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Health Implications of *Stevia rebaudiana*

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INTRODUCTION

The main source of sugar has for long been cane sugar with beet sugar contributing a small percentage. These sugars along with sweetening qualities also have been found to contribute calories, which can lead to obesity, a risk factor for some chronic diseases such as Diabetes mellitus, Hypertension, Cardiovascular diseases, etc. Hence craving for sweetness led man to discover several forms of alternative intense sweeteners, which have made possible to offer consumers sweet taste without the calories.

Stevia (*Stevia rebaudiana* Bertoni) is a natural herb, low calorie sweetener. Although there are more than 180 species of the stevia plant, only *stevia rebaudiana* gives the sweetest essence due to the fact that these leaves accumulate eight sweet diterpene glycosides (Soejarto et al., 1983). Stevioside is one of the principal diterpene glycoside having a sweetness of 250-300 times that of sucrose. The crude stevia leaves and herbal green powder is 10-15 times sweeter than sucrose (Crammer and Ikan, 1986).

Research studies on the health benefits of consumption of stevia are few and therefore this investigation was undertaken to determine the effect of consumption of stevia and its therapeutic uses among selected non-insulin dependent diabetics and hypertensives.

MATERIALS AND METHODS

Stevia leaf powder was incorporated in selected recipes such as Basen ladu, Wheat ladu, Sweet bun, Chikki, Biscuit, Milk shake, etc. and the recipes were standardized. The recipes developed were scored for quality attributes such as appearance, texture, taste, aroma and overall acceptability by a panel of trained and semi trained judges. Bun was selected for feeding trials for Diabetes Mellitus, which had 100 per cent sugar replacement with stevia. Chikki was selected for Hypertensives, which had 50 per cent jaggery replacement.

The experimental subjects were selected from Staff Dispensary of Indian Veterinary Research Institute at Bangalore. Thirty patients were interviewed, 15 each in Diabetic and Hypertensive group. Borderline patients who volunteered to be the subjects were selected for the study. Thus eight hypertensives (2 men and 6 women) and 6 Diabetics (4 men and 2 women) were selected and the age group was 35-55 years. As per the advise of the institute doctors, the border line patients were advised not to use drugs during experimental period.

About 0.5 g and 1.0 g of stevia leaf powder was substituted to sweet bun and chikki respectively per 100 gms of the end product. The feeding trial was for 30 days. These patients were counselled to adhere to modified diet as advised by the physicians and were asked to consume these products as snacks in substitution to their daily snacks.

The biochemical parameters estimated before and after the study period included fasting glucose level, post prandial blood glucose level, lipid profile and serum insulin level for diabetic group where as blood pressure, lipid profile and urinary sodium level for hypertensive group.

RESULTS AND DISCUSSION

A. Incorporation of Stevia in Selected Recipes to Substitute Sugar / Jaggery. Ten products were tried at different levels of substitution i.e., 50%, 60%, 75% and 100%. The best acce-pted level standardized for each product is shown in Table 1. Products such as biscuit, grape juice, sweet bun, tea and milk shake were found to be acceptable at 100 per cent substi-tution to sugar. Basen ladu and wheat ladu at 60 per cent and fruit custard, jam and chikki at 50 per cent substitution to sugar / jaggery. The quantity of powder accepted per 100g of the final product was found to be very low and this is to minimize the after taste bitterness imparted by the stevia leaf powder. Hence stevia can be used as sweet-ener in dietetic foods. In this direction, Polyanskii (1997) reported that stevia is used as sweeteners in dietetic foods, with particular reference being made to foods for diabetics.

Table 1: Acceptability of stevia with different substitution level in developed products

Products	*% Sugar/Jaggery substitution*	*Acceptable level g/100g or g/100ml*
Fruit custard	50%	0.25
Jam	50%	1.00
Chikki	50%	1.00
Basen ladu	60%	0.50
Wheat ladu	60%	0.50
Biscuit	100%	0.50
Grape juice	100%	0.25
Bun	100%	0.50
Tea	100%	0.25
Milk shake	100%	0.25

B. Background Information of the Selected Diabetics and Hypertensives. The subjects selected for the study were in the age range of 35-55 years maximum being in 45-55 years of age, mostly from the nuclear families with a family size ranging from 3-6 members. Majority of the subjects were found to be literates (93%) having received high school education (53%) and graduation (27%). Very few had obtained their post graduation (13%). Most of the subjects had moderate activity (56%) and other were sedentary workers (44%). The patients had the history of the disease for one to nine years. All patients were on diet control and 63% were non-vegetarians.

