Garlic-Induced Alteration in Liver and Kidney of Diabetic Rats

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ABSTRACT

Alternative treatment based on food compounds obtained from food products is one of the most important methods used in dealing with chronic diseases that cause oxidative stress such as Alzheimer's, blood pressure, high fat, and diabetes. In this study, the experiment has been designed to study the possible effects of antioxidants in the organic compound Allyl Methyl Sulfide (AMS) extracted from garlic and investigate its role in relieving the oxidative stress caused by diabetes in the liver and kidney in rats model. In this research, we used garlic oil as a source for AMS. Forty adult male albino rats were divided into five groups: control group, the diabetes group and three diabetes groups treated with garlic oil (200mg/kg bw) and vitamin E (300 mg in the water next to the daily diet) or both by mouth For 6 weeks. Diabetes was caused by injecting rats with streptozotocin at a dose of 50mg/kg bw for 4 days. The results showed that diabetes had a significant increase in the level of blood glucose and lipid peroxidation (Malondialdehyde). Also, findings indicate a significant increase in the activity of some Liver enzymes (Alanine transaminase, Aspartate transaminase) and an insignificant relative increase in renal function activity (creatinine, urea). Meanwhile, significant decreases in antioxidants (Superoxide dismutase, catalase, reduced glutathione, glutathione peroxidase) were found in liver and kidney tissues. Furthermore, the results showed that garlic oil and vitamin E had possible therapeutic effects on improving oxidative stress in the treated rats. This was explained by inhibiting lipid peroxidation, increasing the antioxidant ratio and reducing the activity of (Alanine transaminase, Aspartate transaminase) in the liver compared to the control group.

Key Words:*Anti-oxidant, oxidative stress, garlic, allyl methyl Sulfide, diabetes, liver, kidney.*

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INTRODUCTION

Researchers focus on studying the properties of defense, protection, and antioxidants in natural dietary plants [1]. Various medicinal plants have been utilized traditionally to treat diseases all over the world [2].Some of them have been used in traditional systems of medicine for hundreds of years in many countries. Traditional medicines, e.g. Ayurveda and Unani in India and other countries, since ancient times, have employed hypoglycaemic plants, such as garlic (Allium sativum), Tulsi (Ocimum sanctum), Neem (Azadirachtaindica), Bittergourd (Momordicacharantia) and ginger (Zingiberofficinale), to treat diabetic pathogenesis [3]. It has been used since ancient times for medicinal and culinary aims all over the world [4]. Various reports have demonstrated that garlic has hypoglycaemic, hypocholesterolemic, antiarthritic, antirheumatic and antidiabetic properties in humans and experimental animals [5, 6]. This medicinal herb is considered to be an excellent candidate for oral therapy as it is effective, non-toxic and without serious side effects. It has become possible to reduce the risks caused by excessive generation of free radicals and prevent disease progression by either enhancing the body's natural antioxidant defenses or by supplementing with proven dietary antioxidants.

Allyl methyl sulfide (AMS) is a potential garlic-derived organosulfur compound displaying a substantial range of optimistic actions in various diseases. Herein, we investigated the potential role of AMS in ameliorating the

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effects of oxidative stress and inflammation in the liver and Kidney of streptozotocin (STZ)-induced experimental rats. AMS was identified as one of the major bioactive components in garlic. AMS is a leading compound of volatile garlic metabolites which was shown to exhibit antibacterial, antioxidant and anticancer properties. Amongst the potential biological properties of AMS [7].

