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The Potential Protective Effect of Sesame Oil and Canola Oil on Rats Exposed to Malathion

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ABSTRACT

Currently, the environmental pollution is occurring on a vast and unprecedented scale around the globe. Pesticides are the largest group of chemicals that are used widely in modern agricultural practices**.** Pesticides have been associated with health and environmental issues, and the agricultural use of certain pesticides has been abandoned. Pesticides are basically poisons and therefore toxic to living organism at particular dose. Medicinal plants have a promising future because there are about half million plants around the world, and most of them their medical activities have not investigate yet, and their medical activities could be decisive in the treatment of present or future studies. Natural products from plants, animals and minerals are the basis for treating human diseases. The purpose of the present study was to evaluate the effects of sesame oil and canola oil on male rats exposed to malathion. Experimental rats were divided into six groups. Group 1 was served as normal control. Rats of group 2 were exposed to malathion. Rats of group 3 were treated with sesame oil and malathion. Rats of group 4 were subjected to canola oil and malathion. Rats of group 5 and 6 were supplemented with sesame oil and canola oil respectively. After the end of experimental duration (8 weeks), rats of group 2 showed significant reduction of body weight gain, and severe hematological and biochemical alterations including significant decreases of RBC, HB, Hct, WBC, total protein, glucose and CAT, and increases of ALT, AST, ALP, total bilirubin, triglycerides, cholesterol, creatinine, uric acid and MDA values. Administration of sesame oil and canola oil improved the observed hematological and biochemical alterations induced by malathion intoxication. These new findings indicate that sesame oil and canola oil represent protective roles on hematological and biochemical disturbances induced by malathion toxicity due to their antioxidant activities.

Keywords: Malathion, Sesame oil, Canola oil, Antioxidant, Blood, Rats

Introduction

Environmental pollution is the contamination of the ecosystem that causes harm or discomfort to the physical systems or living organisms. The increase in pollution is a global problem, due to the use of toxic chemical substances or by synthetic compounds such as pesticides. Humans whose position in the food chain is at the top were exposed to various types of environmental contaminants at different stages of life, majority of which are harmful. An increasing number of natural and man-made pollutants have pervaded the environment in the last few decades, which ultimately affect the health and well being living organisms. Health risks due to pesticides toxicity are one of the world's current problems. Environmental pollutants are believed to be factors adversely affecting animal and human organisms (Mamane *et al*., 2015; Lushchak *et al*., 2018). Pesticides are widely utilized chemicals in agriculture, intended to preserve the productivity of crops and the quality of harvests. The universal use of assorted groups of pesticides causes global environmental pollution, as well as the accidental exposure of humans to these pesticides (Kapka-Skrzypczak *et al*., 2011). Exposure to pesticides may be a major cause of various disorders in humans and animals (Hariri *et al*., 2018; Paul *et al*., 2018). Malathion is one of the most widely used organophosphorus insecticides throughout the world. Malathion is used mostly in agriculture and in public health programs to control infestations of insects. It is also used as pest control for agricultural food and feed crops (U.S. EPA, 2006). Malaoxon, the oxon generated from malathion, is more toxic than malathion and is formed by the oxidation of malathion and may also be present as an impurity in the parent compound. Structurally, malathion has similarities with naturally occurring compounds, and their primary target of action in insects is the nervous system (Taylor, 1990; Klaasen, 1990). One of the main toxic effects of malathion on the central nervous system is related to the inhibition of acetylcholinesterase (AChE)

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activity, which produces acute hypercholinergic syndrome (Kwong, 2002). Moreover, previous experimental investigations showed that malathion induced various biochemical and histological changes in experimental animals (Baiomy *et al*., 2015; Abdel-Salam *et al*., 2018; Gupta *et al*., 2019; Hosseini *et al*., 2019).

Nowadays, a lot of research has been conducted on the use of plants products as natural remedies because of their fewer side effects, easy and cheap availability. The therapeutic use of plants and their extracts may be a promising approach for the treatment of different diseases. The use of herbal medicines for health prevention and ailments is an increasing trend worldwide (Kennedy *et al*., 2016). Sesame oil is the extract of the plant, *Sesamum indicum*, Pedaliaceae family. Sesame oil has phenolic compounds, non-protein amino acids, alkaloids, cacogenics glycosides, polyunsaturated fats and lipids, mucilage, phospholipids, thiazole, disulphide, ketones, aldehyde, vitamins as B1, B2, C and E and trace elements such as calcium, magnesium, iron, copper, zinc and phosphorus (Konan *et al*., 2008; Shittu *et al*., 2009). Sesamin and sesaminol are the major phenolic constituents of sesame oil with broad spectrum pharmacological effects including antimutagenic, antioxidant, antihypertensive, anti-inflammatory, and antithrombotic (Sankar *et al*., 2005). Canola (*Brassica napus*), Brassicaceae family, is one of the top five oilseed crops cultivated worldwide and the major oilseed crop in Canada. It contains almost 2:1 ratio of n6 to n3 fatty acids which has been reported to be preferred from the health point of view as well as high content of vitamin E. Canola seed is much richer in phenolic compounds than any other oilseed (Ackman, 1994; Rice, 1944; Naczk *et al*., 1998). Additionally, the seeds contain bioactive compounds including antioxidant vitamins such as tocopherol (mainly alpha tocopherol), phenolic molecules (canolol, sinapic acid, sinapine), coenzyme Q (CoQ) and phytosterols. These micronutrients have healthy metabolic, anti-inflammatory and physiologic effects (Xu *et al*., 2014). Recently, there are no experimental investigations on the effect of sesame oil and canola oil on malathion toxicity. Therefore, The main objective of this study was to investigate malathion impact on blood parameters and to examine the ability of sesame oil and canola oil to combat malathion toxicity in albino male rats. The findings could be useful to understand malathion toxicity and useful protection.

