

## EFFECT OF *ALOE BARBADENSIS* ON THE LIPID PROFILE AND FASTING BLOOD SUGAR CONCENTRATION OF RABBITS FED HIGH CHOLESTEROL DIET

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### ABSTRACT

The effect of aqueous extract of *Aloe barbadensis* on plasma total cholesterol (CHOL), Low – density lipoprotein cholesterol (LDL), high – density lipoprotein cholesterol (HDL), triacylglycerol (TAG), and fasting blood sugar (FBS) concentrations in rabbits fed high cholesterol diet was examined. Two groups of animals were fed a basal diet and a high cholesterol diet {basal diet containing 1% cholesterol and 1% vegetable oil (wt/wt)} respectively, for 3 months. A third group of animals received a daily oral intake of aqueous extract of *Aloe barbadensis* in addition to the high cholesterol diet for the same duration of time. The high cholesterol diet elicited 12.2 – , 67.5 – and 2.3 – fold increases in the CHOL, LDL and FBS concentrations respectively ( $P < 0.001$ ) but a 1.2 – fold decrease in the HDL concentration ( $P < 0.01$ ) relative to the control group. Treatment with *Aloe barbadensis* resulted in a decrease of 3.8% ( $P > 0.001$ ), 4.0% ( $P > 0.001$ ) and 52.3% ( $P < 0.001$ ) in the CHOL, LDL and FBS concentrations respectively while the HDL concentration was elevated by 50.9% ( $P < 0.01$ ) relative to the group fed high cholesterol diet. Our results bring to the fore again, the link between hyperlipidemia (coronary heart disease) and increased sugar concentration in the body (diabetes) and show that *Aloe barbadensis* has protective effects against these two pathological states.

**KEY WORDS:** *Aloe barbadensis*; hypercholesterolemia; fasting blood sugar; rabbits

### INTRODUCTION

The deleterious effects of hyperlipidemia, in particular high cholesterol levels, in the body are well known. Hypercholesterolemia predisposes to arteriosclerosis, atherosclerosis and other cardiovascular problems (Matin et al. 1986; Anderson et al., 1987). It is a leading cause of mortality among the affluent. A direct correlation between hypercholesterolemia and coronary heart disease (CHD) has for long been established (Brown and Goldstein, 1983). Lowering cholesterol level decreases the incidence of CHD. Several studies have shown that adequate treatment of hypercholesterolemia not only prevents CHD but also reverses it (Kuo et al., 1979). Emphasis is mainly on dietary therapy since most hypolipidemic drugs have harmful effects (Schucker et al., 1987). However, many patients are often reluctant to alter diet and life – style and scientists are increasingly turning to medicinal plants to find a compromise between harmful drug therapy and the relatively safe but unattractive dietary therapy.

*Aloe barbadensis* (Aloe vera or simply Aloe) is one of the most widely accepted and used medicinal plants in history. It has been shown to

have curative or ameliorative effects on a wide range of diseases from relatively minor ones like colds and constipation to life – threatening ones like CHD and cancer without any side effects (Robson et al., 1982; Danhof, 1987; Schauss, 1990; Pittman, 1992). CHD has been reported as a complicating factor in diabetes mellitus and vice versa (Haffner et al., 1988; Amanti and Schumann, 1998; Miettinen et al., 1998; Grungy et al., 1999). Cases of diabetic patients dying of cardiac arrest are common place. The present work was designed to investigate the correlation between hyperlipidemia and elevated blood sugar level and the effects of Aloe on the two pathological states.

### MATERIALS AND METHODS

#### Chemicals

Cholesterol was obtained from Eagle Scientific Ltd., England. Glucose oxidase, peroxidase, glycerol kinase, 4-aminophenazone and 4-chlorophenol were obtained from Biotec Laboratories, Surrey, U.K. All other reagents were of analytical grade.

