A Review of Metabolic Effects of Stevia in Diabetes Mellitus

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Abstract: *Stevia rebaudiana* (SR) is used in the food industry as a sweetener. In that steviol glycoside is present and that content, which is a help in decreasing the calorie. Further, both in clinical and pre-clinical studies indicate that stevioside glycosides and the extracts are given the beneficial effect on diabetic condition as well as reduced the cholesterol level. In this article reviews the antihyperglycemic effects of the majority of glycosides and aqueous/alcoholic/methanolic extracts from the leaves, flowers, and roots of the SR. These compounds can serve as a natural and alternative treatment for diabetes and it is associated with metabolic syndrome, thus benefaction to health promotion. Stevia is available in market, but detailed studies involving their metabolic effects are lacking. Stevia may have important metabolic effects as well as pharmacological interaction with anti-diabetic agents. However, nodetailed studies are available assessing the effects on chemical mediators like cytokines.

Keywords: SR- stevia rebaudiana, GK- Goto kakizaki

1. Introduction of Stevia

Stevia has at least 110 identified species. Stevia contain stigmasterol, tannins, ascorbic acid, alkaloids, steroids, saponins, flavonoids, b-carotene, chromium, cobalt, magnesium, iron, potassium, phosphorus, riboflavin, thiamine, tin, zinc, apigenin, austroinilina, avicularin, b-sitosterol, caffeic acid, campesterol, caryophyllene, centaureidin, chlorogenic acid, chlorophyll, kaempferol, luteolin, and quercetin.\(^1\)

Biological properties of stevia:antacid, cardiotonic, anticaries, antitovirus, anti-bacterial, anti-hypertensive, antifungal, antiinflammatory, anti-viral, anti-yeast, diuretic, antioxidants, hypotensive, antihyperlipidemic, and anticancer.\(^2\)

![Figure 1: Stevia rebaudiana](image)

In the last decades, increase the problem about life and quality of life have revitalize humans to avoid the consumption of food rich in sugar and fat.\(^3\)NNS are available in two types.(a) Natural sweeteners (b) Artificial sweeteners.\(^4\)Most of the Non Nutritive Sweeteners approved for human consumption are synthetic (artificial sweeteners; AS). However, Increasing numbers of NonNutritive Sweeteners of natural origin are available on the market (natural, non-caloric sweeteners; NNCSs). Although peoples are using the Non Nutritive Sweeteners, it contains the low calories and is also beneficial in the metabolic disorders. The most familiar NNCSs are *Stevia rebaudiana*-based products. They contain stevioside and rebuloiode. Steviol glycosides, extracted from the plant.\(^5\)Risk factors for metabolic syndrome are characterized by the presence of abdominal Obesity, high arterial pressure, and disorder in the carbohydrate and lipid metabolism.\(^6\)There are huge number of studies available for stevioside though molecular studies are not properly available and there is also lack of comprehensive review article for stevioside. Non Nutritive sweeteners may have important metabolic effects.

In present review, we provide a comprehensive account of various studies available on the metabolic effects of stevioside. Metabolic disorders affected by a number of risk factors that affect the fat deposition in tissue, lipid metabolism, effect on inflammatory cytokines, adiponectin, leptin and plasminogen.\(^7-8\)

So, in that metabolic disorders stevia is very beneficial for controlling all parameters like BGL, lipid, cytokines and fats.

1.1 Studies are available for stevia

a) For Animal studies:

<table>
<thead>
<tr>
<th>Stevioside extracts</th>
<th>Methodology</th>
<th>Result</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetic GK rats</td>
<td>99.6% pure stevioside daily dose 0.025g/kg for 6 weeks</td>
<td>It gives positive effect tin antidiabetic that significantly lowered the blood glucose level.</td>
<td>9</td>
</tr>
<tr>
<td>Streptozotocin-induced Oral treatment with SR under a 2, 5, and 10mg/kg</td>
<td>It give antihyperglycemic effect and also</td>
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<td></td>
</tr>
</tbody>
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**Volume 9 Issue 7, July 2020**

