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The Effects of Hypoglycemic and Hypolipidemic Properties of *Aloe vera* on Type 2 Diabetics.

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Abstract

Background: Uncontrolled glucose levels and high cholesterol levels in type 2 diabetics can be considered risk factors for cardiovascular diseases. *Aloe vera* has been used for years as a glucose lowering and cholesterol agent due to its hypoglycemic and hypolipidemic properties.

Aims and objectives: The aim of the study was to identify the effect of consuming *Aloe vera* on blood glucose levels and lipid profile of type 2 diabetics.

Materials and methods: Forty five type 2 diabetes mellitus patients participated in this study. The participants were divided into 3 groups, each group consisted of 15 patients. Group I was given capsules containing 100 mg AV powder, group II was given capsules containing 200 mg AV powder whereas group III was considered as control. Glycated hemoglobin (HbA1C) and lipid profile (Total cholesterol (TC), LDL/C, HDL/C and triglycerides) were measured at the beginning and at the end of the study which lasted for 12 weeks.

Results: There was a significant decrease ($p<0.05$) in the HbA1c value of groups I and II. The reduction was 11.1% and 25% in groups I and II respectively and the decrease was not significant ($p<0.05$) among subjects of group III. There was a significant ($p \leq 0.05$) reduction in total cholesterol 6.5% and 7.11%, triglycerides 10.4 % and 12.6%, low density lipoprotein cholesterol (LDL-C) 7.5% and 11.9%, and a significant increase in high density lipoprotein cholesterol (HDL-C) 8% and 25% was observed in the subjects of group I and II respectively. The ratio of LDL-C to HDLC dropped from 3.71 to 3.2 and 3.9 to 2.7 in the subjects of groups I and II respectively after the study.

Conclusion: *Aloe vera* can be used partially as an agent to manage type 2 diabetes mellitus and to lower blood cholesterol because of its therapeutic properties.

Keywords:

Aloe vera, Lipid profile, Glycated hemoglobin, Type 2 diabetes mellitus.

Introduction

Medicinal plants have been used around the globe for treatment for various diseases especially metabolic ones. In a systematic review done by Lee et al. it is revealed that using herbal supplements is effective in treating and also preventing diabetes mellitus type 2 [1]. *Aloe vera* is one of species of genus *Aloe* which is classified as belonging to *Aloe barbadensis* Miller [2]. It is used traditionally for treating hypertension, constipation, worm infection, skin diseases and in some countries as a treatment for diabetes [3]. *Aloe vera* is one of the herbs which many studies have been *Aloe vera* is a type of succulent plant that has been used as an herbal medicine for thousands of years and is currently incorporated into a multitude of personal care products. *Aloe vera* is a perennial succulent xerophyte, which develops water storage tissue in the leaves to survive in dry areas of low or erratic rainfall.

The *Aloe* leaf can be divided into two major parts, namely the outer green rind, including the vascular bundles, and the inner colorless parenchyma containing the aloe powder. Main chemical constituents of *Aloe vera* include: amino acids, anthraquinones, enzymes, minerals, vitamins, lignins, monosaccharide, polysaccharides, salicylic acid, saponins, and phytosterols [4] as shown in Figure 1.

