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Hypoglycemic Action of Barley in Diabetic Rats

Dr. Haidar Alsaedi

Department of Basic Science, Faculty of Dentistry, Al-Qadisyah University, Iraq

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***Corresponding author:**

Dr. Haidar Alsaedi

Department of Basic Science
Faculty of Dentistry
Al-Qadisyah University
Iraq
Email: haider.k.abaas@gmail.com

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ABSTRACT

The present study was aimed. to find out. the protective effect of whole barley grain administration on lipid peroxidation (LPO), activities. of antioxidant. enzymes in erythrocytes and insulin gene expression.of pancreas in streptozotocin (STZ)-Induced, diabetic rats. Experimental diabetes, Single was triggered. Dose of the STZ injection (60 mg/kg, i.p.). The tissue measured the oxidative stress. LPO amount, reduced content of glutathione (GSH) and enzymatic activities of Dismutase (SOD) superoxide, catalase (CAT). The peroxidase glutathione of erythrocytes (GPx) and glutathione reductase (GR). Blood rise, glucose, LPO level with Reduction and decrease in GSH content. Those were enzymatic operations. Observed distinguishing characteristics of monitoring rats for diabetes. Administration oral of a grain for barley. Complete grain to this caused a significant 42 days. Reduction of degree of LPOs. Rats treated in STZ (Class IV) diabetic control rats (group II).

KEYWORDS

Barley, Streptozotocin (STZ), Diabetes meltus, Insulin

INTRODUCTION

Persistent hyperglycemia during diabetes increases reactive oxygen species (ROS) production by glucose self-oxidation (Acworth, McCabe, and Maher 2017) (Wolff, Jiang, and Hunt 1991). Oxidative stress is well known to have been observed mainly due to increased production of oxygen-free radicals and a significant reduction in the antioxidant defense system in diabetes. Additionally there is a oxidative stress is well known to have been found primarily as a result of increased production of oxygen-free radicals and a significant reduction in the diabetes antioxidant defence. There is also a link between diabetes and lipid metabolism failure There is currently a trend to replace the commonly used synthetic antioxidants with natural antioxidants to increase food shelf-Life Researchers were interested in flavonoids because they show promise to be efficient antioxidants capable of defending cells against and against oxidative stress (Bors 1996). The human body is unable to produce flavonoids, and is brought in through the daily diet. The evidence shows that flavonoids play a crucial biological role including reactive oxygen scavenging (Pietta a) organisms. The antioxidants have been shown to be effective (Karadeniz et al. 2005). Phenolics antioxidant properties stem from their high reactivity as donors of hydrogen or electron, and the ability of polyphenol-derived radicals to stabilize and transfer the unpaired electron or their ability to chelate transition metal ions (Rice-Evans, Miller, and Paganga 1997), so the search for possibilities Of great interest are antioxidant agents derived from natural products. A number of plants have shown a free radical scavenging activity among laboratory animals and one of these is whole grain barley. Barley is abundant in a wide array of antioxidants, including phenolic acid derivatives, proanthocyanidins, quinones, and flavonoids (Bonoli, Marconi, and Caboni 2004) barley is used mostly in.

MATERIALS AND METHODS

Experimental Animals

Male Weighing in for this article. Sprague-Dawley rats were used (150-200 g). They stayed at the house. For livestock (Faculty for Veterinary Medicine, College of Veterinary Medicine Cairo, Egypt) for I week for proper acclimatization before starting the experiment. They were housed under laboratory conditions, maintained on a standard pellet diet and water throughout the experimental period. The experimental research, has been accepted by faculty of Veterinary Medicine's Animal Care and Use Committee, University of Cairo, Egypt.

Drugs and Chemicals

Sigma Chemicals (USA) had obtained streptozotocin. Glucose kit was procured. from Diagnosis. Randox, U.S. All the ingredients left over. Analytical classification used.

Experimental Design

The rats were split in accordingly. Which consists for five groups. Of each group eighteen animals; group I: standard control.rats were fed 42 days. on regular laboratory animal feed. Group II: rats with diabetic. control, got single dose STZ (60 m^g, i.p.). Group III: diabetic rats treated with barley were fed whole grains of barley seed after Treatment with STZ, and continuing. Class IV: insulin treated over 42 days. Diabetic rats, received insulin after STZ treatment (4 IU / rat, subcutaneous) and continued for 42 days. Class V: barley only treated rat, fed only whole grain (p.o.) of barley seeds for 42 days. Citrate STZ buffer (pH 4.5) was administered intraperitoneally (i.p.) To classes II, III and IV, at a single dose of 60 mg / kg. Diabetes development was confirmed three days after Treatment with STZ by calculating blood glucose levels. Rats with blood glucose content. Diabetes is considered to be greater than or 250 mg / dl. Five days after STZ diagnosis, groups Ill and V were given a full gray diet (42 Days) Blood samples have been collected from. All groups, 2 and 4. Weeks on. The Barley Supplement. There were blood samples. Getted on the last one. Test day, for biochemical. Forecast. Then the poultry. They got slaughtered. On the expression of genes. Pancreas analyzes and. Was sliced, was dried, and cleaned in standard ice-cold saline.