Material and Methods

Animals and experimental design

The experiments were done using male albino rats of Wistar strain, weighing 205-223 g. The animals were maintained in controlled temperature (20±1°C), humidity (65%) and a 12-hour dark-light cycle, with balanced food and free access to water. Experimental rats were randomly divided into six equal groups (n=10 each). Group 1 was untreated and served as normal control. Rats of group 2 were orally treated with malathion at a dose of 150 mg/kg body weight, BW, five times weekly for a period of eight weeks. Rats of group 3 were orally supplemented with sesame oil at a dose of 800 mg/kg BW and after three hours treated with malathion at the same dose given to group 2. Rats of group 4 were orally treated with canola oil at a dose of 800 mg/kg BW and after three hours received malathion at the same dose given to group 2. Rats of group 5 were orally supplemented with sesame oil at the same dose given to group 3. Rats of group 6 were orally supplemented with canola oil at the same dose given to group 4.

Body weight changes

Body weight changes of all rats were measured at the start of the experimental duration and after eight weeks using a digital balance. The experimental rats were observed for signs of abnormalities throughout the period of study.

Blood sampling and analysis

After eight weeks, animals were fasted for 8 hours, water was not restricted, and then anaesthetized with diethyl ether. Blood samples were collected from orbital venous plexus in heparinized tubes and non-heparinized tubes. Blood samples in heparinized tubes were used to estimate the values of red blood corpuscles count (RBC), hemoglobin (Hb), hematocrit (Hct) and white blood corpuscles count (WBC) using auto hematology analyzer (BC-2800 vet.). Blood samples in non-heparinized tubes were centrifuged at 2000 rpm for 20 minutes to obtain serum. Serum levels

of alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total bilirubin, total protein, glucose, triglycerides, cholesterol, creatinine and uric acid were evaluated using Dimension Vista® 1500 System, USA. The levels of serum malondialdehyde (MDA) and catalase (CAT) were estimated using the methods of Ohkawa *et al*. (1979) and Aebi (1984) respectively.

Statistical analysis

Data are reported as the mean ± standard deviation (SD). Differences between means were evaluated by one-way analysis of variance (ANOVA). Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) for Windows version 22.0 software. The level of significance was set at $P < 0.05$.

Results

The body weights after eight weeks of all experimental groups are represented in Fig. 1. Gradual increases in the body weight gain of normal control rats (55.2%) and those supplemented with sesame oil (55.7%) and canola oil (52.3%) compared with their initial body weights. Moreover, Significant increases of body weight gain were observed in rats treated with sesame oil plus malathion (50.3%) and canola oil plus malathion (50.4%). The minimum body weight gain was noted in rats treated with only malathion (36.2%).

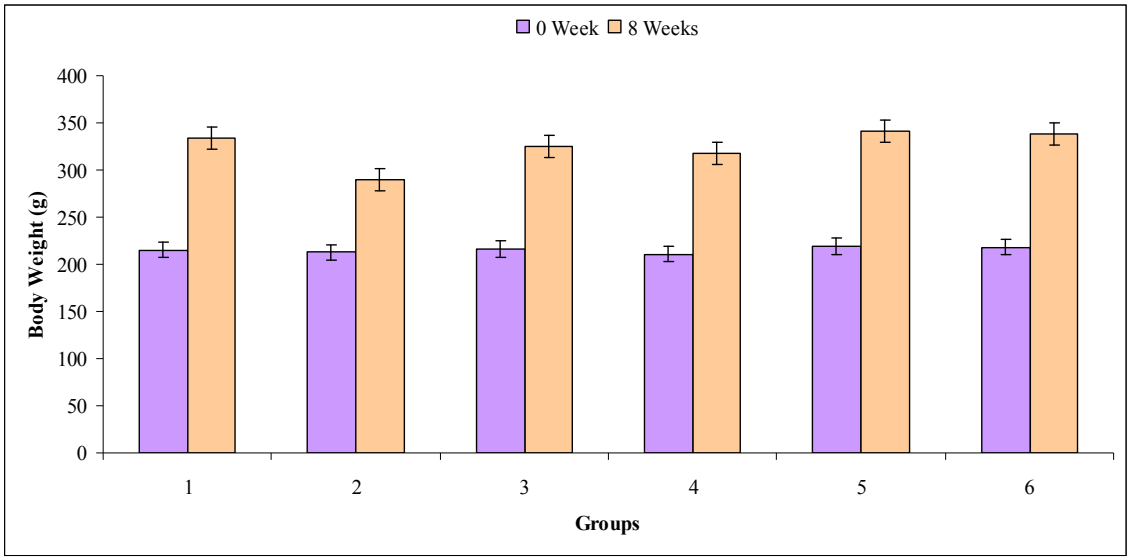

Fig. 1: Changes of body weight after eight weeks in control (group 1), malathion (group 2), sesame oil plus malathion (group 3), canola oil plus malathion (group 4), sesame oil (group 5) and canola oil (group 6) treated rats.