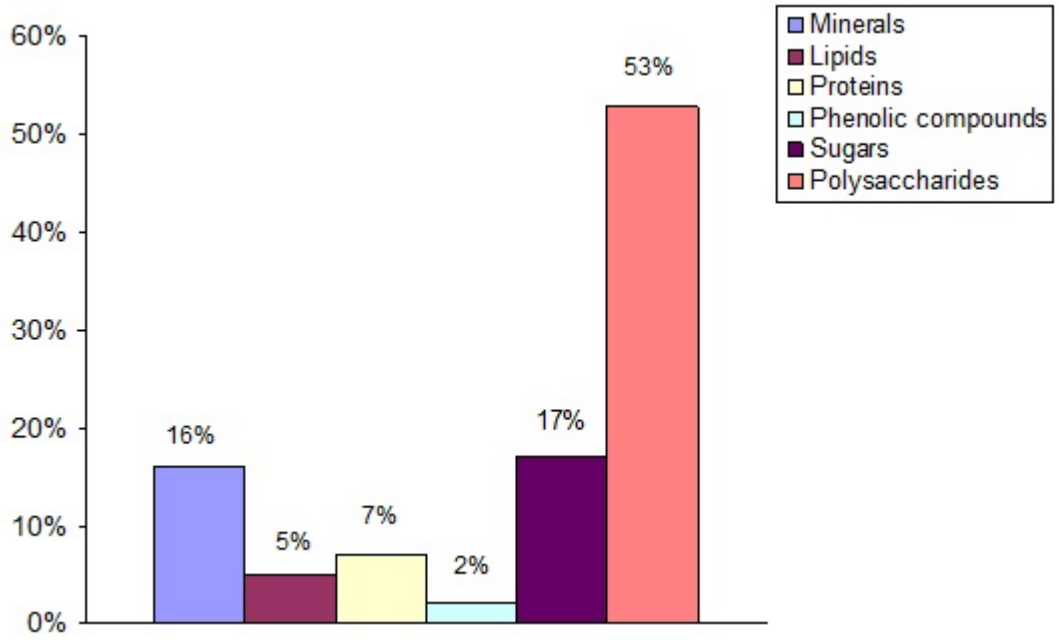

Figure 1. Chemical analysis of *Aloe vera.*

Aloe vera has been used as a medicinal plant for centuries as an oral treatment for type 2 diabetes and hyperlipidemia [5]. Oral use of aloe powder decreased fasting blood glucose (by more than 100 mg/dL) and hemoglobin Al c levels in three studies of people with type 2 diabetes [6].

Aloe vera has marvelous medicinal properties. It lowers serum cholesterol and tri-glycerides and increasing level of high density lipoprotein cholesterol (HDL-C). Phytosterols (Sitosterol, campesterol and lupeol) which are structurally similar to cholesterol help in reducing serum concentrations of cholesterol by reducing the absorptions of cholesterol from the gut by competing for the limited space for cholesterol in mixed micelles [7].

The aim of the present study was to identify the hypoglycemic and hypolipidemic effects of *Aloe vera* on type 2 diabetics.

Material and Methods

Forty five non-insulin dependent diabetic male patients in the age group of 45-60 years free from serious complications of diabetes were recruited for this study. subjects gave their written consents to participate in this study, and an approval from the ethical committee in the department was obtained prior to the commencement of this study.

Selection was based on their fasting and post-prandial blood glucose level. The subjects had HbA1c less than 7 and were on oral glucose lowering medications (Metfoemin 500 mg 3 times a day). Also, the selected subject had almost similar values of lipid profile but were taking no cholesterol lowering medications. The selected subjects were divided into three groups. groups I-III, each group having fifteen subjects each. The subjects of groups I and II were given 100 mg and 200 mg of *Aloe vera* powder respectively for a period of 3 months. Group III was given no AV supplements and was considered as a control group.

Blood glucose determination was done according to Trinder [8], serum total cholesterol (TC) [9], triglycerides (TG) [10], high density lipoprotein cholesterol (HDL-C) [11], low density lipoprotein cholesterol (LDL-C) [12]. The ratio of LDL-C to HDL-C was also calculated. *Aloe vera* powder used in this study was manufactured by herbs and crops located in Ahmadabad, Gujarat, India and was purchased locally.

Statistical analysis results were presented as mean ± S.D and total variation present in a set of data was analysed through one-way analysis of variance (ANOVA). Difference among means had been analysed by applying Tukey's multiple comparison test at 95% ($p<0.05$).

Results

Results in Table 1 have shown that supplementation of *Aloe vera* powder has led to a significant reduction in blood glucose levels and has improved lipid profile of the diabetic patients.

HbA1c has dropped by 25% inpatients in group II who received a 200 mg of AV powder compared to 11.1% in group I with 100 mg of AV powder and the difference was significant between groups II, I and III ($p<0.05$). Group III has the least decrease in blood glucose level with only 3.9% as shown in Figure 2.