Diabetes mellitus (DM) is the third 'killer' of mankind after cancer and cardiovascular diseases due to its high prevalence as well as mortality [8]. Diabetes mellitus refers to a group of diseases that affect how your body uses blood sugar (glucose). It is a metabolic syndrome, initially characterized by a loss of glucose homeostasis resulting from defects in insulin secretion, insulin action or both, which is responsible for regulating the blood glucose level which leads to the impairment the glucose metabolism [9]. DM produces serious changes in organs and tissues of the body such as the heart, pancreas, kidney, liver, brain and nervous system. It is due to an unhealthy lifestyle and a lack of cultural awareness about these types of diseases in societies. In the Arab world, diabetes is one of the causes of death at a high rate due to a lack of interest in physical activity and exercise. Physical activity helps control body weight, uses up glucose as energy and makes the cells more sensitive to insulin which means the body needs less insulin to transport sugar to your cells also lowers blood sugar level by moving sugar into cells, where it's used for energy. In other words, food and values are parts of the main causes of diabetes. Concentration in Arabic foods depends on carbohydrates such as rice, pasta, and lack of attention to a balanced diet. Therefore, the disease is increasing every year at very high rates [10].

DM is a state of increased free radical formation that leads to oxidative stress. The oxidative stress defined as an imbalance between the production of free radical and antioxidant defenses [11]. The existence of oxidative stress resulting from increased free radicals has been postulated in diabetes [12]. Diabetes manifested by the experimental animal model exhibit high oxidative stress due to persistent and chronic hyperglycemia, which thereby depletes the activity of antioxidative enzymes and thus promotes the free radical generation [13].

In the present study, attempts to reduce the oxidative stress of diabetes by garlic oil, vitamin E and their combinations and also to explore whether this treatment can restore the altered antioxidant defense system in the liver and kidney of STZ-induced diabetic rats**.**

MATERIALS AND METHODS

Animals

The present study was conducted on forty (40) adult male albino rats, obtained from the Animal House of King Fahad Research Center, Jeddah-Kingdom of Saudi Arabia. The weight of each rat was ranged (150-170g). The animals were maintained under a standard condition of temperature and humidity with access to one gram of food were added into each cage daily, and water for one-week ad libitum before experimentation. The animals were maintained by professional human care in compliance with the guidelines of the Ethical Committee of King Fahad Research center, Jeddah-Kingdom Saudi Arabia. They were housed in standard cages then left to acclimatize for 7 days in laboratory conditions before the commencement of the experiment.

Preparation of Drug and Induction of Experimental Diabetes

Streptozotocin

In the present experiment, diabetes was induced by oral injection of streptozotocin at a dose of 50mg/kg body weight dissolved in 50mM citrate buffer, PH4.5. Four days after the injection, the blood glucose level will be estimated. The rats were considered diabetic when fasting blood glucose level over 200mg/dl [14].

Plant material

Garlic oil, purchased from a commercial supplier [15]

Vitamin E

Vitamin E was obtained from the warehouse of the Faculty of Science at King Abdul-Aziz University in Jeddah [16].

The Experimental Design

The rats were divided into five groups comprising of 8 animals in each group as follow:

Group 1: normal control and were given only distilled water and diet.

Group 2: STZ-induced diabetic rats served as diabetic control.

Group 3: STZ-induced diabetic rats were treated orally with 200mg/kg bodyweight of garlic oil, purchased from a commercial supplier [15].

Group 4: STZ-induced diabetic rats were treated with 300mg of vitamin E in tap water beside regular diet daily [16].

Group 5: STZ-induced diabetic rats were treated with garlic oil and Vitamin E.

The duration of the experiment was 6 weeks.

Note: some rats died during the study period, so we performed tests analysis on 6 rats in each group instead of 8 rats.

Blood Collection and analytical procedures

On the final day of the experiment, the blood was collected and left to clot and centrifuged at 3000 rpm for 10 minutes for separation of sera. All samples were frozen at -20ºC till assayed [15].

Tissue sampling and Preparation of Homogenates

Tissue Sampling

The animals were sacrificed by decapitation. The two organs liver and kidney were washed with ice-cold saline immersed in liquid nitrogen and stored at -20 for further biochemical analysis.

Preparation of Homogenates

The tissues (liver and kidney) of each rat were perfused with a PBS (phosphate-buffered saline) solution, ph 7.4, containing 0.16mg/ml heparin to remove any red blood cells and clots. Then, the tissue was homogenized in 5-10ml cold buffer (i.e, 50mM potassium phosphate, ph 7.4, 1mM EDTA and 1ml/L Triton X-100) per gram tissue. The homogenate was centrifuged at 4,000 rpm for 15 minutes at 4°cand the resultant supernatant was used for different determinations.

