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To Study the Effect of Ginger (*Zingiber officinale)* on Fasting Blood Sugar and Glycated Haemoglobin Level in Diabetics

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Original Research Article

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Abstract: Diabetes mellitus (DM) describes a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbance of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both. Aim of present study was to see the effect of GINGER (*Zingiber officinale)* on fasting blood sugar and glycated haemoglobin level in patients of Diabetes mellitus. Selected patients were divided randomly in two groups each comprised of 50 patients. GROUP I – These patients were taken conventional treatment and served as the control group. GROUP II – Patients besides conventional treatment were given *Zingiber officinale* (Ginger) powder and served as the study group. Fasting blood and Glycated haemoglobin (HbA_1C) had shown a significant decrease in study group after Ginger powder supplementation. Ginger powder mainly used in Ayurvedic practice is beneficial for overall health, it is suitable for Diabetes mellitus and as an anti-inflammatory compound used in Osteoarthritis or Rheumatoid arthritis, so it should be advised as continued therapy in patients of Diabetes mellitus.
Keywords: Diabetes mellitus (DM), Glycated haemoglobin (HbA_1C), American diabetic association (ADA)

INTRODUCTION

Diabetes mellitus (DM) describes a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbance of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both. The worldwide prevalence of diabetes has risen dramatically over the past two decades, from an estimated 30 million cases in 1985 to 382 million in 2013. Based on current trends, the International Diabetes Federation projects that 592 million individuals will have diabetes by the year 2035.

American Diabetes Association (ADA) Diagnostic Criteria for the Diagnosis of Diabetes Mellitus[1].

- A random plasma glucose concentration 11.1 mmol/L (200 mg/dL) or higher in a patient with classical symptoms of hyperglycaemia.
- Fasting plasma glucose 7.0 mmol/L (126 mg/dL) or higher.
- $HbA_1C > 6.5\%$.
- Two-hour plasma glucose 11.1 mmol/L (200 mg/dL) or higher during a 75 gram oral glucose tolerance test.

Symptoms of marked hyperglycemia include polyuria, polydipsia, weight loss, sometimes with polyphagia, and blurred vision. Impairment of growth and susceptibility to certain infections may also accompany chronic hyperglycemia. Acute, life-threatening consequences of uncontrolled diabetes are hyperglycemia with ketoacidosis or the non-ketotic hyperosmolar syndrome.

Long-term complications of diabetes include retinopathy with potential loss of vision, nephropathy leading to renal failure, peripheral neuropathy with risk of foot ulcers, Charcot joints and autonomic neuropathy causing gastrointestinal, genitourinary, and cardiovascular symptoms and sexual dysfunction. Patients with diabetes have an increased incidence of atherosclerotic cardiovascular, peripheral arterial and cerebrovascular disease. Hypertension and abnormalities of lipoprotein metabolism are often found in people with diabetes.

An Indian shrub, known as *Zingiber officinale* has been mainly used in Ayurvedic medicine. The family zingiberaceae is represented by about 46 genera,

distributed through the tropics and subtropics. The ginger plant has a perennial, tuberous root or rhizome; the stems are erect, oblique, round, annual, and invested by the smooth sheaths of the leaves, 2 or 3 feet in height, yellow green flowers and thick tuberous rhizome. Laterally compressed rhizomes are 7-15 cm long and 1-1.5 cm broad. About 1-3 cm long branches arise and terminate in depress scars or in undeveloped buds. The flesh of the ginger rhizome can be yellow, white or red in color, depending upon the variety. It is covered with a brownish skin that may either be thick or thin, depending upon whether the plant was harvested when it was mature or young.

In the fresh ginger rhizome, the gingerols were identified as the major active components[2]. The sensory perception of ginger arises from two distinct groups of chemical namely volatile oils and non-volatile pungent compounds. The volatile oil components in ginger consists mainly of sesquiterpene hydrocarbons, predominantly zingeberene (35%), curcumene (18%) and farnesene (10%)[3]. Many of these volatile oil constituents contribute to the distinct aroma and taste of ginger. Non-volatile pungent compounds include gingerols, shogaols, paradols and zingerone that produce a 'hot' sensation in the mouth. The gingerols, a series of chemical homologs differentiated by the length of their unbranched alkyl chains, were identified as the major active components in the fresh rhizome. In addition, the shogaols, another homologous series and the dehydrated form of the gingerols are the predominant pungent constituents in dried ginger. Paradol is similar to gingerol and is formed on hydrogenation of shogaol. Other constituent in addition is oleoresins. Ginger contains fats, waxes, carbohydrates, vitamins and minerals. Ginger rhizomes also contain a potent proteolytic enzyme called zingibain.