	Group I			Group II		%	Group III		
	100 mg AV powder		%	200 mg AV powder		Control No AV powder			%
Index	Before	After	Before	After	Before	After			
HbA1c %	7.2 ± 3.4	6.4 ± 3.1	11.1	7.6 ± 3.6	5.7 ± 2.6	25*	7.7 ± 3.8	7.4 ± 3.5	3.9
TG (mg/dL)	169.5 ± 12.2	151.9 ± 10.4	10.4	204.4 ± 14.1	178.7 ± 13.3	12.6*	177.8 ± 12.5	174.9 ± 11.5	1.7
HDL/C (mg/dL)	39.9 ± 2.3	43.1 ± 3.1	8	38.4 ± 3.4	48.2 ± 4.6	25*	37.6 ± 3.4	38.7 ± 3.5	3
LDL/C (mg/dL)	148.2 ± 10.3	137.1 ± 9.9	7.5	149.7 ± 10.6	131.9 ± 8.4	11.9*	165.4 ± 13.3	161.9 ± 12.4	2.1
LDL/HDL	3.71	3.2	13.7	3.9	2.7	30.7*	4.3	4.1	4.7
TC (mg/dL)	236.6 ± 16.2	221.2 ± 15.4	6.5	234.8 ± 16.1	218.1 ± 14.6	7.11*	242.7 ± 17.3	239.3 ± 16.2	1.4

Table 1. HbA1c and lipid profile before and after supplementation of volunteers with AV powder in groups I-III.

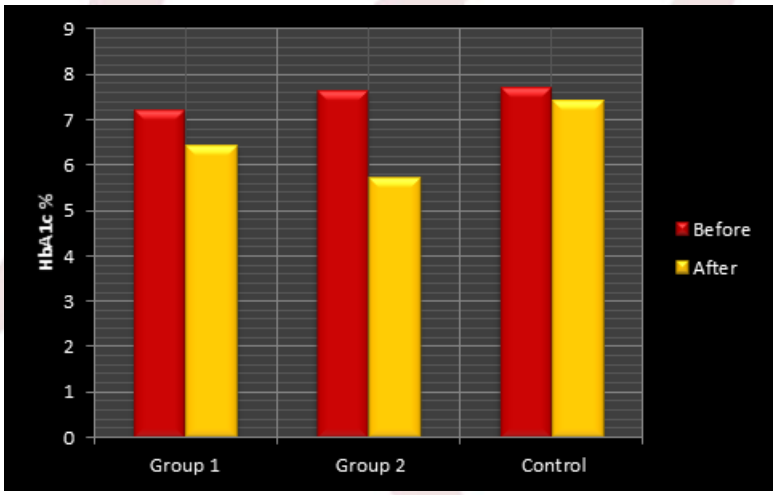

Figure 2. HbA1c level changes after among groups.

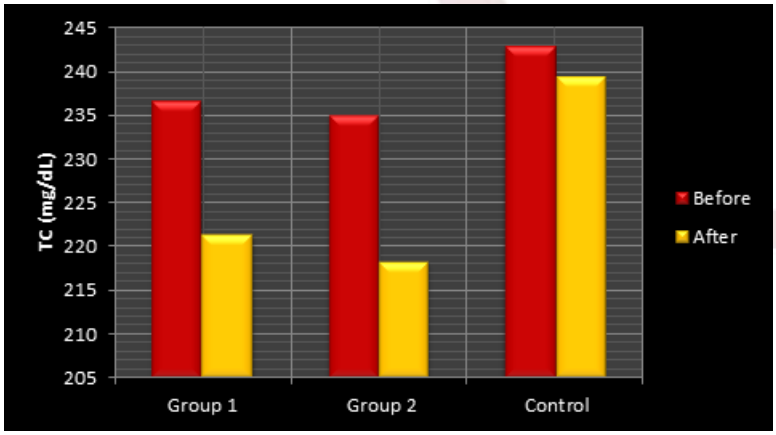

Figure 3. TC level changes among groups.

Figures 3-5 demonstrate significant ($p<0.05$) reduction in total cholesterol 6.5% and 7.11%, triglycerides 10.4% and 12.6%, low density lipoprotein cholesterol (LDL-C) 7.5% and 11.9%.