Biochemical Assay

Determination of Serum Glucose

The concentration of blood glucose level was measured three times in the present study before the injection of STZ and after induced diabetes and the last time was before the anatomy by used normal glucose monitoring meter and test strips by taking a blood sample from the rat's tail.

Determination of Serum Lipid Profile

Low-density lipoprotein (LDL), Triglycerides (TG), Total Cholesterol (TC) were estimated by adopting the protocol given by Friedewald, W. T., et al [17] Burstein et al [18] and Allain, Charles C., et al 1974 [19] respectively by used commercial kits.

Determination of Liver and Kidney Marker

The activities of serum alanine aminotransferase and aspartate aminotransferase were assayed using kits with the kinetic method according to the recommendation of the Expert Panel of IFCC (International Federation of Clinical Chemistry) without pyridoxal phosphate activation. Serum creatinine and urea were assayed using colorimetric kits.

Determination of Antioxidant and Malondialdehyde (MDA)

Antioxidant and malondialdehyde were determined using commercial kits. Catalase activity (CAT) superoxide dismutase activity (SOD), reduced glutathione level (GSH), glutathione peroxidase level (GSH-px) and malondialdehyde levels (MDA) were assayed according to the methodsdetailedbyAebi [20], Nishikimi [21], Ellman [22]Paglia [23] and ohkawa [24] respectively.

Statistical Analysis

The data were analyzed by using a one-way ANOVA test followed by Tukey posthoc analysis to compare various groups. Results are expressed as mean ± SEM and values of $P>0.05$ were considered non-significantly different, while those of $P<0.05$ and $P< 0.01$ were considered significant and highly significant, respectively. The data analysis was done by using Mega Stat Excel.

RESULT

Impact of Allyl Methyl Sulfide (AMS), Vitamin E and Their Mixture on Blood Glucose and Body Weight

Table 1 showed the blood glucose level and the bodyweight of the rats in the different treatment groups in which the bodyweight was monitored from the beginning of treatment DM with AMS. Vitamin E and their mixture were mentioned at the start (week 1), middle (week 3) and end (week6) and the blood glucose level were measured before induced diabetic and after injection by STZ and before anatomy. The result of blood glucose level showed a significant increase ($p<0.05$) in the concentration of DM untreated group compared to the normal group, whilst there was a significant decrease ($p <0.05$) in groups treated with their mixture **compared** with DM untreated group. But still high concentration level of glucose in the blood ($p>0.05$) compared to the normal group. Bodyweight affected by STZ-induced DM and significantly decreased ($P<0.05$) in DM untreated groups compared to the normal group. Administration of AMS, Vitamin E and their mixture improved the weight of DM treated groups.

Impact of Allyl Methyl Sulfide (AMS), Vitamin E and Their Mixture on Serum Lipid Profile

Table 2 shows the result obtained from the analysis of the serum lipid profile. LDL showed no significant difference ($p>0.05$) in DM untreated group comparable to the normal group and no change in concentration in treated groups ($p>0.05$). Whilst triglycerides were increased significantly in DM untreated group ($p<0.05$) from the normal group, administration withAMS, Vitamin E and their mixture had a positive effect on the level of TG. It was significantly decreased ($p<0.05$) compared to DM untreated group. On another hand, the rats' group treatment with their mixer has significantly decreased ($p < 0.05$) compared to other DM untreated and treatment groups and also, there was a slight decrease in TG concentration compared to the normal group. Cholesterol in the statues of STZ induced DM had significantly increased ($p<0.05$) in the level of DM untreated group compared to the normal group whilst the level significantly decreased ($p<0.05$) in the group treated with the combination compared to all groups. Also, there was a significant decrease ($p < 0.05$) in it is level in

the group treated with ASM compared to DM untreated group.

