Blood sugar and lipid profile: effects of garlic and ginger

Comparative Efficacy of Garlic and Ginger on Blood Sugar and Lipid Profile of Alloxan Induced Diabetic Mice

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Allium sativum and Zingiber officinale are vegetables used for seasoning, flavoring, culinary and in herbal remedies as they hold insulinotropic properties playing significant role in maintaining Î² cells helpful to lower blood glucose level in diabetes. Both are also siginificant in lowering blood lipid levels. The experimental trial of 4 week is planned to investigate the comparative effect of ginger and garlic on blood sugar level and lipid profile in alloxan induced diabetic mice. 25 male mice rats weighing between 40 and 50 g will be used for the study. Diabetes will be induced in fasted mice (12hrs) by a single dose intraperitoneal injection of 40 mg/kg body weight of alloxan. The diabetic state will be assessed by measuring the non-fasting plasma glucose concentration 72hrs after alloxan treatment. The rats with a plasma glucose level above 180mg/dl will be selected for the experiment and considered as diabetics. Mice will be divided into 5 groups having 5 in each as: Normal Control (group 1), Diabetic control (group 2), Diabetic+ garlic (30g/100g diet group 3), Diabetic + ginger (30mg/kg diet group 4) and Diabetic + ginger and garlic (30g/ 100g group 5). In the end of trial the blood sugar and lipid parameters will be checked and compared.

INTRODUCTION:

Diabetes mellitus and its allied discrepancies is one of the prominent menaces of developing economics. Pakistan is at 6th position however, at the end of the year 2030; approximately 376 million people will be suffered (Wild et al., 2004). Diabetes is a metabolic syndrome that steadily affects

different physiological systems of the human body. It is one of the leading causes of mortality in worldwide and, if uncontrolled, can threat multi-organs system (Zakir et al., 2008). Uncontrolled blood glucose is believed to be the cardinal feature in the onset of diabetic difficulties of both type 1 and type 2 (American Association of Diabetic Educators, 2002). Most common type is Type 2 category, while Type 1 diabetes develops in early childhood. Main reasons include sedentary lifestyles, energy rich diet, lack of physical exercise and obesity (Yajnik, 2001).

Diabetes is mainly characterized by relative deficiency in insulin secretion or insulin action associated with hyperglycemia and malfunctioning in the metabolism of carbohydrate, lipid and protein. It may also leads to various other complications like cardiovascular disorders, oxidative stress and immune dysfunction may develop (Nogichi, 2007; Rana et al., 2007). Cardiovascular complications are the major cause of morbidity and mortality all across the globe. Increased cholesterol level and LDL oxidation trigger events that initiate atherosclerosis (Matsuura et al., 2008; Andican et al., 2008; Whale and Heys, 2008).

To cope with this situation a number of herbal medicines for diabetes mellitus and its allied diseases have been emerged (Alarcon-Aguilara et al., 1998; Marles and Farnsworth, 1995). Drug treatment is obligatory nevertheless, accompanied by various side effects and their effectiveness decreases with the passage of time (Zakir et al., 2008; Lapshina et al., 2006). Physical exercise and diet selection is one of the significant strategies to manage diabetes and its allied complications including immune dysfunction, degenerative and cardiovascular disorder.

Allium sativum, Zingiber officinale and their bioactive constituents hold insulinotropic properties playing significant role in maintaining Î² cells helpful to address the menace.

Garlic (Allium sativum) is an essential vegetable that has been widely utilized as seasoning, flavoring, culinary and in herbal remedies (Rivlin, 2001). Garlic has been shown to have diverse biological activities including antidiabetic, antithrombotic, anticarcinogenic, antiatherosclerotic, antitumorigenetic and various other biological actions (Augusti, 1996). Scientific investigations have depicted that it contains 65% water, 30% carbohydrates along with 5 % of other bioactive components mainly sulfur containing compounds (Milner, 2001). Its important constituents are classified as; sulfur containing compounds and non sulfur containing compounds. Among these organosulphur compounds particularly cysteine sulfoxides and thiosulfinates have greater importance (Tapiero et al., 2004). Allicin (diallylthiosulfinate) and S-allay cysteine are the main thiosulfinates out of which 60-80% is allicin (Lawson et al., 2001). Garlic and its various preparations have potential to lower total plasma cholesterol, reduction in blood pressure and alleviation of blood glucose level (Sterling and Eagling, 2001).