Indian traditional medicinal remedies especially for cough and asthma consists of juice of fresh ginger with a little juice of fresh garlic mixed with honey. It is also suggests 1-2 tea spoons of ginger juice with honey is a potent cough suppressant. Besides these ginger is very often used to cure many illness such as indigestion, tastelessness, loss of appetite, flatulence, intestinal, nausea, vomiting, allergic reactions, acute and chronic cough, common cold, fever, allergic rhinitis, sinusitis, acute chronic bronchitis, respiratory troubles, pain, headache, backache or any kind of muscular catch, painful tooth and swelled gum etc[4].

MATERIAL AND METHODS

This study was conducted in the Department of Physiology, S.P. Medical College, Bikaner subjects were selected from Diabetes Care and Research Centre, P.B.M. Hospital, Bikaner.

The study has been undertaken to observe the effect of Ginger in diabetic patients of middle age group 36-55 years. Ginger supplementation was given for 3 months and data was collected at before supplementation of ginger and after 3 months of ginger supplementation. The selected patients were divided randomly into two groups each comprising of 50 patients.

Group I

In this group diabetic patients (FBS > 126mg/dl) who were on conventional treatment were served as a control group.

Group II

In this group diabetic patients (FBS > 126mg/dl) who were on conventional treatment along with supplementation of ginger powder, served as a study group. Dried rhizomes of ginger (*Zingiber officinale*) were purchased from a local market in Bikaner. The ginger rhizomes was finely ground and then prepared as tablets containing 2gm ginger powder in each tablet or ginger powder is taken orally directly without prepared in capsule.

PROCEDURE

- Estimation of fasting blood sugar-
  The quantitative estimation of the fasting blood sugar was done by glucose oxidase method, using enzymatic kits (GOD-POD) provided by Diabetes Care and Research Centre.

Glucose oxidase

Glucose + O_2 + H_2O ----------→ Gluconic acid +H_2O_2

H_2O_2 + Phenol + 4-aminoantipyrine peroxidase -----→ quinoneimine + H_2O

The red colored complex quinoneimine formed was measured colorimetrically and the intensity of the color formed was directly proportional to the concentration of the glucose in the sample.

COMPOSITION

Concentration of ready to use solutions

- Enzymes reagent
- Amino-4-antipyrine 0.125mmol/L
- Glucose oxidase 30.000U/L
- Peroxidase 10.00U/L
- Phosphate Buffer 100 mmol/L
- Standard
- Glucose (5.5mmol/L) 100 mg/dL
- Buffer
- Sodium Phenolate 16nmol/L
- Based on NCEPATP III guide lines, diabetes mellitus is characterized according to glycemic control:-

	Normal (mg/dl)	Impaired Fasting Glucose (mg/dl)	Diabetes (mg/dl)
Fasting Blood Glucose	<100	100-125	≥126

- Estimation of glycated haemoglobin: Ion exchange chromatography.

RESULTS

Table 1 show: the Age and Sex of the study. Out of the total 100 subjects, 50 were in control group (Group I) and 50 were in study group (Group II). Within the control group (Group I) 31 were males and 19 were female subjects.In the study group (Group II) 29 were males and 21 were female subjects. The mean age of the subjects in the control group (Group I) was 50.46±9.5 years. In the study group (Group II) was 49.20±8.69 years.

Table-1: Characteristics of the present study

Parameter		**Control group**	**Study group**
		Group I	**Group II**
Age (Mean±SD)		50.46±9.5	49.20±8.697
Sex	**Male**	31	29
	Female	19	21

Table-2: Comparison of mean value of FBS & HbA_1C, pre and posttest in the control group

Parameters	**Group I (Control group) (Mean Value ± SD)**		**p-value**
	Pre-test (0 month)	**Post-test (3 month)**	
FBS (mg/dl)	166.8±27.10	159.5±26.75	0.7576
HbA_1C (%)	7.054±1.614	6.910±1.624	0.7369

Table 2 shows the comparison of mean value of FBS and HbA_1C in pre (0 month) and posttest (3 month) in control group. Mean value of FBS in control group (group I) at 0 month and 3 month was 166.8±27.10 mg/dl and 159.5±26.75 mg/dl. The difference was statistically insignificant (p=0.7576). Mean value HbA_1C in control group (group I) at 0 month and 3 month was 7.05±1.61% and a 6.91±1.62%. The difference was statistically insignificant (p=0.7369).