Impact of Allyl Methyl Sulfide (AMS), Vitamin E and Their Mixture on Liver and Kidney Function

For determining the efficacy of Allyl methyl sulfide (AMS), vitamin E and their mixture on liver marker activity, we measured as shown in Table 3, the activity of alanine aminotransferase (ALT) and aspartate aminotransferase (AST). The activity of ALT and AST were increased significantly ($p < 0.05$) in the diabetic rats when compared to the normal group. That increased demonstrates liver damage. DM groups treated with either AMS or vitamin E showed a non-significant change in ALT activity when compared to the untreated DM group. Also, the level of AST significantly decreased in the DM group treated with Vitamin E compared to the untreated DM group. The treated group with their mixture showed a significant decrease ($p < 0.05$) in ALT and AST activity.

To determine the efficacy of Allyl methyl sulfide (AMS), vitamin E and their mixture on kidney marker concentration, we measured urea and creatinine concentration. As shown in Table 3, there was no significant change ($p > 0.05$) in the concentration of urea in all groups. While Creatinine concentration was treated with ASM, it was the only group that did not significantly differ proportionally to the normal group.

Impact of Allyl Methyl Sulfide (AMS), Vitamin E and Their Mixture on Tissues (Liver and Kidney) Antioxidant and Malondialdehyde

The influence of ASM, vitamin E and their mixture on liver antioxidant status and Malondialdehyde as a marker of lipid peroxidation is presented in table 4. There was a significant difference in the catalase level. It decreased significantly ($p < 0.05$) in DM untreated groups compared to the normal group, and there was a relative increase in catalase level in DM treated groups with ASM, vitamin E and their mixture if we compared to DM untreated group. There was a significant decrease in the level of superoxide dismutase ($p < 0.05$) in all groups of DM (untreated group and DM treated groups with ASM, vitamin E and their mixture) compared to the normal group. There was a high decrease ($p < 0.05$) in level of reduced glutathione in DM group compared to normal group, the group treated with ASM is the only group that showed no significant defer relative to normal group ($p > 0.05$) and there was a significant increase ($p<0.05$) in level if GSH compared to DM Untreated group. There was a highly significant difference ($p < 0.05$) in the level of glutathione peroxidase in DM (untreated group and DM treated groups with ASM, vitamin E and their mixture). There was highly decreasing, in the level of GSH-Px in the DM untreated group. and also showed that there was a significant difference ($p<0.05$) in the level of GSH-Px in DM treated group with a mixer of AMS and Vitamin E if we compared with other DM groupstreated and untreatedgroups showed highly increased in the level of GSH-Px. There was a significant difference in the level of Malondialdehyde in the DM group compared to the normal group. There was a high increase ($P<0.05$) in level**,** whilst there was a significant decrease ($P < 0.05$) in the level of MAD in DM treated group AMS, vitamin E and their mixture when we compared it with DM untreated group.

The influence of ASM, vitamin E and their mixture on kidney antioxidant status and Malondialdehyde as a marker of lipid peroxidation is presented in table 5. There was a significant difference in the catalase level. It decreased significantly ($p < 0.05$) in DM untreated group compared to the normal group. There was a higher increase in catalase level ($p < 0.05$) in DM treated groups with ASM when we compared to DM untreated group that was observed. There was a significant decrease in level of superoxide dismutase ($p < 0.05$) in groups of DM (untreated group and DM treated groups with ASM and their mixture) compared to the normal group, except the group of DM treated with vitamin E. It showed significant increase in SOD level compared to normal group and other groups. There was a high decrease ($p < 0.05$) in the level of reduced glutathione in DM group compared to the normal group, and the group treated with their mixture is the only group that showed increased significantly in the level of GSH defer relative to the normal group and other DM groups ($p > 0.05$). There was a high significant difference ($p < 0.05$) in level of glutathione peroxidase in DM (untreated group and DM treated groups with their mixture) it was highly decreased and also showed that there was a significant difference ($p < 0.05$) in level of GSH-Px in DM treated group with ASM, vitamin E and when we compared to other DM group (untreated and treated with their mixer), it was highly increased. There was a significant difference in the level of Malondialdehyde in the DM group compared to the normal group. There was a high increase ($P < 0.05$) in level**,** whilst there was a significant decrease ($P < 0.05$) in the level of MAD in DM treated group AMS, vitamin E when we compared it with DM untreated group whilst their mixture showed a high increase in level when we compared to other groups.