Some studies confirmed anti hyperglycemic effects of garlic (Eidi et al., 2006). Garlic may act on blood glucose through various mechanisms and therefore directly lowers blood glucose level by exciting glycogenisis and preventing glycogenolysis and gluconeogenisis in muscles and hepatic (Ebomoyi et al., 2010). The fiber of garlic may also hamper carbohydrate absorption; thereby affecting blood glucose (Gholamali A Jelodar, 2005). Antioxidant property of garlic is another possible mechanism that makes it a

contender as antidiabetic agent (Queiroz et al., 2009; Lee et al., 2009). Antioxidant effect of S-allyl cysteine sulfoxide, isolated product from garlic is considered to have antiglycation properties.

Different supplementations of garlic hold remarkable effect on cholesterol level, LDL cholesterol and HDL cholesterol. Consumption of garlic and garlic preparations are very useful in regulating plasma lipid levels (Lau, 2006), plasma anticoagulant activity (Pierre et al., 2005; Lawson et al., 1992) and also contributed toward the prevention of atherosclerosis process (Rehman and Lowe, 2006). Ginger is also very effective for lowering blood sugar, cholesterol and triglyceride levels (Bhandari et al., 1998). Ginger (Zingiber Officinale) commonly called “ Adrak” belongs to family Zingiberaceae (Joshi, 2000). It is used in both ways as food additives (Flavor) or as a medicine and it is useful in preventing or treating a variety of human ailments including migraine headache, elevated cholesterol level, hepatotoxicity, burns, peptic ulcers, nausea, vomiting and motion sickness (Robbers and Tyler, 2002). Chemical constituents of ginger are camphene, cineol, zingiberine, gingerol and Î²-phellandrene (Shinwari et al., 2006).

Ethyl acetate extract of ginger produces significant reduction in glucose concentration and also decreases lipid level (Goyal and Kadnur, 2006). Acute dose of aqueous extracts of Z. Officinale rhizome shows hypoglycaemic activity (Kalejaiye et al., 2002). Ginger promotes glucose clearances in insulin responsive peripheral tissues, which is vital in maintaining blood glucose homeostasis (Li et al., 2012). Ginger treatment considerably reduces the both serum cholesterol and triglycerides (Akhani et al., 2004).

The ethanolic extract of ginger also appreciably reduces serum total cholesterol and triglycerides and elevates the HDL-cholesterol levels; also, the extract can protects tissues from lipid peroxidation and shows a significant lipid lowering activity in diabetic rats.

Objective:

The present study is designed to investigate and explore the hypoglycemic and hypolipidemic perspectives of raw garlic and ginger using alloxan induced biabetic mice modeling.

Review of Literature:

Ahmed and Sharma, (1997) studied on adult Wister rats were fed diet containing 0. 5% ginger (group 3) and combination of ginger and garlic (group 4). Their results showed that the combination of garlic and ginger was much more effective in reducing blood serum cholesterol and blood glucose and in increasing HDL cholesterol. Hence a combination of garlic and ginger is much more effective in reducing blood glucose and serum lipids.

Bhandari et al. (1998) studied the effect of ginger on cholesterol fed rabbits, after ten weeks, cholesterol fed rabbits had increased cholesterol, serum triglycerides, serum lipoproteins and phospholipids. When extract of ginger was given the remarkably reduction in the cholesterol, serum triglyceride and serum lipid proteins and phospholipids was observed.

Ahmed et al. (2000) examined the dietary effect of ginger on antioxidant dependent system in rats, and his results showed that ginger (Zingiber Officinale; 1% w/w) significantly lowered lipid peroxidation by maintaining

the activities of the antioxidant enzymes-superoxide dismutase, catalase and glutathione peroxidase in rats.