#### Animals and treatment

Male albino rabbits weighing 1.0 - 1.2kg were

obtained from Biochemistry Department, University of Ibadan, Nigeria. The animals were divided into three groups of 6 animals each. Animals in group 1 served as control and were fed a basal diet and sterile water *ad lib*. The basal diet contained 12% moisture, 14.5% protein, 4.8% crude fat, 8.0% crude ash, 7.0% cellulose and 50% carbohydrate (wt/wt). Animals in group 2 were fed the basal diet supplemented with cholesterol (1% wt/wt) and vegetable oil (1% wt/wt) - high cholesterol diet. The third group of animals received the high cholesterol diet (basal diet + 1% cholesterol + 1% vegetable oil) with a daily oral administration of the aqueous extract of Aloe. Feeding was carried out for 3 months after which blood samples were collected from the animals for the analyses.

#### Preparation of extract

The leaves of the plant were washed and the gel removed and crushed in distilled water (1g/10ml). The solution was filtered after 48 hours to obtain the extract used for the experiment. The extract was stored at 4°C throughout the duration of the experiment. Fresh samples were prepared at 2 weeks interval.

#### Preparation of plasma

Blood was collected from the dorsal veins of the ear lobes of the animals, using a hypodermic syringe and needle, into tubes containing EDTA. Plasma was prepared by centrifugation for 10 minutes at 3000g using an MSE bench centrifuge. The clear supernatant obtained was used for the estimation of the concentration of glucose and the lipids.

#### Determination of the concentration of plasma lipids

##### Total Cholesterol (CHOL)

This was determined according to the method of Allain et al. (1974).

The intensity of the pink colour formed when  $H_2O_2$  formed from the hydrolysis of esterified cholesterol reacts with 4-antipyrene and phenol was measured at 500nm.

##### Triacylglycerol (TAG)

The concentration of triacylglycerol was determined as described by Trinder (1969).

##### Low - density lipoprotein cholesterol (LDL).

This was determined according to the method of Friedwald et al. (1972).

##### High - density lipoprotein cholesterol (HDL)

The HDL concentration was determined after the precipitation of the low-density lipoproteins and chylomicron fractions as described by Lopes - Virella (1977).

#### Glucose Assay

Portions (0.5 ml) of the plasma were assayed for glucose by the glucose oxidase method of Trinder (1969).

#### Statistical Analysis

The results were expressed as mean  $\pm$  SEM. Comparisons between- and within- groups were assessed by One-way ANOVA. Comparisons between two groups were further analyzed by a two - tailed Student's t- test.  $P < 0.05$  was considered to represent significant differences between means.

#### RESULTS

The results presented in Table 1 show that feeding the high cholesterol diet to the animals induced hypercholesterolemia but not hypertriglyceridemia. There were also significant increases in the concentration of the LDL fraction and the FBS ( $P < 0.001$ ). However, the concentration of the HDL fraction was markedly reduced ( $P < 0.01$ ) by feeding the high Cholesterol diet to the animals.

It could also be seen from the results that concentrations of CHOL and LDL in the Aloe-treated group remained high when compared with the control ( $P < 0.001$ ) indicating that treatment with Aloe had negligible effects on them while those of HDL, TAG and FBS were not significantly different from the control showing that treatment with Aloe normalized the cholesterol-induced alterations in these parameters. Comparison of Aloe-treated group (HC + Aloe) with the group fed high cholesterol diet (HC) revealed that treatment with Aloe decreased the FBS concentration by 52.3% ( $P < 0.001$ ) while the HDL concentration was increased by 50.9% ( $P < 0.01$ ). The differences between the concentrations of the HC + Aloe and HC group for the remaining parameters were not statistically significant. For CHOL and LDL, these amounted to a decrease of 3.8% and 4.0% respectively.