Table 1: Effect of AMS, or/and vitamin E on blood glucose and body weight changes in different studied groups

Group	Blood glucose mg/dl			Bodyweight		
	Before STZ	After STZ	Before the anatomy	Week1	Week 3	Week 6
Control	86.6±5.8	89.6±3.9	85.6±2.8	235.0± 5.1	282.0±13.5	323.1±7.2
DM	93.1±3.8	351.5±28.0 [a]	356.3±22.4 [a]	221.1± 6.3 [a]	168.5±13.1 [a]	161.0±12.8 [a]
DM+AMS	89.6±5.3	438.3±25.3 [a]	382.5±27.8 [a]	209.3 ± 4.4 [a]	194.3±4.7 [a]	207.1±4.8 [a]
DM+ vitamin E	89.0±2.6	405.3±21.1 [a]	389.8±17.9 [a]	204.1 ± 1.8 [a]	183.3±4.7 [a]	219.0±1.7 [a]
DM+ Combination	89.5±3.3	390.1±14.0 [a]	219.3±35.5 [a b c d]	207.6 ± 6.2 [a]	239.8±9.9 [a]	279.1±14.5 [a]

Results are expressed as mean ± SEM (n = 6). [a] indicates a significant difference compared to the control group. [b] indicates a significant difference compared to the diabetes group. [c]indicates significant differences compared to diabetes + garlic group. [d]indicates significant differences compared to diabetes + vitamin E group. $p \leq 0.05$

Table 2: Effect of AMS, or/and vitamin E on serum lipid profile in different studied groups

Group	Lipid profiles		
	LDL	TG	Cholesterol
Control	15.67±0.8	14.50± 0.9	33.17±2.8
DM	15.77±1.1	25.00±1.3 [a]	47.50±2.1 [a]
DM+AMS	15.52±0.4	15.33±1.8[b]	36.83±1.4[a b]
DM+ vitamin E	16.33±1.3	15.33±0.7 [b]	40.33±1.0[a b]
DM+ Combination	15.72±0.6	13.00±0.5 [b]	29.50±1.4 [b c d]

LDL: low-density lipoprotein, TG: Triglycerides, Cholesterol
All values expressed as (mg/dl)
*Results are expressed as mean ± SEM (n = 6). [a] indicates a significant difference compared to the control group. [b] indicates a significant difference compared to the diabetes group. [c]indicates significant differences compared to diabetes + garlic group. [d]indicates significant differences compared to the diabetes + vitamin E group. $p \leq 0.05$

Table 3: Effect of AMS, or/and vitamin E on liver and kidney function in different studied groups

Group	**Liver function**		**Kidney function**	
	ALT	AST	Creatinine	Urea
Control	23.5 ± 1.8	44.8 ± 3.9	0.51 ± 0.03	5.1 ± 0.21
DM	51.4 ± 4.9 [a]	76.4 ± 2.1 [a]	1.39 ± 0.2 [a]	6.0 ± 0.30
DM+AMS	43.5 ± 3.2 [a]	62.7 ± 2.8 [a]	0.78 ± 0.06 [b]	5.3 ± 0.31
DM+ vitamin E	38.5 ± 4.7	55.2 ± 5.1 [b]	1.17 ± 0.13 [a]	5.7 ± 0.33
DM+ Combination	28.0 ± 2.8 [b, c]	45.8 ± 3.3 [b, c]	1.16 ± 0.18 [a]	4.8 ± 0.28