Ackermann et al. (2001) conducted a study to see the effect of garlic on lipid profile and results indicated that garlic preparations had comparatively lower declines (1. 2-17. 3 mg/dl and 12. 4-25. 4 mg/dl) in total cholesterol level as compared to whole garlic after 1 and 3 month correspondingly.

Bhandari et al. (2005) discovered that ethanolic extract of ginger significantly reduced serum total cholesterol and triglycerides levels and increased HDL-cholesterol level as compared to diabetic rats, and the extract showed a significant lipid lowering activity and protect the tissues from lipid peroxidation.

Goyal and Kadnur, (2006) reported that goldthioglucose cause a significant increase in body weight, glucose insulin level and lipid level in mice and when methanol and ethyl acetate extract of ginger were given to mice for eight weeks that produced significant reduction in glucose concentration and lipid level.

Amin et al. (2006) studied the hypoglycemic potential of ginger. The aqueous extract ofraw ginger (500mg/kg) was given to the streptozitocin (STZ) induced diabetic rats for seven weeks. Fasting blood serum was examined and results indicated that the raw ginger was very effective in lowering the serum glucose.

Afshari et al. (2007) estimated the effect of ginger powder on nephropathy induced by diabetes, and measured the changes in plasma lipid

peroxidation, Wistar rats were treated after the grouping of 3 rats in each. Blood sample was collected from the heart of each rat. The results showed that ginger powder caused decrease in lipid peroxidation.

Al-Qattan et al. (2008) reported that in STZ-induced diabetic rats which were injected intraperitoneally with ginger extract for seven weeks, the serum glucose was significantly lowered, and the urine protein reduced to the same level as the normal group. Histological examination clearly depicted that ginger effectively reduced the progression of structural nephropathy in diabetic rats.

Islam and Choi, (2008) compared the anti-diabetic effects of dietary ginger and garlic in STZ induced Diabetic rats. In this trial 5-week-old male Sprague-Dawley rats were fed a high-fat (HF) diet (22% fat) for 2 weeks and then randomly divided into six groups of eight animals: Normal Control (NC), Diabetic Control (DBC), Ginger Low (GNL), Ginger High (GNH), Garlic Low (GRL), and Garlic High (GRH) groups. “ Low” and “ High” indicate addition of 0. 5% and 2. 0% freeze-dried ginger or garlic powder in their respective diets. After 4 weeks data of this study suggested that ginger and garlic are insulinotropic rather than hypoglycemic while overall anti-diabetic effects of ginger are better than those of garlic.

Shariatzadeh et al. (2008) exhibited the effect of garlic on lowering blood sugar and preventing and curing nephropathy in STZ induced diabetic rats. 32 male Wister rats were randomly divided into control, control+extract, diabetic and diabetic+extract groups (n= 8). Treatment with aqueous-ethanolic extract of garlic (50mg/ kg/day) was followed for 4 weeks. The

results revealed that there was significant decrease in blood sugar and increase in weight of kidney and volume of cortex, medulla and kidney.

Abd-Elraheem et al. (2009) depicted the effect of ginger extract consumption on levels of blood glucose, lipid profile and kidney functions in alloxan induced-diabetic rats. In this study rats (130-150gm) were divided into 4 groups; normal control rats, diabetic control rats, diabetic rats post-treated with ginger and diabetic rats pretreated with ginger. Ginger extract was administered orally for 6 weeks to post-treated and pre-treated rats, and they were compared with the normal and diabetic groups, respectively. Plasma glucose, plasma lipid, plasma creatinine, urea and uric acid levels were reduced significantly in both post-treated and pretreated groups.

Bing et al. (2011) conducted a study to evaluate the hypolipidemic effect of enteric-coated ginger and garlic essence tablet on lipid profile of rats fed high-fat diet and hyperlipidemic subjects. One experimental group having hyperlipidemic rats was assigned to orally expose to three different doses of essence tablet for 30 consecutive days. In addition other experimental group of hyperlipidemic subjects received one piece of ginger and garlic essence tablet twice daily. After 30 days the data of serum lipid profile of both group was obtained which depicted that enteric-coated ginger and garlic tablet remarkably improved blood lipid profile in rats fed high-fat diet and hyperlipidemic subjects.