Determination of Blood Glucose

Glucose was determined to be oxidase. For blood glucose levels (Barham and Trinder 1972) Generic-based system. Randox Diagnostic System, USA.

Determination of Serum Insulin Level

Serum insulin. level was quantified. using commercial available rat insulin kit from EMD Millipore USA.

Determination of LPO

There was LPO estimated by. The Thiobarbituric reaction Malondialdehyde (MDA) acid (TBA), a compound formed by lipid peroxidation membrane (Ohkawa, Ohishi and Yagi 1979).

Determination of GSH

GSH content was estimated by method of (Sedlak and Lindsay 1968).

Determination of SOD, activity

The SOD activity was measured using the (Marklund and Marklund 1974).

Determination of CAT, activity

The CAT operation was calculated according to the (Mohandas et al., 1984).

Determination of GPx, activity

Operation of GPx was calculated by method of (Mohandas et al., 1984).

Determinationof GR, activity

GR activity was measured by the (Mohandas et al. 1984).

RESULTS

Body Weight

Results of daily body weight clarified in Figure 1 revealed significant differences ($P<0.05$) between diabetic groups, normal control group and barley only group starting on the third day and continue throughout the following days of the experiment. On the other hand, the statistical comparison between the three diabetic groups showed that the overall body weight recorded insignificant changes ($P>0.05$) throughout the experimental period.

Blood Glucose

On day five, blood glucose has been measured to select the diabetic rats, whose levels exceed 200 mg/dl. The results revealed that male rats treated with insulin and that treated with barley whole giain recorded the best hypoglycemic effects compared with diabetic control rats. However, their blood glucose concentrations are still higher than that of normal control rats. On othe hand, blood glucose of barley only treated rats showed significant lower concentration ($P<0.05$) and reached to that of normal control rats.

Insulin Concentration

Results clarified the insulin concentration (LU/ml) of the experimental groups at the end of the experiment. It has been found that male diabetic rats treated with insulin and with barley whole grain recorded insignificant difference when compared with each other or with that of diabetic control male rats (12.51, 15.1 L and 10.62 L U/ml means respectively). But their averages were significantly ($P<0.05$) lower than that of normal control rats and that of barley only treated rats, which showed insignificant ($P>0.05$) difference when compared with each other (19.34 and 18.72 LU/ml, respectively).

Table 1: Effect of Barley whole Status Grain on Oxidalive Antioxidant Parameters

Antioxidant Capacity Parameters	G1	G2	G3	G4	G5
GSH (µmol/g Hb)	10.16	4.05	7.88	9.00	10.88
SE	0.66	0.46	0.60	0.84	0.78
MDA (nmol/g Hb)	14.61	27.94	20.55	15.11	14.72
SE	0.88	0.98	1.04	0.79	0.79
GST (U/g Hb)	7	17.77	11.33	8.55	7.33
SE	0.51	0.64	0.59	0.61	0.55
GPx (U/g Hb)	16.27	38.16	21.61	18.5	16.11
SE	0.77	0.93	1.10	1.25	1.00
GR (U/g Hb)	11.61	24.55	14	12.16	11.5
SE	0.64	1.01	0.82	0.67	0.63
CAT (U/mg Hb)	50.77	75.5	58.27	53.38	51.16
SE	0.92	1.04	0.83	1.29	1.11
SOD (U/g Hb)	580.27	701	599.94	581.5	585.61
SE	1.65	2.78	2.68	1.58	1.55

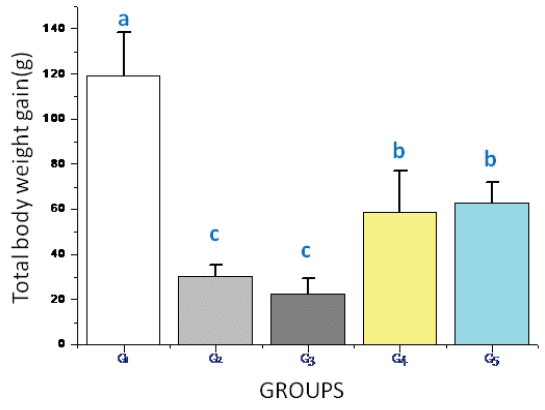

Figure 1: Effect of whole-grain barley. on daily body weight (g) in streptozotocin-induced mature. male rats on body weight gain (g).

