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***Salvia verticillata* Effects on Diabetes and Diabetes Complications**

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Diabetes is an abnormal rise in blood glucose level, which is caused by defects in insulin production and its metabolism. It might have occurred due to changes in gut microbiota, which increased the membranes permeability, glucose resistance, oxidative stress and reduced expression of macrophages (Cani *et al.*, 2008). These microbiota changes are associated with use of antibiotics; moreover the use of high fat diet may also responsible for this metabolic imbalance and diabetes. Thus antibiotics and diet plan should be properly managed to avoid non-healthy changes in metabolism. Diabetes can also result from decrease in β -cell (insulin producing cells) volume and/or their numbers (Butler *et al.*, 2003). As in diabetic patients these cells have 41% decrease in volume than normal cells and have a low rate of replication associated with increased apoptosis. This increases the risk factor of other diseases like, cardiovascular, renal damage, cancer, blindness, respiratory and other lethal infection (Riaz, 2009; Woodward *et al.*, 2003). Thus diabetes is a dangerous disease as it increases the possibility of deaths; in United States its prevalence is high among females (Narayan *et al.*, 2003). This decreased their survival rate and when it occurs at the age of 40, men loses 11.6 while female loses 14.3 years of their life. In developing countries peoples have double diabetic risk and in 2020 it will be one of the non-communicable diseases (Boutayeb, 2006). Since diabetes with other non-communicable diseases (cancer and cardiovascular) in 2020 will be responsible of every 7 out of 10 deaths. In addition between 2010 and 2030 there will be 69% increase in diabetic adults in developing while 20% in developed countries, which will results in almost 439 million diabetic adults (Shaw *et al.*, 2010). Hence there are chances of increased diabetic problems in future, which will put a large burden on human population. It demands for more attention of practitioners to fulfill the increasing needs of reliable antidiabetic agents. Diabetes can be treated through the use of plant products (Karim *et al.*, 2011), which have the ability to lower the glucose levels and other metabolic abnormalities (increased demands of water and food) in diabetic rats (Irshaid *et al.*, 2010). Furthermore their use in diabetic rats along with anti-diabetic property showed hepatoprotective, renal protective and hypolipidemic effects (Ahmed and Urooj, 2009; Gupta *et al.*, 2011). Therefore the use of

plants in case of diabetes can be promoted as it may help in reducing the increased glucose levels and associated damages to organs.

Salvia verticillata is common growing perennial herb; its leaves are rich source of curative antioxidant rosmarinic acid (Tepe *et al.*, 2007). Eidi *et al.* (2011) in their research on *S. verticillata* found its hypoglycemic activity, associated with protection to other organs from streptozotocin-induced diabetes. They inoculated the Wistar rats with 70 mg kg⁻¹ of streptozotocin and observed its effect in rats; streptozotocin caused diabetes mellitus symptoms in rats. Its application resulted in significant decrease of body weight and insulin, while it increased the amount of serum glucose, urea, uric acid, creatinine, Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT). Thus with inducing diabetes it poorly affected the kidney (urea, uric acid and creatinine) and liver (AST and ALT) parameters, besides this it also increased the triglycerides and cholesterol levels. But the application of *S. verticillata* ethanolic extracts considerably maintained these abnormal levels. Its application for 14 days protected the rat from lethal decrease in weight, in concentration dependant manner. Weight loss was significantly resumed in rats treated with its 0.2 g kg⁻¹ b.wt. concentration and this effect was comparable to standard anti-diabetic drug; glibenclamide. While its 0.05 g kg⁻¹ b.wt. concentration did not cause any significant difference in weight when compared to diabetic control, thus *S. verticillata* caused a concentration dependant response. Its other hypoglycemic properties were reduction in serum glucose and increase in serum insulin levels, which were positively accelerated with an increase in concentration. Hence *S. verticillata* was a great subject for anti-diabetic activity and these extracts were further examined for their healthy effects on some parameters of liver and kidney. In which these extracts showed the concentration dependant hepatoprotective and renal protective effects. Their maximum concentration 0.2 g kg⁻¹ was most effective against streptozotocin-induced renal and hepatic damages. These damages were recognized by increased levels of various serum parameters and 0.2 g kg⁻¹ was extremely active in reducing the elevated levels of serum urea, uric acid, creatinine, AST and ALT. Furthermore, it also lowered the raised concentration of triglycerides and

cholesterol, hence protected the rat's body from hyperlipidemia. The *S. verticillata* extracts did not cause any harmful effect on rats' metabolism as after its application in non-diabetic rats all studied parameters were within the normal ranges. Consequently this can be said that *S. verticillata* ethanolic extracts showed many health protective effects in diabetic rats and its use may prevent the abnormal regulation of various serum concentrations.

Diabetes is an important non-communicable disease of today and even in future its prevalence is predicted to be high. It is diagnosed as increased glucose and decreased insulin levels and promoted by various biological agents. It can damage organs e.g., liver, kidney, eyes, heart etc. and can increase the risk of cancer, which strongly demands for its proper treatment. Plants provide an easy way to treat the diabetes and its associative health problems because of their multiple constructive effects. Recently Eidi *et al.* (2011) examined the anti-diabetic property of *S. verticillata* ethanolic extracts. According to them these extracts were competent source of curative activities, which could not only reduce the glucose levels but can also lessen triglycerides and cholesterol elevations induced by streptozotocin. Moreover, some hopeful hepatic and renal protective effects were also obtained from these extracts. Due to which they considered *S. verticillata* application as promising treatment for diabetes. Further investigation on its ethanolic extracts will facilitate its appropriate utilization.

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