C. Impact of the Administration of Stevia Incorporated Wweet Bun and Chikki on Selected Laboratory Parameters in Diabetes and Hypertensives. The fasting and post prandial blood glucose levels, serum insulin levels, blood pressure, urinary sodium level, lipid profile and weights of the subject were assessed before and after the study period and are presented in tables 2, 3, 4, 5 and 6, respectively.

Table 2 shows the serum insulin levels of the diabetic group. The mean initial serum insulin level was 8.2 μIU/ml and after 30 days the mean serum insulin level was 15.3 μIU/ml. There is increase in mean serum insulin level after 30 days of consumption of stevia but not significant increase. This may be due to stimulation of pancreas as reported by Jeppesen et.al., in 2000 that the stevioside, diterpene glycoside of *Stevia rebaudiana* stimulate insulin secretion via direct action on beta cells.

From Table 3 it is seen that among the diabetic subjects the mean initial fasting blood sugar level (FBS) was 119.6 mg/dl and mean initial post prandial blood sugar level (PPBS) was 165.5 mg/dl. After 30 days the mean FBS and PPBS were 136.6 mg/dl and 173 mg/dl respectively. There is no significant difference in blood glucose levels. This does not support the study conducted by Hiroo et al. (1977). He studied the effect of feeding rats with a high carbohydrate diet containing 0.5% stevioside, after 4 week there was a signifi-cant decrease in blood glucose. This may be due to the form of sweetener given and the dosage given may be low. Stevioside is a refined form of stevia leaf powder, which is said to have hypoglycemic activity.

The mean initial systolic and diastolic blood pressures were 144.5mmHg and 90.5mmHg respectively (Table 4). After 30 days the mean systolic and diastolic blood pressures were 133.3 mmHg and 84.8 mmHg. There was decrease in mean systolic and diastolic blood pressure after 30 days of intake of stevia, but statistically non-

Table 2: Effect of stevia on serum insulin levels of the Diabetic group (N=6)

Code	*Sex*	*Initial (μIU/ml)*	*After 30 days (μIU/ml)*
A	F	8	19
B	F	9	19
C	M	8	7
D	M	10	7
E	M	8	25
F	M	8	15
Mean ± S.D.		8.2 ± 1.32	15.33 ± 7.2
't' Value		0.029^{NS}	

NS – Non-significant

Table 3: Effect of stevia on blood glucose levels of the diabetic group fed with sweet bun (N=6)

Code	*Fasting Blood Sugar (mg/dl)*		*Post Prandial Blood Sugar (mg/dl)*	
	Initial	*After 30 days*	*Initial*	*After 30 days*
A	153	125	173	166
B	86	115	141	125
C	91	118	124	130
D	118	109	153	138
E	135	182	192	225
F	135	171	210	254
Mean ± S.D.	119.6 ± 26.6	136.6 ± 31.4	165.5 ± 32.3	173 ± 54.2
't' Value	0.168^{NS}		0.389^{NS}	

NS – Non-significant

Table 4: Blood pressure levels of hypertensive group fed with chikki (N=8)

Code	*Sex*	*Systolic Blood Pressure (mmHg)*		*Diastolic Blood Pressure (mmHg)*	
		Initial	*After 30 days*	*Initial*	*After 30 days*
A	M	166	158	120	94
B	M	132	136	84	84
C	F	146	140	90	96
D	F	140	120	84	80
E	F	146	136	90	84
F	F	146	140	92	88
G	F	144	130	80	82
H	F	136	106	84	70
Mean ± S.D.		144.5 ± 10.1	133.3 ± 15.3	90.5 ± 12.5	84.8 ± 8.2
't' Value		0.053^{NS}		0.150^{NS}	

NS – Non-significant

significant. This may be due to short study period. Whereas Melis in 1995 reported that oral administration of the crude extract for 40 or 60 days induced hypotension, diuresis and natriuresis in normal wistar rats.

Table 5 indicates the urinary sodium level of the hypertensive group. The mean initial urine sodium level was 113.4µIU/ml and after 30 days it was 110.1µIU/ml. There is increase in urine sodium excretion after 30 days of intake of stevia. Melis (1997) confirmed that steviol infusion in wistar rats induced a significant increase in the fractional sodium excretion and urinary flow.

