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Effect of *Aloe vera* gel on lipid profile in alloxan induced diabetic mice

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Abstract

Ethanolic extract of *Aloe vera* gel was assessed for its hypolipidemic and hypoglycaemic activity. Twenty four mice were divided into four groups. First group act as control and remaining were induced diabetes by administrating alloxan @ 150 mg kg^{-1} body weight. Second group served as diabetic control and third group treated with glibenclamide (600µg/kg body weight). Fourth group received ethanolic extract of *A. vera* gel @ 300 mg kg^{-1} body weight for 21 days. The antihyperglycaemic (93.40 mg dL^{-1}) and hypolipidemic (101.37 mg dL^{-1}) activity of the gel and was compared with group treated with the standard oral hypoglycaemic agent. Treatment with ethanolic extract of *A. vera* gel caused the significant change when compared to untreated animals with respect to blood glucose level and lipid profile. The present study clearly indicate a significant reduction in blood glucose level, plasma level, low density lipoprotenis (LDL), cholesterol and increased plasma level of high density lipoproteins (HDL) in alloxan induced diabetes in mice.

Keywords: *Aloe Vera*, alloxan, antihyperglycaemic, glibenclamide, hypolipidemic.

Introduction

Diabetes mellitus is a universal health hazard and is seventh cause of death in the world (Trivedi *et al.,* 2004). It is the most important endocrine disorder that harms about 10% of the world population (Burke *et al.,* 2003). It is divided into insulin-dependent diabetes mellitus and non insulin-dependent diabetes mellitus, known as type-I and type-II, respectively (Bastaki, 2005). Type-I is an autoimmune disorder due to demolition of insulin producing β-cells, which shows the way of hypoinsulinemia or in other words hyperglycemia (Akira *et al.,* 2009). Type-II, in which chronic insulin resistance is parallel to insulin secretion (Lupi and Del-Patro, 2008) and mechanism of biological system, fails to reply to insulin effects (Shullman, 2000).

Type-II is the common form of disease in which 90% of diabetics are suffered that leads to hyperinsulinemia, trailed by β-cells destruction and in later stages hyperglycemia (Defronzo *et al.,* 1990). It is also coupled with various complications like retinopathy, nephropathy, neuropathy, atherosclerosis, and hyperlipidemia and develops lipoprotein abnormalities (Sheetz, 2002; Scoppola *et al.,* 2001). Moreover, low levels of high density lipoproteins levels (HDL) and in contrast increasing levels of triglycerides (TG) and low-density lipoproteins (LDL) leads to untimely atherosclerosis (Betteridge, 1994). According to Car *et al.* (2004), remnants of TG rich lipoproteins are atherogenic in nature. LDL-C is correlated with life style issues like diet and exercise (Khatit and Quazi, 2008). Lipid profile is a danger sign of coronary heart disease (Edem, 2002).

High concentration of LDL-cholesterol in blood leads to atherosclerosis but its lower level helps in avoiding atherosclerosis and hypertension (Ostland, 2000). Herbal treatments are popular due to no or least side effects (Rajasekaran *et al.,* 2001). In oral administration of *Aloe vera* gel in streptozotocin-induced diabetic rats, found to be effective in reducing blood glucose cholesterol of plasma and tissue, free fatty acids (FFA), triglycerides, phospholipids and hepatic transaminases and also observed increased insulin level in plasma (Rajasekaran *et al.,* 2006). Decreased levels of HDL-choleterol and increased levels of LDL-cholesterol in streptozotocin-induced rats were observed to come back to normal when treated with *A. vera* (Rajasekaran *et al.,* 2006). The present study was carried out to investigate the effect of *A. vera* gel on lipid profile in alloxan induced diabetic mice.

Materials and Methods

A. vera powder was prepared from *A. vera* leaf gel. White mice were used and diabetes was

induced with the help of Alloxan. Mice were divided into four groups, six mice in each group, as follows: group I, control mice; group II, Alloxan-induced diabetic control mice; group III, diabetic mice were given *A. vera* leaf gel extract (300 mg/kg) in aqueous solution daily for 21 days and group IV, diabetic mice were given glibenclamide (600 mg kg^{-1}) in aqueous solution daily for 21 days. After 21 days blood was collected in tubes containing heparin. Plasma was separated and used for the estimation of cholesterol; high density lipoproteins, low density lipoproteins (LDL) were separated from the plasma using the dual precipitation technique and the cholesterol content of the lipoproteins were estimated. Cholesterol was determined by the enzymatic colorimetric method (Friedweld *et al.*, 1972). Estimation of Triglycerides, High density lipoprotein and Low density lipoprotein were determined by the human kit method.

Results

Raised levels of all factors were observed in diabetic control group as compared to normal control group except HDL, for which low levels were observed in diabetic mice.

The mean value of total cholesterol (TC) in control mice was 103.1 ± 6.1 mg dL^{-1}. In diabetic control, diabetic + *A. vera* extract and diabetic + glibenclamide, the observed mean values of were 273.9 ± 15.4, 113.6 ± 4.1 mg dL^{-1} and 107.6 ± 3.6 mg dL^{-1}, respectively (Table 1).

The mean value of triglycerides in control mice was 90.56 ± 2.9 mg dL^{-1}. In diabetic control, diabetic + *Aloe vera* extract and diabetic + glibenclamide the observed mean values of were 237.9 ± 6.0, 107.9 ± 3.9 and 95.6 ± 4.0 mg dL^{-1}, respectively (Table 1).

The mean value of high density lipoprotein cholesterol in control mice was 37.2 ± 0.99 mg dL^{-1}. In diabetic control, diabetic + *Aloe vera* extract and diabetic + glibenclamide, the observed mean values of HDL-C were 30.5 ± 1.1, 34.8 ± 1.0 and 38.6 ± 1.9 mg dL^{-1}, respectively (Table 1).

