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ASSESSMENT OF HYPOGLYCEMIC EFFECTS OF APPLE CIDER VINEGAR IN TYPE 2 DIABETES

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ABSTRACT

Type 2 diabetes is the most common metabolic disorder worldwide and its prevalence is growing at an alarming rate in both developed and developing countries. It is characterized by abnormalities in carbohydrate, lipid and lipoprotein metabolism, which lead to hyperglycemia and many complications such as hyperlipidemia, hyperinsulinemia, hypertension and atherosclerosis. In order to prevent diabetes, in addition to oral hypoglycaemic drugs, the dietary component such as Apple cider vinegar seems to be promising for glycemic control in patients with type 2 diabetes as well as for diabetes related medical conditions. Apple cider vinegar is fermented juice from crushed apples. Acetic acid in vinegar seems to suppress disaccharidase activity and increase glucose-6-phosphate levels in skeletal muscle. Thus an attempt is made in the present study to find out the impact of apple cider vinegar in patients with type 2diabetes. Apple cider vinegar was purchased from local market and 15ml was given before meals – twice a day for 3 months. The study was conducted for three month with 40 individuals with type 2 diabetes and divided randomly in to two equal groups are as vinegar group (n=20) and control group (n=20). Information pertaining to the socio economic status, anthropometry assessment, biochemical assessment, dietary pattern, health status and personal habits were collected from the selected subjects. There was a significant decrease in BMI, WHR, fasting blood sugar, post prandial blood sugar levels and HbA1c in vinegar group after supplementation of apple cider vinegar (p value <0.05). No such differences were found among the control group during study period. On conclusion, the above results revealed that apple cider vinegar has got an exclusive antidiabetic property and help in preventing diabetic complications. Vinegar is inexpensive, readily available, and a flavor enhancer. Apple cider vinegar was most effective to decrease glucose, total cholesterol, triglycerides, LDL and increases HDL because of its higher concentration of organic acids and phenolic compounds.

Keywords: Diabetes, hyperglycemia, hyperinsulinemia, disaccharidase, post prandial and Vinegar.

INTRODUCTION

Type 2 diabetes is the most common metabolic disorder worldwide and its prevalence is growing at an alarming rate in both developed and developing countries. It is characterized by abnormalities in carbohydrate, lipid and lipoprotein metabolism, which lead to hyperglycemia and many complications such as hyperlipidemia, hyperinsulinemia, hypertension and atherosclerosis. All forms of diabetes increase the risk of long-term complications. These typically develop after many years (10–20), but may be the first symptom in those who have otherwise not received a diagnosis before that time. The major long-term complications relate to damage to blood vessels. In order to prevent diabetes, in addition to oral hypoglycaemic drugs, the dietary components such as Apple cider vinegar seems to be promising for glycemic control in patients with type 2 diabetes as well as for diabetes related medical conditions. (Khan et al, 2003, Anderson et al 1999 and Soltan SA et al , 2012).

Apple cider vinegar is fermented juice from crushed apples. Like apple juice, it likely contains some pectin; vitamins B1, B2, and B6; biotin; folic acid; niacin; pantothenic acid; and vitamin C. There is interest in using apple cider vinegar for diabetes and cardiovascular diseases. Feeding apple cider vinegar to animals with experimentally induced diabetes significantly reduces hemoglobin A1C (HbA1C), lowers low-density lipoprotein (LDL) cholesterol and triglycerides, and increases high-density lipoprotein (HDL) cholesterol. In another animal model, apple cider vinegar decreased triglycerides and very low-density lipoprotein (VLDL) cholesterol. Preliminary clinical research suggests that vinegar can lower postprandial glucose levels in healthy volunteers. Vinegar is thought to affect glucose levels by delaying the gastric emptying rating. Acetic acid in vinegar also seems to suppress disaccharidase activity and increase glucose-6-phosphate levels in skeletal muscle. (www.therapeuticresearch.com).

Many medicinal components that are good for health have been reported in natural vinegar, such as carbohydrates, organic acid (acetic, formic, lactic, malic, citric, succinic and tartaric), alcohols and amino acids and peptides (Cocchia et al., 2006), vitamins and mineral salts, polyphenolic compounds (Gallic acid, catechin, caffeic, ferulic acid). Different types of vinegar are available in market. Traditional vinegar is produced from regional foods according to well established customs. The balsamic vinegar of Modena, Italy is made from the local white Trebbiano grapes. Traditional rice wine vinegar is produced in Asia, coconut and cane vinegar is common in India and Phillippines and date vinegars are popular in the Middle East. Some scientific investigation clearly states the benefits of vinegar such as antimicrobial properties (Vijayakumar and Wolf Hall., 2002.), prevent inflammation and hypertension (Murooka and Yamshita, 2008), lower serum cholesterol (Fushimi et al., 2006), reduction in systolic blood pressure (Kondo et al., 2000), enhanced calcium absorption and retention (Kishi et al.,1999), decrease the glycemic index of carbohydrate food for people with and without diabetes (Sugiyama et al., 2003; Johnston et al., 2004). Antiglycemic effects of vinegar have been known for more than a century and have been demonstrated in animal as well as human studies (Salbe et al., 2009).