ALT, alanine aminotransferase and AST, aspartate aminotransferase expressed as (U/L), Creatinine and Urea expressed as (mg/dl)
*Results are expressed as mean ± SEM (n = 6). [a] indicates a significant difference compared to the control group. [b] indicates a significant difference compared to the diabetes group. [c]indicates significant differences compared to diabetes + garlic group. [d]indicates significant differences compared to the diabetes + vitamin E group. $p \leq 0.05$

Table 4: The effect of the AMS or,/and vitamin E on liver CAT, SOD enzyme activity, GSH, GSH-Px levels and oxidative stress (MAD) in rats induced DM

Group	CAT (U/mg tissue)	SOD (U/mg tissue)	GSH (mg/g tissue)	GSH-Px (U/g tissue)	MDA (nmol/g tissue)
Control	423 ± 8.1	48 ± 4.1	13.2 ± 0.4	572 ± 17.5	27 ± 2.0
DM	254 ± 15.8 [a]	21 ± 1.6 [a]	5.4 ± 0.2 [a]	141 ± 15.9 [a]	55 ± 3.1 [a]
DM+AMS	351 ± 6.3 [a, b]	25 ± 2.7 [a]	10.0 ± 0.8 [b]	178 ± 8.9 [a]	23 ± 1.2 [b]
DM+ vitamin E	341 ± 13.2 [a, b]	32 ± 3.1 [a]	7.3 ± 0.3 [a, c]	185 ± 23.9 [a]	31 ± 4.2 [b]
DM+ Combination	325 ± 4.2 [a, b]	31 ± 0.9 [a]	6.7 ± 0.2 [a, c]	369 ± 13.7 [a, b, c, d]	33 ± 1.9 [b]

CAT catalase, SOD superoxide dismutase, GSH, reduced glutathione, GSH-px glutathione peroxidase, MAD malondialdehyde
*Results are expressed as mean ± SEM (n = 6). [a] indicates a significant difference compared to the control group. [b] indicates a significant difference compared to the diabetes group. [c]indicates significant differences compared to diabetes + garlic group. [d]indicates significant differences compared to the diabetes + vitamin E group. $p \leq 0.05$

Table 5: The effect of the AMS or,/and vitamin E on Kidney CAT, SOD enzyme activity, GSH, GSH-Px levels and oxidative stress (MAD) in rats induced DM

Group	CAT (U/mg tissue)	SOD (U/mg tissue)	GSH (mg/g tissue)	GSH-Px (U/g tissue)	MDA (nmol/g tissue)
Control	347 ± 10.5	74 ± 3.6	12.4 ± 0.5	615 ± 25.1	28 ± 1.4
DM	144 ± 11.1 [a]	34 ± 2.3 [a]	6.2 ± 0.2 [a]	146 ± 9.3 [a]	52 ± 4.0 [a]
DM+AMS	336 ± 11.0 [b]	66 ± 2.6 [a, b]	6.6 ± 0.7 [a]	343 ± 10.4 [a, b]	34 ± 2.9 [b]
DM+ vitamin E	190 ± 9.8 [a, b, c]	77 ± 7.3 [a, b]	6.1 ± 0.6 [a, c]	351 ± 35.2 [a, b]	34 ± 0.8 [b]
DM+ Combination	222 ± 8.8 [a, b, c]	46 ± 5.3 [c, d]	15.5 ± 0.4 [a, b, c, d]	199 ± 23.4 [a, c, d]	75 ± 2.9 [a, b, c, d]

CAT catalase, SOD superoxide dismutase, GSH, reduced glutathione, GSH-px glutathione peroxidase, MAD malondialdehyde
*Results are expressed as mean ± SEM (n = 6). [a] indicates a significant difference compared to the control group. [b] indicates a significant difference compared to the diabetes group. [c]indicates significant differences compared to the diabetes + garlic group. [d]indicates significant differences compared to the diabetes + vitamin E group. $p \leq 0.05$

DISCUSSION

Alternative medicine has been used for plants for treatment, control of more diseases, and also chronic diseases and their complication. The natural product has fewer side effect and for that, there is a growing interest in the beneficial therapeutic role of herbal medicine in the prevention and management oxidative stress caused by different diseases. Therefore, we investigated this report of the study on antioxidant effects of allyl methyl sulfide, an organosulfur compound in liver and kidney tissues of rats.
Diabetes mellitus is a major endocrine disorder leading to complications in multiple organs and systems [25]. In the present study, we induced DM by injecting rats with streptozotocin, which leads to oxidative stress. Oxidative stress (OS), the imbalance between the free radicals and antioxidant defense [26]. Streptozotocin induces diabetes through the generation of oxygen free radicals [27].