#### DISCUSSION

Cholesterol feeding has often been used to elevate serum or tissue cholesterol levels to study the etiology of hypercholesterolemia - related metabolic disturbances (Huseyin et al., 1995). The results obtained in this study show that elevation of blood sugar level, increase in LDL concentration and decrease in HDL concentration are some of these metabolic disturbances. Of particular interest is the association of

**Table 1: Effect of Aloe on concentrations of plasma lipids and fasting blood Sugar (FBS) of Rabbits fed high cholesterol diet (HC)**

|                | Control                   | HC                            | HC + Aloe                     | F     | P      |
|----------------|---------------------------|-------------------------------|-------------------------------|-------|--------|
| CHOL(mmol/L)   | 47.50 ± 2.46 <sup>a</sup> | 578.00 ± 46.67 <sup>*,b</sup> | 555.83 ± 32.88 <sup>*,b</sup> | 82.74 | <0.001 |
| HDL (mmol/L)   | 21.00 ± 3.13 <sup>a</sup> | 17.67 ± 2.35 <sup>*,b</sup>   | 26.67 ± 5.59 <sup>###,a</sup> | 13    | <0.05  |
| LDL (mmol/L)   | 8.00 ± 0.45 <sup>a</sup>  | 539.83 ± 51.62 <sup>*,b</sup> | 517.50 ± 32.54 <sup>*,b</sup> | 72.90 | <0.001 |
| TAG (mmol/L)   | 92.50 ± 5.59 <sup>a</sup> | 56.57 ± 11.55 <sup>a</sup>    | 76.38 ± 14.21 <sup>a</sup>    | 2.64  | >0.05  |
| FBS (mg/100ml) | 58.00 ± 0.26 <sup>a</sup> | 133.17 ± 4.83 <sup>*,b</sup>  | 63.5 ± 6.24 <sup>###,a</sup>  | 94.48 | <0.001 |

Results are the means ± SEM for six rabbits in each group.

<sup>a, b, c</sup> Values not sharing a common superscript letter are significantly different by ANOVA (Turkey test).

Significantly different from control: \* P<0. 001; \*\* P<0. 01 (Student's t- test).

Significantly different from HC: # P<0. 001; ### p<0.01 (Student's t- test).

hyperlipidemia with elevation of blood sugar level. Hyperlipidemia, especially hypercholesterolemia and high concentration of LDL, is generally acknowledged to be a major factor in the pathogenesis of CHD. The present results therefore show that hypercholesterolemia can promote, at least, two health disorders simultaneously – cardiovascular problems and diabetes-related problems. Diabetic patients are at risk of developing cardiovascular problems and vice versa (Haffner et al., 1988; Amanti and Schumann, 1998; Miettinen et al., 1998; Grungy et al., 1999). Medical health practitioners should take note of this point when dealing with diabetics or people with CHD in order to guard against avoidable complications. On the other hand, it could be seen from the results that there is an inverse relationship between the concentration of HDL on one hand and that of CHOL, LDL and FBS on the other (Table 1). This supports the cardio-protective effect that has been alluded to HDL (Kwiferovich, 1998; Safeer and Cornel, 2000; Boden and Pearson, 2000).

The present study shows the efficacy of the extract of *Aloe barbadensis* in lowering plasma sugar level while increasing that of HDL. Agarwal (1985) has reported that Aloe decreased fasting blood sugar and post-prandial elevation in blood sugar in diabetic patients. Joshi and Dixit (1986) later reported that feeding of an Aloe fraction decreased the levels of total cholesterol, triacylglycerol, phospholipids and non-esterified fatty acid but increased HDL-cholesterol levels

and markedly increased HDL/Total cholesterol ratios in laboratory rats fed high cholesterol diets. The present study has corroborated these findings.

However, the effect of Aloe on TAG concentration in the present study looks inconsistent with that of Joshi and Dixit (1986). Also, the absence of a significant lowering effect, by Aloe, on the concentrations of LDL and CHOL relative to both the control and HC groups in the present study, is not expected in view of the fact that Aloe increased the concentration of HDL (the relationship between HDL concentration and LDL concentration is usually inverse). This may however lend credence to the suggestion that HDL and LDL are metabolized by independent pathways and therefore other factors could have come into play. The significant effect of Aloe on the FBS and HDL levels are enough proofs of its salubrious effect on lipid and carbohydrate metabolism in the body (Joshi and Dixit, 1986). Low HDL concentration has been reported to be a strong independent risk factor for CHD irrespective of whether the concentration of LDL is high or not (Boden and Pearson, 2000). The present study has shown that Aloe may be capable of normalizing hypercholesterolemia - related metabolic disturbances.

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