The mean value of low density lipoprotein cholesterol (LDL-C) in control mice was 47.76 ± 6.8 mg dL^{-1}. In diabetic control, diabetic + *Aloe vera* extract and diabetic + glibenclamide, the observed mean values of LDL-C were 195.1 ± 15.0, 57.18 ± 5.4 and 50.9 ± 7.0 mg dL^{-1}, respectively (Table 1).

The mean value of very low density lipoprotein cholesterol (VLDL-C) in control mice was 18.15 ± 0.61 mg dL^{-1}. In diabetic control, diabetic + *A. vera* extract and diabetic + glibenclamide the observed mean values of VLDL-C were 47.5 ± 1.2, 21.5 ± 0.8 and 19.12 ± 0.81 mg dL^{-1}, respectively (Table 1).

Discussion

In experimental rats, Alloxan is used frequently to induce diabetes type 1 (Tomlinson *et al*., 1992). By quick exhaustion of β-cells due to alloxan, insulin levels are decreased in the body. It has been observed that glibenclamide produces hypoglycaemia by producing insulin from existing β-cells. But it shows its inactivity in powerful STZ induced diabetes (Proks *et al*., 2002).

In the present study, glibenclamide showed its effect by reducing blood glucose level in hyperglycemic mice. Moreover, diabetic state was not much severe. Treatment with extract of medicinal plant in alloxan induced diabetic mice showed the activation of β-cells exhibiting insulinogenic effect (Kedar and Chakrabarti, 1982).

A. vera showed antihyperglycaemic activity with the increase in the insulin level in the blood that showed insulinogenic effect of gel extract. Diabetes induced by alloxan, showed increase in glucose level and associated with rise in the level of cholesterol, TGs, LDL and VLDL in plasma and low level of HDL (Mitra *et al.*, 1995). During insulin deficiency, hormone-sensitive lipase is activated that results in release of free fatty acids from adipose tissues (Alshamaony *et al.*, 1994). Surplus fatty acids in the plasma due to alloxan induced diabetes prop up the conversion of surplus fatty acids into phospholipids and cholesterol in the hepatocytes. These substances, beside with excess TGs in the hepatocytes may be released into blood appearing lipoproteins (Bopanna *et al.*, 1997).

Plasma phospholipids are raised in the blood due to elevation of lipoproteins. Treatment with the extract of *A. vera* normalized lipid condition in plasma, which was apparently interceded by lipid metabolism. Liver has a crucial position in glucose and lipid homeostasis andinsulin-dependent tissue but it is sternly affected during diabetes (Seifter and England, 1982).

Liver plays a part in oxidation and metabolism regarding synthesis of fatty acids, the production of cholesterol and phospholipids and the discharge of particular serum lipoproteins. During diabetes, fatty acids are highly concerned with liver and triglycerides are formed after esterification of fatty acids with glycerol phosphate. Hence, steatosis develops (Brixova, 1981).

Diabetes is associated with hyperlipidemia. The results of this study showed significant increase in serum total cholesterol and triacylglycerols in untreated diabetic group (group-II). Treatment with *Aloe vera* gel extract showed a hypolipidemic effect in diabetic group (group-III) when compared with untreated diabetic group (group-II). The results of Rajasekaran *et al.* (2006) supported the results of the present study which showed that oral administration of *A. vera* gel extract for 21 days resulted in a significant reduction in plasma cholesterol and triglycerides. Also, Kim *et al.* (2009) confirmed significant decrease in serum triglycerides with processed *A. vera* gel for 8 weeks. Oxidative stress has a significant function in the pathogenesis diabetes. Hyperglycemic condition is due to excess production of free radicals having oxygen, which help in the development of diabetes. Moreover, problems during diabetes are also allied with oxidative stress. Alloxan acts as a producer of reactive oxygen species that could damage the β-cells and produce abnormality in diabetic animals induced by alloxan.

The results of present study are consistent with previous findings. The diabetic mice have increased levels of TC, TG, LDL-C, VLDL-C and low levels of HDL-C. Thus *A. vera* extract decrease the increased levels of TC, TG, LDL-C and increase the level of HDL-C in diabetic mice very near to the normal levels.

It is concluded from the present study that the extract of *A. vera* gel has antihyperlipidemic effect in alloxan induced diabetic mice.

Table 1: Effect of *Aloe vera* gel on lipid profile in alloxan induced diabetic mice.

	Control	**Diabetic control**	**Diabetic + *Aloe vera* extract 300 mg/kg**	**Diabetic + Glibenclamide 600 µg/kg**
TC (mg dL^{-1})	103.1 ± 6.1	273.9 ± 15.4	113.6 ± 4.1	107.6 ± 3.6
TGs (mg dL^{-1})	90.56 ± 2.9	237.9 ± 6.0	107.9 ± 3.9	95.6 ± 4.0
HDL-C (mg dL^{-1})	37.2 ± 0.99	30.5 ± 1.1	34.8 ± 1.0	38.6 ± 1.9
LDL-C (mg dL^{-1})	47.76 ± 6.8	195.1 ± 15.0	57.18 ± 5.4	50.9 ± 7.0
VLDL-C (mg dL^{-1})	18.15 ± 0.61	47.5 ± 1.2	21.5 ± 0.8	19.12 ± 0.81

± indicates the standard error of means.
TC: total cholesterol; TG: Triglycerides ; HDL-C: High density lipoprotein cholesterol ; LDL-C: Low density lipoprotein cholesterol; VLDL-C: Very low density lipoprotein cholesterol.

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