Blood Glucose and Body Weight

The body weight and blood glucose of rats were recorded in the experiment to define the rats' health and to compare the treated groups with the DM control and normal control rats. As shown in our results, there was a significant increase in blood glucose and a significant decrease in body weight of rats in DM untreated group if compared to the normal group and this finding agrees with the study of [7, 28]. Allyl methyl sulfide (AMS), vitamin E and their mixture restrained the level of blood glucose resulting from injection experimental rats with streptozotocin and improvement of body weight when compared to DM untreated group. This result consistent with [7].

Serum Lipid Profile

As shown in the present study, Streptozotocin-induced diabetes in rats had a significant effect on total cholesterol and triglycerides, and the level of that lipid profile was significantly increased and this finding matched with the result from the study carried out by [29, 30]. Administration with Allyl methyl sulfide (AMS), vitamin E and their mixture had significantly decreased the level of serum lipid profile in our study as shown in the report detailed by [30].

Tissues Function

Our study findings illustrate that there is a great significant increase in liver marker ALT and AST due to oxidative stress caused by streptozotocin-induced DM. This increased observation in DM untreated group compared to the normal group and we compared these results with the results of [7]. It significantly decreased in the DM groups treated with Allyl methyl sulfide (AMS), vitamin E and their mixture compared to DM untreated group. The result is similar to the finding result of[7]. On the other hand, streptozotocin-induced DM showed no significant change in the concentration of urea and a slight change in the concentration of creatinine.

Antioxidant and Oxidative Stress Marker

As shown in the present study Streptozotocin produced a state of oxidative stress revealed as a decrease in CAT, SOD activities and GSH, GSH-px level with an inherent increase in MAD level in the liver and kidney of Streptozotocin-induced DM rats as compared to the normal group. This finding is conformity with the result of [7, 28].
Diabetes rats with Allyl methyl sulfide (AMS), vitamin E and their mixture treatment showed an increase in CAT, SOD activities and GSH, GSH-px level with an inherent decrease in MAD level in the liver and kidney of Streptozotocin-induced DM rats as compared to the normal group. The result matched with the research studies reported by [7, 31].

CONCLUSION

In conclusion, DM is Chronic Disease, none of the available therapy appears to be able to end the disease, but it can control it. Based on the previous results, it was revealed that streptozotocin-induced Diabetes Mellitus

disease in rats showed a significant increase in the level of glucose in the blood, oxidative stress and liver enzymes accompanied by a significant decrease in the antioxidant in the liver and kidney.

However, treatment of Diabetes group with the Allyl Methyl Sulfide, an Organosulfur Compound, and vitamin E supplement had a significant therapeutic effect on the improvement of liver and kidney tissue disorder in rats. They were demonstrated by inhibition of lipid peroxidation and decrease in the level of glucose in the blood, increase antioxidant and reduction of the activity of liver enzymes compared to untreated diabetic rats.

The combination of Allyl Methyl Sulfide, an Organosulfur Compound, and vitamin E supplement showed higher therapeutic results than other treated groups.

Recommendations

According to the result obtained, it could be recemented that the use of Allyl Methyl Sulfide, an Organosulfur Compound, and vitamin E supplement could be a good supplementary food to reduce the symptoms of Oxidative stress caused by streptozotocin-induced DM in rats and to improve the function of the liver and kidney. The AMS, an Organosulfur Compound and vitamin E contributed to the elimination of free radicals, which increased in oxidative stress.

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