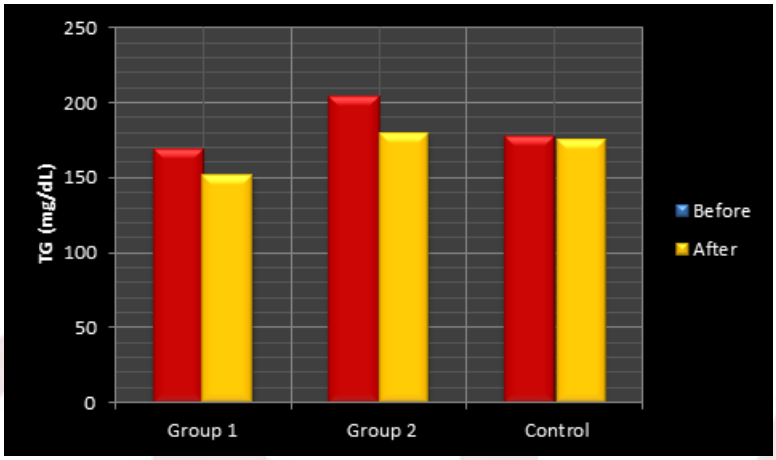

Figure 4. TG levels changes among groups.

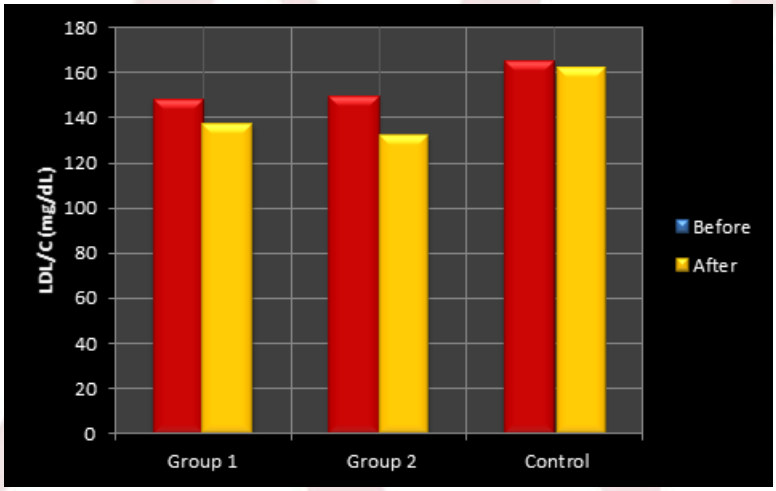

Figure 5. LDL/C level changes among groups.

Results presented in Figure 6, showed an increase in high density lipoprotein cholesterol (HDL-C) 7.5 % and 25 % was observed in the subjects of groups I and II respectively.

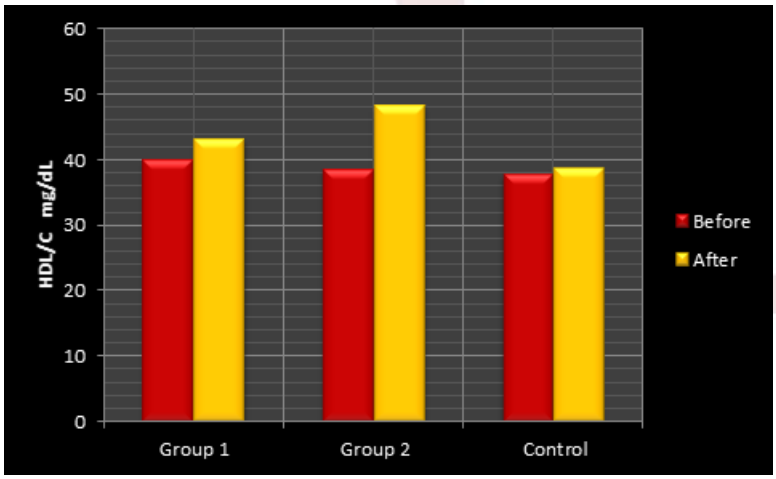

Figure 6. HDL/C level changes among groups.

The ratio of LDL-C to HDLC dropped from 3.71 to 3.2 and 3.9 to 2.7 in the subjects of groups I and II respectively as shown in Figure 7.