Eyo et al. (2011) revealed the comparative hypoglycemic effect of the hypoglycemic increasing dosages of A. cepa, A. sativum and Z. officinale aqueous extract on alloxan -induced diabetic rats. Increasing dosages (200,

250 and 300mg/kg bw ip) of A. cepa, A. sativum and Z. officinale aqueous extracts were given to the diabetic rats for six weeks and after six weeks blood glucose levels were determined and concluded that A. sativum, A. cepa and Z. officinale significantly decreased blood glucose as 79. 7%, 75. 4% and 56. 7% respectively.

Ashour et al. (2011) conducted a study was to investigate the short term effect of garlic oil on the antioxidant status as well as insulin level in streptozotocin (STZ) induced diabetic rats. In diabetic rats (two groups), one treated by garlic oil (200 mg/kg b. wt) and the other group treated by vehicle (corn oil; 2 ml / kg b. wt,) for 8 weeks. Results showed the significant increase in levels of superoxide dismutase (SOD), catalase, GPx, C-peptide and insulin on oral administrations of the garlic oil in the diabetic rats.

Prasad et al. (2012) investigated hypolipidimic effects of ginger-juice in rat. Albino rats (n= 6-12) were administered G. J at single dose (4ml/rat, p. o) as a chronic treatment over period of 21 days. After the 21 days the lipid profile parameters were checked and which indicated that treatment with ginger-juice in rats significantly reduced the total serum cholesterol level and significantly increased the serum HDL-cholesterol. So it was concluded that ginger juice has hypolipidemic effect.

Sanghal et al. (2012) conducted a trial to check the comparative efficacy of ginger and garlic on hypertension and hyperlipidemia in rats. In this study total 18 rats were taken and equally divided into three (control, ginger and garlic) groups by random selection. Ginger and garlic (500 mg/kg orally) were given to two separate groups of rats fed on high fat diet for a period of

7 weeks. Blood pressure and lipid profile were measured on day 0 and after 7 weeks. Comparative results depicted that ginger has better although not significant preventive effect on systolic blood pressure and garlic has better preventive effect on lipid levels.

MATERIAL AND METHODS:

This experiment will be conducted to investigate the comparative effect of garlic and ginger on blood sugar level and lipid profile of alloxan induced diabetic mice.

Plant Material:

The A. sativum and Z. officinale used for the experiment will be purchased from the Ayub Agricultural Research Institute, Faisalabad.

Animal Model:

25 mice weighing 30-35g will be purchased from National Institute of Health, Islamabad and kept in the animal house of the National Institute of Food Science and Technology (NIFSAT), University of Agriculture Faisalabad. They will be maintained at a temperature of 25 ± 1°C and relative humidity of 45 to 55% under 12-h light: 12-h dark cycle. They will be fed with normal diet and water ad libitum.

Induction of Diabetes Mellitus:

Diabetes will be induced in mice by a single intraperitoneal injection of aqueous alloxan monohydrate (40 mg/kg, i. v.) solution. After 72 hrs animals showing serum glucose level above 180 mg/dl (diabetic) will be chosen for the study.

Experimental Protocol:

The experimental animals will be divided into 5 groups; each group will contain 5 animals: Control group G1 (normal without treatment), diabetic control group G2 (injected with 40mg/kg b. w. of alloxan), diabetic mice treated with 30g/100g diet of garlic for 4 weeks G3, diabetic mice treated with 30g/100g diet of ginger for 4 weeks G4 and diabetic mice treated with 30g/100g diet containing mixture of garlic and ginger G5.

Data Collection:

Data will be collected for different parameters for body weight, feed and water intake.

Collection of Blood Samples:

At the end of 4 weeks blood samples will be collected by sacrificing the animals for determination of blood glucose and lipid profile.

Proximate Analysis:

The proximate analysis of garlic and ginger for moisture, total ash content, crude protein, fat, crude fiber and nitrogen free extract will be done by using the method given by AOAC (1990).

Statistical Analysis:

The resulting data will be subjected to some appropriate statistical techniques.