Table 5: Individual and Mean levels of urine sodium level of hypertensive group (N=8)

Code	*Initial (mIU/ml)*	*After 30 days (mIU/ml)*
A	91	106
B	49	56
C	36	43
D	160	149
E	121	127
F	196	181
G	107	101
H	147	198
Mean ± S.D.	113.4 ± 54.5	120.1 ± 53.9
't' Value	0.453^{NS}	

NS – Non-significant

The lipid profile of both the groups indicated that the initial mean total serum cholesterol, HDL cholesterol and LDL cholesterol were found to be 215.8, 54.7 and 134.7 mg/dl and after 30 days of consumption of stevia, the mean levels were 167.28, 34.78 and 102.94 mg/dl respectively (Table 6). There was decrease in the mean levels of total serum cholesterol, HDL cholesterol and LDL cholesterol. There is increase in mean serum triglyceride level from 132.78 to 147.78 mg/dl and VLDL cholesterol from 26.42 to 29.55 mg/dl but not significantly. Stevia appears to have an effect on lipid profile of the subjects.

Table 7 indicates the initial mean weight pf both groups was 72 and after 30 days the mean weight was 71kg. There is decrease in mean weight after 30 days of consumption of stevia

Table 6: Effect of stevia on mean serum lipid parameters for both the groups (N=14)

Lipid parameters	*Initial (mg/dl)*	*After 30 days (mg/dl)*	*'t' Value*
	Mean ± S.D.	*Mean ± S.D.*	
Total Serum cholesterol	215.85 ± 47.56	167.28 ± 26.69	0.0016^{NS}
Serum triglyceride	132.78 ± 29.96	147.78 ± 39.15	0.133^{NS}
HDL cholesterol	54.71 ± 9.32	34.78 ± 4.47	4.197*
LDL cholesterol	134.71 ± 49.63	102.94 ± 24.00	0.0227^{NS}
VLDL cholesterol	26.42 ± 5.86	29.55 ± 7.70	0.1191^{NS}

NS – Non-significant
* Significant at 1 per cent level

Table 7: Effect of stevia on subjects weight of both the groups (N=14)

Sex	*Initial (Kg)*	*After 30 days (Kg)*
M	76	74
M	64	63
M	70	68
M	76	77
M	71	70
M	72	70
F	87	84
F	64	64
F	63	62
F	86	85
F	59	59
F	83	81
F	72	69
F	70	69
Mean ± S.D.	72.32 ± 8.6	71.07 ± 8.1
't' Value	0.348^{NS}	

NS – Non-significant

and this may be due to the reduced level of sugar intake and less contribution of calories from this sweetener.

SUMMARY AND CONCLUSION

The present study was undertaken to evaluate the effect of consumption of stevia incorporated in selected recipes in substitution to sugar/ jaggery on the blood sugar level and blood pressure levels in selected patients. The results revealed that stevia products influenced blood sugar levels, insulin level, blood pressure, urine sodium excretion, lipid profile and weight of the subject but not statistically significant. It can be concluded that stevia possess a potential hypoglycemia effect provided the study is conducted on a large sample size for an extended period of time under controlled conditions. It is also found to have anti-hypertensive effect, however long term studies on sizable sample are necessary.

KEYWORDS Naural Herb. Diseases. Energy.

ABSTRACT *Stevia rebaudiana* is a natural herbal low- calorie sweetener of the composite family, a native of North Eastern Paraguay. The study was conducted to determine the effect of consumption of *Stevia rebaudiana* on selected non-insulin dependent Diabetics and Hypertensives. This sweetener has slight after taste bitterness but allows people to keep their sugar and energy intake low and yet enjoy the sweet taste of foods and beverages. Stevia leaf powder was incorporated and standardised in selected recipes. Out of the 10 standardised recipes, sweet bun and chikki were selected and fed to groups of diabetic (N=6) and hypertensive (N=8) respectively belonging to the age group of 35 – 55 years for a period of 30 days. Sweet bun had 100 percent sugar replacement where as chikki had 50% jaggery with stevia leaf powder. The results revealed that the effect of consumption of stevia products on blood sugar levels are in variance, but the mean values of serum insulin and urine sodium level increased and the mean values of blood pressure, lipid profile and weight of subjects decreased. But the results were found to be statistically non-significant. Thus, it can be concluded that stevia could be a potential hypoglycemic effect provided the study is conducted on a large sample size for an extended period of time under controlled conditions. It is also found to have anti-hypertensive effect, however long term studies on sizable sample are necessary.

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