Table-3: Comparison of mean value of FBS & HbA_1C, Pre and Posttest in the study group (Group II)

Parameters	Group II (Study group) (Mean Value ±SD)		p-value
	Pre-test (0 month)	Post-test (3 month)	
FBS (mg/dl)	220.6±52.06	195.9±51.67	0.0192*
HbA_1C (%)	8.582±1.608	7.873±1.55	0.0280*

Table 3: show comparison of mean value of FBS and HbA_1C at pre (0month) and post (3month) test in the study group (Group II):- Mean FBS in study group (group II) at o month and 3 month was 220.6±52.06 mg/dl and 195.9±51.67 mg/dl. The difference was statistically significant (p<0.0192). Mean HbA_1C in study group (group II) at 0 month and 3 month was 8.58±1.605% and 7.87±1.55%. The difference was statistically significant (p<0.0280).

Table-4: Comparison of mean value of Glycemic control posttest in the control (Group I) and study group (Group II)

Parameters	Control group (Group I) (Mean value ±SD)	Study Group (Group II) (Mean value ±SD)	t- value	p-value
FBS(mg/dl)	159.5±26.75	195.9±51.67	5.492	<0.0001***
HbA_1C (%)	8.130±1.51	7.873±1.55	3.891	0.0002***

Table 4 depicts the comparison of FBS and HbA_1C parameters between the groups at post-treatment. The mean fasting blood sugar in control group and in study group was 159.5±26.75 mg/dl and 195.9±51.67 mg/dl. The difference in FBS of both groups was statistically significant ($p<0.0001$). The mean HbA_1C in control group and study group was 8.13±1.51% and 7.87±1.55%. The difference in HbA_1C of both groups was statistically significant ($p<0.0002$).

DISCUSSION

Diabetes is recognized as one of the leading causes of morbidity and mortality in the world, while about 2.5 to 7% of the world's population has been diagnosed with diabetes mellitus, it is still expected to increase in future [5]**.** In spite of the fact that synthetic drugs such as insulin-like substances are the most important therapeutic agents known to medicine, researchers have been making efforts to find insulin-like substances from plant sources for the treatment of diabetes [6]**.** Recent scientific investigation and clinical studies had confirmed the efficacy of some medicinal plants and herbal preparations in the improvement of normal glucose homeostasis.

Herbal therapies have been used in patients with insulin-dependent and noninsulin-dependent diabetes [7]**.** The herbal drugs have been prescribed widely because of their effectiveness, fewer side effects and relatively low cost [8]**.** In our study, after three months of treatment, ginger powder showed highly significant improvement in FBS ($p<0.0192$) and HbA_1C ($p< 0.0280$) in study group.

Li Y. *et al*. [9] found that polar portion of ginger extract containing mainly gingerols, particularly (S)-[6]- and (S)-[8]- gingerol, promoted glucose uptake significantly in cultured rat skeletal muscle cells. This action of gingerols was attributed to facilitation of insulin-independent glucose uptake by increasing translocation of glucose transporter GLUT4 to the muscle cell plasma membrane surface, together with small increases in total GLUT4 protein expression. Another mechanism for reducing blood glucose by ginger hydroalcoholic extract, is the inhibition of hepatic phosphorylase enzyme, hereby it prevents the breakdown of hepatic glycogen storages, also, can increases the activity of enzymes improving glycogen synthesis. The other possible effect is suppression of the activity of hepatic glucose 6-phosphatase enzyme, that causes degradation of glucose 6-phosphate to glucose, and consequently increases blood glucose level[10].

Khadem Ansari MH. *et al*. [11] found blood glucose concentration have decreased more in STZ-diabetic rats treated with ginger powder (5% of daily dietary intake for 6 weeks) compared to control diabetic rats. The HbA_1C level in the ginger-treated group was significantly lower than that in the non-treated diabetic group. It has been showed that HbA_1C level is increased during diabetes and it is a marker which shows the degree of protein glycation. Administration of ginger to diabetic rats significantly decreased the level of glycosylated hemoglobin and this may be due to the decreased level of blood glucose. Our results are in agreement with these results.

CONCLUSION

Our study reflects that ginger therapy had highly significant glycemic control (FBS) ($P<0.05$). Ginger therapy can be used as an adjunct with diet and drugs in management of diabetes mellitus. Such studies should be further encouraged as medicinal herbs constitute the cornerstone of traditional medicinal practice worldwide. A Ginger therapy is relatively cheap, easily available and represents a great deal of untapped reservoir of drugs and the structural diversity of their component molecules makes a valuable source of novel lead compounds. It possesses important phytoceutical or nutraceutical property and can be used as an alternative in management of various diseases with diet and drugs.

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