According to Soltan SA et al., 2012, Different types of vinegar have protective effect on pancreas and stomach with 15% concentration for 6 weeks. So that using vinegar has a beneficial effect on diabetic patients. Among all types of vinegar, apple vinegar was most effective to decrease glucose, total cholesterol, triglycerides, LDL and increases HDL followed by grape, sugarcane, coconut, artificial and palm vinegar. These results support a therapeutic effect for Apple cider vinegar in individuals at risk for type 2diabetes. Thus an attempt is made to supplement Apple cider vinegar in patients with type 2diabetes.

MATERIALS AND METHODS

The present study was carried out in M.G. Diabetes Hospital, Salem. This hospital was selected because of the easy accessibility of the diabetic subjects and convenience of the investigator. A total of 60 patients with type 2 diabetes were selected to participate in the study. From the 60 non insulin dependent diabetic subjects, 40 NIDDM subjects aged 30-65 years of both sexes with the range of Fasting blood glucose levels between 120-190 mg/dl, HbA1c 6-8%, post prandial blood glucose levels between 140-200mg/dl were selected for the study. Exclusion criteria were alcohol consumption, pregnancy and lactation women, allergy to vinegar, existing with liver or renal or thyroid diseases and haemolytic anaemia. Patients were informed and oriented about the study and written consent form was taken from them.

Apple cider vinegar was purchased from local market and 15ml was given before meals – twice a day for 3 months. The study was conducted for three month with 40 individuals with type 2 diabetes and divided randomly in to two equal groups. The experiment group are as

Group I (n=20) : Vinegar group - Consumption of 15 ml of apple cider vinegar before meals twice a day for three month. (Before breakfast and dinner)
Group II (n=20) : Control group – no intervention.

All medications were continued as usual and subjects were advised to maintain their normal diets and continue their habitual physical activity throughout the study. On days 0, 30, 60, and 90, approximately 10ml of fasting blood was collected from each subject and analysed for Fasting blood glucose levels and HbA1c. On the same day approximately 5ml of blood sample was collected 2hours after breakfast to analyse post prandial blood sugar level.

A detailed interview schedule was developed by the investigator in order to elicit information pertaining to the socio economic status, dietary pattern, health status and personal habits of the selected subjects. The general information such as age, sex, educational status, work pattern, income level, type and composition of family were collected from the selected subjects. The following techniques were employed to carry out the assessment of nutritional status. Anthropometric parameters like height, weight, Body Mass Index (BMI) and Waist Hip Ratio (WHR) were calculated for all the subjects. Precise information on food consumption pattern was collected through 24 hour recall method and food frequency method. The biochemical parameters such as Fasting blood glucose, post prandial blood glucose levels and Glycosylated haemoglobin (HbA1c) were analysed for the selected subjects. Clinical data regarding family history of diabetes, duration and complications were collected from selected diabetic subjects. Data collected by Interview schedule were consolidated.

RESULTS AND DISCUSSION

Baseline characteristics of the participants were shown in table 1. Significant decrease in the BMI was observed in vinegar group when compared to control group. No weight reduction was noticed in the control group and they tend to have more or less same weight at the end of the study. Waist Hip Ratio (WHR) is considered as another important factor in assessing nutritional status of an individual. Like BMI, Vinegar group shows the decrease in the WHR at the end of the trial when compared to that of Control group. Hence there is a significant difference in the BMI and WHR in vinegar group before and after supplementation (p value <0.05). This result reveals that apple cider vinegar helps in weight reduction.

Table 1: Baseline Characteristics of the participants

Particulars	Vinegar group (n=20)				Control group (n=20)			
	0 day	30th day	60th day	90th day	0 day	30th day	60th day	90th day
Gender, F/M	5/5	-	-	-	4/6	-	-	-
Age in years	42.3±10.0	-	-	-	50.1±10.6	-	-	-
BMI (kg/m^2)	27.6±2.9	27.2±1.5	26.6±2.0	25.8±2.2	28.1±2.4	28.3±3.4	27.9±2.6	28.2±2.1
WHR	1.05±0.5	1.01±0.2	0.99±0.4	0.95±0.3	1.24±0.23	1.245±0.35	1.25±0.28	1.248±0.19

Dietary intake of the participants was tabulated in the table 2. As the month progress there was a gradual fall in the food intake of the participants in vinegar group, but they met their recommended daily allowances. Carbohydrate is the main component in the diet which influences the blood sugar levels. Gradual decrease in the energy, carbohydrate and fat intake was noticed during the period of the study. This might also be one of the reasons in controlling the blood sugar levels. There was a mild difference between the protein, fibre and calcium intake among the participants in vinegar group. No changes were observed in control group. The energy, protein, carbohydrate, fat, calcium and fibre intake of participants in control group almost remains the same at the end of the study period. This result reveals that apple cider vinegar also controls the appetite. Significant decrease in energy and fat intake of the individuals in vinegar group were observed at the end of the trail (p value <0.05). The same was found by P.Nazni and K.Ramya (2011).