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Paper ID: SR20711101633

DOI: 10.21275/SR20711101633

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<table>
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<tr>
<th>Treatment</th>
<th>Duration</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-obese diabetic GK rats</td>
<td>Oral treatment with stevioside in water (25mg/kg) for 6 weeks</td>
<td>The treatment gives an antihyperglycemic effect and resulted in an increase in insulin.</td>
</tr>
<tr>
<td>Non-obese diabetic GK rats</td>
<td>Oral treatment with stevioside in water (30mg/kg) coupled with a soy-based diet for 3 weeks.</td>
<td>It gives an antihyperglycemic effect, a reduction in glucagon level, and an increase in insulin level.</td>
</tr>
<tr>
<td>Streptozotocin-induced (55mg/kg) diabetic rats</td>
<td>Oral treatment with aqueous extract of powdered SR leaves under doses of 150, 200, and 250mg/kg for 3 weeks.</td>
<td>It gives a hypoglycemic effect. Decrease in the body weight of the rats.</td>
</tr>
<tr>
<td>Alloxan-induced diabetic Wistar rats</td>
<td>Oral treatment with the aqueous, methanolic, and etheric extracts during 28 days.</td>
<td>It reduced the blood glucose level in rats.</td>
</tr>
<tr>
<td>Alloxan-induced diabetic Long-Evans rats</td>
<td>Oral treatment with five alcoholic extracts from SR leaves under a unique dose of 150mg per kg of body weight of hyperglycemic rats.</td>
<td>It gives a favorable effect on decreasing the intensity of the hyperglycemia and also an improvement in the glucose tolerance activity.</td>
</tr>
<tr>
<td>Alloxan-induced (180mg/kg) albino diabetic Wistar rats</td>
<td>Oral treatment with medium-polar extract from SR leaves under doses of 200 and 400mg/kg for 10 days.</td>
<td>This treatment significantly decreased blood glucose levels.</td>
</tr>
<tr>
<td>Streptozotocin-induced (60mg/kg) diabetic Wistar rats</td>
<td>During a month, rats had a dairy diet consisting of powdered Stevia leaves and polyphenols and fiber (both taken from SR).</td>
<td>It gives reduction in blood glucose and an increase in insulin.</td>
</tr>
<tr>
<td>Alloxan-induced (150mg/kg) diabetic rats</td>
<td>Oral treatment with extract from SR leaves under a 250mg/kg dose during 28 days.</td>
<td>It gives significant antioxidant effect and a reduced hyperglycemic levels.</td>
</tr>
<tr>
<td>Alloxan-induced (150mg/kg) diabetic mice</td>
<td>The methanolic extract from SR leaves was administered under a 300mg/kg dose for 21 days.</td>
<td>This treatment significantly reduced the blood glucose level.</td>
</tr>
<tr>
<td>Male diabetic Wistar rats induced with nicotinamide (120mg/kg) and streptozotocin (65mg/kg)</td>
<td>Acute treatment: Oral treatment with aqueous extract from SR leaves (Morita II variety) under a unique 10mg/kg dose. Chronic treatment: Oral treatment with croquettes containing the SR extract under a 500mg/kg dose.</td>
<td>In this treatment had a low glycemic index in both acute and chronic in diabetic animals. So this indicated that both treatments are suitable as sweeteners.</td>
</tr>
<tr>
<td>Alloxan-induced (200mg/kg) diabetic Long-Evans rats</td>
<td>Oral treatment with titanium oxide-based nanomatrixes and ethanolic extracts from Stevia</td>
<td>It gives a significant reduction in the glucose concentration. It maintains the blood glucose level.</td>
</tr>
</tbody>
</table>

Stevia give hypoglycemic effect on diabetic rats. In that diabetic condition increase insulin secretion it caused by the consumption of the stevioside and it gives the suppressive effect of glucagon in α-type cells of the pancreas. Moreover the stevioside it reduced the blood glucose level and it inhibit the enzyme of metabolism of sugar in intestine. It also reduced the postprandial glucose level.20,21

b) For Human studies
- Stevioside extracts
  In human studies stevioside was administered with the meal so that result gives reduction of postprandial glucose level levels in type 2 diabetic patients, indicating beneficial effects on the glucose metabolism.22 (insulinogenic index increase). The extract of Steviarebaudiana increased glucose tolerance and significantly decreased plasma glucose levels during the test and after overnight fasting in all volunteers.23,24 Human studies have reported no negative gastrointestinal side effects. When used to displace carbohydrate and sugar in the diet, studies with high-purity steviol glycosides in reduced sugar and energy intake.25 Stevia used in the diabetes and chronic kidney disorders and it give the constructive effect.8 Different types of formulations of stevia are used for the alternative food sugar for healthy and patients. It control the blood sugar level and insulinogenic index maintained.26

2. Conclusion

Stevia are recently use in market as a sweeteners. Steviosides is beneficial in DM. That decreases the Blood glucose level and also the activity of the pyruvate carboxylase and the phosphoenolpyruvate carboxikinase (PEPCK). So, it also reduced postprandial glucose levels in the blood. Some studies indicate that the SR-based treatment on healthy volunteers increased their glucose tolerance and reduced their concentrations of plasmatic and postprandial glycoses. Although Stevia is widely used as sugar alternative in diabetic patient study reported its effect on parameters like IL-6, Adiponectin, cytokines studies for the better research.

References


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