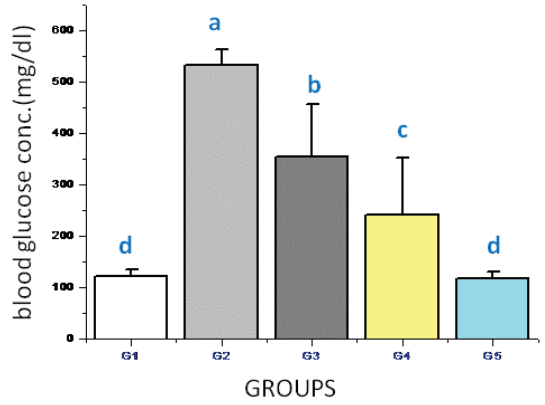

Figure 2: Effect of barley whole grain on blood glucose concentration in streptotozotocin- induced diabetic mature male rats

Antioxidants and Oxidative Markers

Our findings demonstrated. a parallel increase in antioxidant. enzymes in diabetic rats induced by streptozotocin in response to oxidative stress.

DISCUSSION

H > 'poinsulinemia in diabetes increases the activity of the enzyme fatty acyl coenzyme A oxidase, which results in lipid peroxidation by P-oxidation of fatty acids (Esterbauer and Cheeseman 1990). Gained. Lipid peroxidation, by reduction, impairs membrane activity. Membrane fluidity and modifying membrane-bound enzyme and receptor function. The lipid peroxidation arc products are and are toxic to most body cells. Correlated to a number of diseases, including atherosclerosis and brain damage (Howard and Tarrant 1997). In this study, diabetic rats experience increased oxidative stress as evidenced by higher levels of MDA and lower levels of GSH compared to controls on the administration of whole grain barley, the levels of MDA decreased, and the levels of GSH, increased. It suggests an increase in oxidative stress exists in the administration of barley. This may result from the protective effect of insulin as anti- inflammatory and the potential antioxidant properties of barley whole grain. The increase in catalase activity in erythrocytes in diabetic rats in this study could be due to higher oxidative stress. (Godin et al. 1988) Reported an increase in catalase activity. After 12 weeks of diabetes-induction. The increased catalase activity observed in diabetic rats reflects increased production of H_2O_2. The present findings of increased catalase in diabetic rats compared to insulin treated and barley fed groups are consistent with the studies of (Asayama et al. 1989) and can be explained in the context of the potential antioxidant role of barley whole grain. The low levels of antioxidant enzymes in erythrocytes may make it more vulnerable to oxidative stress. (Ho et al. 1997) suggest that GPx plays a primary role in minimizing oxidative damage. (Shull et al. 1991) reported an increase in GPx at higher concentrations. of H_2O_2. In the present study, even with increased catalase and

GPx. The MDA levels were high in diabetic rats compared with insulin treated and barley fed groups. This suggests that oxidative stress was in excess of the capacity of the antioxidant enzymes to scavenge reactive oxygen species. Glutathione Reductase (GR, EC 1.8.1.7) catalyzes dramatically playing a NADPH-dependent reduction in oxidized glutathione (GSSG) to reduced glutathione (GSH). Role in the GSH redox process, with sufficient retention. Reduced GSH rates for defense against oxidative stress a high GSH / GSSG ratio is necessary(Tietze 1969). In this study, whole-grain barley administration has restored the activity of antioxidant enzymes (GR, GST, and GPx) in a similar mechanism to mimic. SOD and CAT some studies have indicated the association between the increased activity of xanthin. oxidase (XOD) and the development of oxygen radicals in diabetes (Swei et al. 1998) (Dobson et al. 2002).

In clinical practice recognized XOD inhibitor decreases oxidative stress in diabetes. Therefore, active constituents of whole grain barley (p-glucan) can be expected to interact with the CfiOO peroxy cell. Thus the activity of SOD, GST. GR, GPx and CAT enzymes has been reduced. Our results showed that whole grain barley has shown an protective antioxidant activity likely due to the presence of flavonoids (Singh and Handa 1995). Flavonoids can interfere with those of the oxidative agent in the initiation stage of peroxidation. Each metabolism scavenges the free radicals, or by microsomal deficiency. Required Enzymatic Program to the metabolism. We should, however scavenge, or kill the Fenton reaction as chelating agents for Fe*-ion, lipoperoxides and their radicals.

CONCLUSION

It can be concluded that barley whole grain has a positive beneficial effect, as an efficient antihyperglycemic and. antioxidant agent in experimentally. induced mature male rats As well as its positive role in raising the level of expression of the genes Reg3a and InsI (Responsible for insulin hormone biosynthesis) in the. pancreatic p-cell, when. used for 42 days. Further investigations are needed to recommend whole gram of barley and its various fractions

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ABBREVIATIONS

Glutathione Peroxidase (GPx); Nitroblue Tetrazolium (NBT); Superoxide dismutase (SOD); Streptozotocin (STZ); Thiobarbituric Oxidative Stress Acid-reactive Substances (TBARS); Thiobarbituric Acid (TBA); Malondialdehyde (MDA); Rezactive Oxygen Species (ROS)

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