 ± 0.0	7.3 ± 0.26	7.6 ± 0.28	7.1 ± 0.24	7.1 ± 0.24
S3	8.0 ± 0.0	8.0 ± 0.0	6.7 ± 0.39	7.7 ± 0.17	6.7 ± 0.39	6.9 ± 0.37
S4	8.0 ± 0.0	8.0 ± 0.0	8.0 ± 0.00	8.0 ± 0.00	8.0 ± 0.00	8.0 ± 0.00
F-Ratio	0.21^{NS}	0.0^{NS}	1.10^{NS}	1.01^{NS}	0.98^{NS}	0.98^{NS}
C.D. at 5%						
Diabetics						
S1	8.0 ± 0.0	8.0 ± 0.0	7.8 ± 0.17	8.0 ± 0.0	7.6 ± 0.19	7.9 ± 0.13
S2	8.0 ± 0.0	8.0 ± 0.0	7.6 ± 0.19	8.0 ± 0.0	7.4 ± 0.28	7.3 ± 0.17
S3	8.0 ± 0.0	8.0 ± 0.0	7.2 ± 0.33	8.0 ± 0.0	7.3 ± 0.33	7.0 ± 0.29
S4	8.0 ± 0.0	8.0 ± 0.0	8.1 ± 0.13	8.0 ± 0.0	8.1 ± 0.13	8.1 ± 0.13
F-Ratio	0.0^{NS}	0.0^{NS}	0.95^{NS}	0.0^{NS}	0.89^{NS}	1.14^{NS}
C.D. at 5%						

S1= modified recipe with 25mg stevi0cal, S2= modified recipe with 37.5mg stevi0cal, S3= modified recipe with 50mg stevi0cal, S4= basic recipe with 25 g sugar, Values are Mean ± S.E.

highest for the same recipe which was liked very much and lowest for 50mg stevi0cal recipe. The overall acceptability ranged from 6.9±0.37 to 8.0±0.0. The most acceptable modified recipe according to the trained panel was recipe with 25mg stevi0cal. It had the overall acceptability score of 7.7±0.17.

According to the scores given by the diabetic panel, the highest score for flavour was for the modified recipe with 25mg stevi0cal i.e. 7.8±0.17. The taste scores ranged from 7.3±0.33 to 8.1±0.13, the highest for the recipe with 25mg stevi0cal. The overall acceptability was highest for the same recipe and lowest for the recipe with 50mg stevi0cal. The scores given by the trained and diabetic panel shows that there is a non-significant difference in the sensory characteristics of *kulfi* with stevia and sugar. Stevia is equally acceptable as sugar at a level of 25 mg in kulfi.

Sandesh- In the trained panel, the scores for flavour ranged from 7.3±0.26 to 8.1±0.13 with the highest for the modified recipe with 25mg stevi0cal which reveals that they liked it very much (Table 3). The taste score was highest for the same recipe. The overall acceptability ranged from 6.6±0.19 to 8.3. The most acceptable modified recipe according to the trained panel was recipe with 25mg stevi0cal. It had the overall acceptability score of 7.4±0.28.

According to the scores given by the diabetic panel, the highest score for flavour was for the modified recipe with 25mg stevi0cal i.e. 7.6±0.37. The taste score was highest for the recipe with

Table 3: Organoleptic evaluation of *sandesh*

S. No.	*Colour*	*Appearance*	*Flavour*	*Texture*	*Taste*	*Overall acceptability*
Trained Panel						
S1	8.0 ± 0.0	8.0 ± 0.0	7.7 ± 0.17	7.9 ± 0.13	7.4 ± 0.28	7.4 ± 0.28
S2	8.0 ± 0.0	8.0 ± 0.0	7.6 ± 0.19	7.9 ± 0.13	7.1 ± 0.24	7.0 ± 0.29
S3	8.0 ± 0.0	7.9 ± 0.13	7.3 ± 0.26	7.4 ± 0.28	6.9 ± 0.31	6.6 ± 0.28
S4	8.1 ± 0.13	8.0 ± 0.0	8.1 ± 0.13	8.1 ± 0.13	8.3 ± 0.17	8.3 ± 0.17
F-Ratio	0.34^{NS}	0.32^{NS}	0.79^{NS}	0.85^{NS}	1.24^{NS}	1.21^{NS}
C.D.at 5%						
Diabetics						
S1	8.0 ± 0.0	8.0 ± 0.0	7.6 ± 0.37	7.9 ± 0.13	7.9 ± 0.24	7.8 ± 0.37
S2	8.0 ± 0.0	8.0 ± 0.0	7.1 ± 0.19	7.9 ± 0.13	7.5 ± 0.4	7.6 ± 0.29
S3	8.0 ± 0.0	8.0 ± 0.0	6.7 ± 0.33	8.0 ± 0.0	6.9 ± 0.32	6.9 ± 0.32
S4	8.0 ± 0.0	8.0 ± 0.0	8.1± 0.13	8.0 ± 0.0	8.4 ± 0.19	8.3 ± 0.17
F-Ratio	0.00^{NS}	0.00^{NS}	1.27^{NS}	0.45^{NS}	1.29^{NS}	1.28^{NS}
C.D at 5%						

S1= modified recipe with 25mg stevi0cal, S2= modified recipe with 50mg stevi0cal, S3= modified recipe with 62.5mg stevi0cal, S4= basic recipe with 10g sugar, Values are Mean ± S.E.