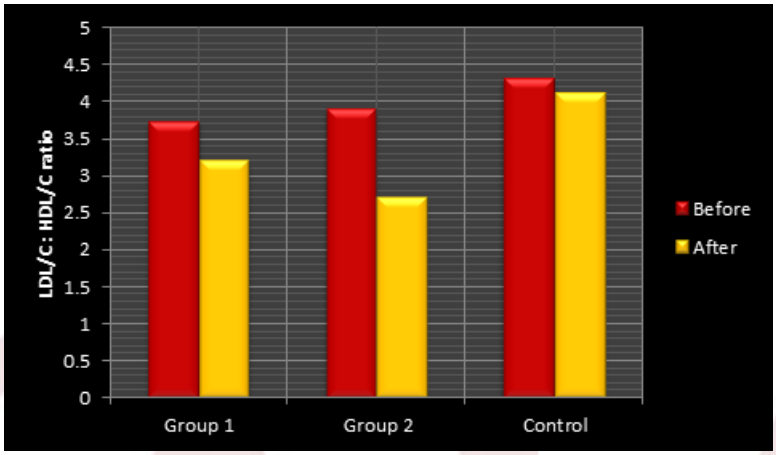

Figure 7. LDL/C to HDL/C ratio.

Discussion

The reduction after supplementation of *Aloe vera* powder could be due to the presence of high molecular weight polysaccharides or phytosterols in the *Aloe vera*. The percent reduction in total cholesterol could be due to phytosterols present in *Aloe vera* which are structurally similar to cholesterol helps in reducing serum concentrations of cholesterol by reducing the absorptions of cholesterol from the gut by competing for the limited space for cholesterol in mixed micelles [13,14]. Singla et al. also reported a significant reduction in cholesterol levels after *Aloe vera* supplementation. After administration of an active component barbaloin and polysaccharide with glycoprotein, verectin present in *Aloe vera*, there was significant reduction in serum triglycerides levels as reported by Yah et al. [15,16]. It was found that second treatment had improved lipid profile more effectively than the first treatment. Shin et al. also observed a significant reduction in glucose and total cholesterol after improvement in weight loss [17].

Trace elements like zinc, chromium, magnesium and manganese also play an important role in the management of diabetes mellitus by enhancing the effectiveness of insulin. Rajendran et al. also reported the role of these inorganic elements in the improvement of impaired glucose tolerance, their indirect role in the management of diabetes mellitus and hypoglycemia. In second treatment i.e. nutrition intervention, reduction in fasting and post-prandial blood glucose level was more as compared to the first treatment in which only supplementation was done [18-21].

To explain the mechanism of action of *Aloe vera* components on glucose and cholesterol levels, a study was carried out and used of oral administration of *Aloe vera* leaf powder extract for 21 days improved glycoprotein metabolism in diabetic animal models [22]. There is also evidence which shows that the glucose metabolism can be regulated with *Aloe vera*. The plant has other properties such as the reduction of hepatic tissue damage resulting from diabetic complications in rats [23] and reduction of the oxidative damage in the hippocampus and cerebral cortex of mice with type 2 diabetes [24].

Researchers have also introduced an important element in the hypoglycaemic effects of *Aloe vera* in a substance called Acemannan. This is actually a D-isomer of compound polysaccharide that is extracted from *Aloe vera* leaf powder and has such properties as anti-virus, anti-cancer, digestive, and immune stimulating properties [25]. *Aloe vera* also contains other compounds such as hydrophilic fiber, glucomannan [26], and phytosterol [27] that reduce blood glucose. It is suggested that *Aloe vera* can increase insulin sensitivity in the cells with reducing the level of blood glucose and insulin in serum perhaps the *Aloe vera* can increase the Insulin Genetics activity In pancreatic beta cells. Study on the effects of anti-diabetic extract of *Aloe vera* showed that this plant cannot reduce the level of blood glucose in non-diabetic animals which is contrary to the results for hypoglycemic effects of glybenclamid [28]. It is known that beta sistostrol, camposterol, and stigmosterol are of close similarity to phytosterols. Besides, it is found that beta sistostrols chain available in some plants such as *Aloe vera* can significantly decrease the level of plasma total cholesterol, LDL-C, and triglycerides by inhibiting activation of fat absorption mechanisms. In one study, it was shown that the use of *Aloe vera* extract as much as 200 mg/kg on a daily basis for as long as 100 days can significantly reduce the level of cholesterol, triglyceride, free fatty acids, and phospholipids in normal mice [29].

Conclusion

Aloe vera contains a wide variety of nutrients and phytochemicals that can have a positive effect on HbA1c values and could alter lipid profile in positive way leading to an improvement in HDL-cholesterol and reduction in LDL-cholesterol.

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