Table 2: Dietary intake of the participants

Nutrients	Vinegar group (n=20)				Control group (n=20)			
	0 day	30th day	60th day	90th day	0 day	30th day	60th day	90th day
Energy	1958±349.5	1832±241.2	1751±228.9	1706±185.4	2152±328.9	2133±287.4	2110±354.2	2087±321.8
Protein	58.8±14.6	55±9.6	56±10.3	56±8.5	59.7±12.4	57±9.4	56±8.7	55±12.3
Carbohydrates	333.8±50.7	317±45.9	304±40.2	301±42.8	370.2±60.1	375±54.6	372±68.1	368±52.8
Fat	43±10.5	38±9.2	34.5±7.6	30±6.8	48.2±8.5	45±10.4	44±9.6	43.5±11.4
Calcium	1353.3±355.6	1298±298.4	1246±245.8	1198±237.2	1423±284.8	1398±250.4	1455±289.2	1418±278.9
Fibre	6.45±1.78	6±1.4	5.8±0.9	5.8±1.2	6.94±1.64	6.7±1.6	6.43±1.23	6.78±1.42

Table 3: Clinical data of the participants

Particulars	Vinegar Group (n=20)	Control Group (n=20)
Family history of Diabetes, Yes/No	8/12	11/9
Duration of diabetes	5.83±2.63	5±2.82
Complications	Only Diabetic – 17 Diabetes + Hypertension – 3	Only Diabetic – 15 Diabetes + Hypertension – 5

Table 3 indicates the clinical data of the participants. Out of 20 participants in vinegar and control group, 8 and 11 participants respectively were found to have family history of diabetes. Duration of diabetes in both vinegar and control group vary from 2 to 10 years. Among 20 participants 17 subjects in vinegar group and 15 subjects in control group were only diabetic. Whereas the remaining 3 subjects in vinegar group and 5 subjects in control group were both diabetic and hypertensive.

Table 4: Biochemical parameters of the participants before and after supplementation

Biochemical parameters	Vinegar group (n=20)				Control group (n=20)			
	0 day	30th day	60th day	90th day	0 day	30th day	60th day	90th day
Fasting Blood glucose (mg/ml)	169.6±18.5	155.8±22.5	142.3±12.9	112.6±8.5	184.6±10.5	173.8±15.4	191.5±33.3	182.3±12.5
Post Prandial Blood Glucose (mg/ml)	190.5±9.3	165.5±12.6	149.7±10.9	126±16.5	188.3±7.31	203.7±34.8	253.5±48.5	224.2±26.8
HbA1c (%)	8±0.2	-	-	6.08±0.22	7.98±0.19	-	-	8.86±0.62

Table 4 shows the results of biochemical parameters such as fasting blood glucose levels, post prandial blood glucose levels and HbA1c levels of the participants during the study. Apple cider vinegar is thought to affect glucose levels by delaying the gastric emptying rating. Acetic acid in vinegar also seems to suppress disaccharidase activity and increase glucose-6-phosphate levels in skeletal muscle Soltan SA et al. (2012),

R Durgadevi and P Nazni (2012). This report supports the current study findings. In the present study, there was a significant decrease in the fasting blood sugar, post prandial blood sugar and HbA1c levels in vinegar group after supplementation of apple cidar vinegar (p value <0.05). Whereas in control group no significant changes was observed. Several mechanisms to account for these effects have been proposed, including interference with enzymatic digestion of complex carbohydrates, delayed gastric emptying and enhanced peripheral glucose uptake and conversion to glycogen. These results strongly prove the antidiabetic activity of the apple cider vinegar.

CONCLUSION

These data reveals that daily consumption of apple cider vinegar favorably influences fasting glucose concentrations, post prandial blood sugar levels and HbA1c levels in diabetic patients and contribute important information to the growing evidence base supporting the antiglycemic effects of vinegar. Vinegar is inexpensive, readily available, and a flavor enhancer. Apple cider vinegar was most effective to decrease glucose, total cholesterol, triglycerides, LDL and increases HDL because of its higher concentration of organic acids and phenolic compounds. In conclusion, Apple cider vinegar has got an exclusive antidiabetic property and help in preventing diabetic complications.

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