25mg stevi0cal. The overall acceptability was highest for the same recipe and lowest for the recipe with 62.5mg stevi0cal. From the scores it can be seen that there was a non- significant difference in the flavor, texture, taste and overall acceptability of sandesh. There is no change in the colour and appearance of *sandesh* after addition of stevia. Thus it can be concluded that stevia is most acceptable in sandesh at 25 mg in place of sugar.

Hence the acceptable level of stevia in custard, *kulfi* and *sandesh* was 25 mg (Table 4). Savita et al. (2004) also reported that custard was acceptable with 25mg stevia/100g in place of sugar.

Table 4: Acceptable levels of stevi0cal in the developed sweet milk products

Recipe	*Acceptable level*			
	Trained panel		*Diabetic panel*	
	mg/100g	*%*	*mg/100g*	*%*
Custard	25	.25	25	.25
Kulfi	25	.25	25	.25
Sandesh	25	.25	25	.25

Nutritional Evaluation

The proximate composition values for the basic and the acceptable recipe were calculated for 100g cooked product, which have been given in table 5.

The modified recipe of custard with 25 mg stevi0cal had 81.92g of moisture, 3.91g of protein, 1.35g of fat, 0.18g of fibre, 1.09g of ash, 11.55g of carbohydrates and provided 74Kcal of energy. While the basic recipe had 76.04g of moisture, 3.72g of protein, 1.21g of fat, 0.15g of fibre, 0.96g of ash, 17.92 g of carbohydrates and provided 97 Kcal of energy.

The modified recipe of *kulfi* with 25 mg stevi0cal had 58.81g of moisture, 9.37g of protein, 13.1g of fat, 0.47g of fibre, 2.3g ash,15.95g of carbohydrates and provided 219 Kcal of energy. While the basic recipe had 35.68g of moisture, 9.15g of protein, 12.97g of fat, 0.41 g of fibre, 1.95g ash, 39.84g of carbohydrates and provided 313 Kcal of energy.

The modified recipe of *sandesh* with 25 mg

Table 5: Proximate composition of the cooked sweet milk products (g/100g)

Recipe	*Moisture(g)*	*Protein(g)*	*Fat(g)*	*Fibre(g)*	*Ash(g)*	*CHO(g)*	*Energy(Kcal)*
Custard							
S1	81.92	3.91	1.35	0.18	1.09	11.55	74
S2	76.04	3.72	1.21	0.15	0.96	17.92	97
Kulfi							
S1	58.81	9.37	13.1	0.47	2.3	15.95	219
S2	35.68	9.15	12.97	0.41	1.95	39.84	313
Sandesh							
S1	67.40	18.84	1.77	0.05	3.57	8.37	125
S2	59.27	18.35	1.59	0.04	3.15	17.90	159

S1–recipe with the most acceptable level of stevi0cal, S2- basic recipe with sugar

stevi0cal had 67.40g of moisture, 18.84g of protein, 1.77g of fat, 0.05g of fibre, 3.57g of ash, 8.37g of carbohydrates and provided 125Kcal of energy. While the basic recipe had 59.27g of moisture,18.35g of protein, 1.59g of fat, 0.04g of fibre, 3.15g of ash, 17.90g of carbohydrates and provided 159Kcal of energy.

Custard with sugar provided 97Kcal while custard with stevia provided 74Kcal. There was a decrease of 23Kcal in the modified recipe which is 23.71% (table 6). *Kulfi* with sugar provided 313 Kcal while *kulfi* with stevia provided 219Kcal. There was a decrease of 94Kcal in the modified recipe which is 30.03%. *Sandesh* with sugar provided 159Kcal while *sandesh* with stevia provided 125Kcal. There was a decrease of 34Kcal in the modified recipe which is 21.38%. The data in tables 5 and 6 reveals that addition of stevia in place of sugar in sweet preparations brings a significant decrease in the caloric content of custard, kulfi and sandesh, without bringing change in its overall acceptability. Thus sweet preparations with stevia can be consumed by diabetics as they are considerably low in calories as compared to the same preparation with sugar.

Table 6: Energy contribution by the developed sweet products

Recipe	*Energy (Kcal)*		*Difference*	
	Basic	*Modified*	*Kcal*	*%*
Custard	97	74	23	23.71
Kulfi	313	219	94	30.03
Sandesh	159	125	34	21.38

CONCLUSION

Stevia can be successfully incorporated upto 25mg in place of sugar in the sweet milk preparations and provides a good taste. The modified recipes were found to be quite acceptable by the trained panel and the diabetic panel as well. The modified recipes with stevia had significantly lower calories. The percent decrease in calories provided by modified recipe compared to the basic recipe was *custard* 23.71%, *kulfi* 30.03% and sandesh 21.38%.

RECCOMENDATIONS

Stevia upto 25mg can be used as a sweetener in place of sugar in sweet milk preparations as it provides sweet taste without calories and has no side effects. People should be encouraged to use stevia as it is natural, safe and has other therapeutic benefits.

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