Figures 2-5 demonstrate the values of RBC (Fig. 2), Hb (Fig. 3), Hct (Fig, 4) and WBC (Fig. 5) in all experimental groups. Statistically decreases in the value of RBC ($P < 0.000$), Hb ($P < 0.000$), Hct ($P < 0.000$) and WBC ($P < 0.000$) in rats treated with malathion (group 2). Likewise, rats of group 4 showed significant decreases in the value of RBC ($P < 0.001$), Hb ($P < 0.05$), Hct ($P < 0.05$) and WBC ($P < 0.001$). In rats of group 3, the value of WBC was statistically declined ($P < 0.05$), while the values of RBC, Hb and Hct were notably unchanged. Additionally, no statistically significant difference was observed in the values of RBC, Hb, Hct and WBC normal rats supplemented with sesame oil (group 5) and canola oil (group 6) compared with normal control rats (group 1).

The levels of serum ALT, AST, ALP and total bilirubin are shown in Table 1. The levels of serum ALT were significantly elevated in rats treated malathion ($P < 0.000$), sesame oil plus malathion ($P < 0.05$) and canola oil plus malathion ($P < 0.000$). The levels of serum AST were markedly raised in rats exposed malathion ($P < 0.000$), sesame oil plus malathion ($P < 0.05$) and canola oil plus malathion ($P < 0.001$). Furthermore, statistically increases in the level of serum ALP

were noted in rats treated with malathion ($P < 0.000$), sesame oil plus malathion ($P < 0.05$) and canola oil plus malathion ($P < 0.001$). Serum total bilirubin level was statistically enhanced in rats treated with malathion ($P < 0.000$), sesame oil plus malathion ($P < 0.05$) and canola oil plus malathion ($P < 0.05$). Insignificant alterations of serum ALT, AST, ALP and total bilirubin levels were noted in sesame oil (group 5) and canola oil (group 6) treated rats as compared with normal control rats of group 1.

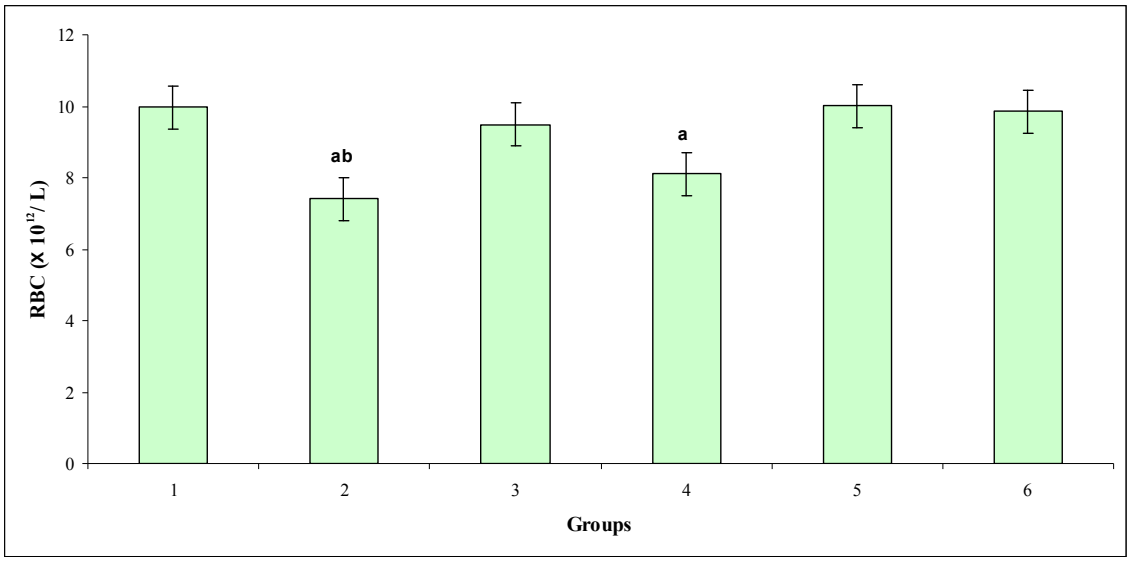

Fig. 2: The value of RBC after eight weeks in control (group 1), malathion (group 2), sesame oil plus malathion (group 3), canola oil plus malathion (group 4), sesame oil (group 5) and canola oil (group 6) treated rats. Data are shown as means ± SD of 8 animals per group. [a]Mean value was significantly different from that of normal control rats. [b]Mean value was significantly different between group 2 and groups 3, 4, 5 and 6.

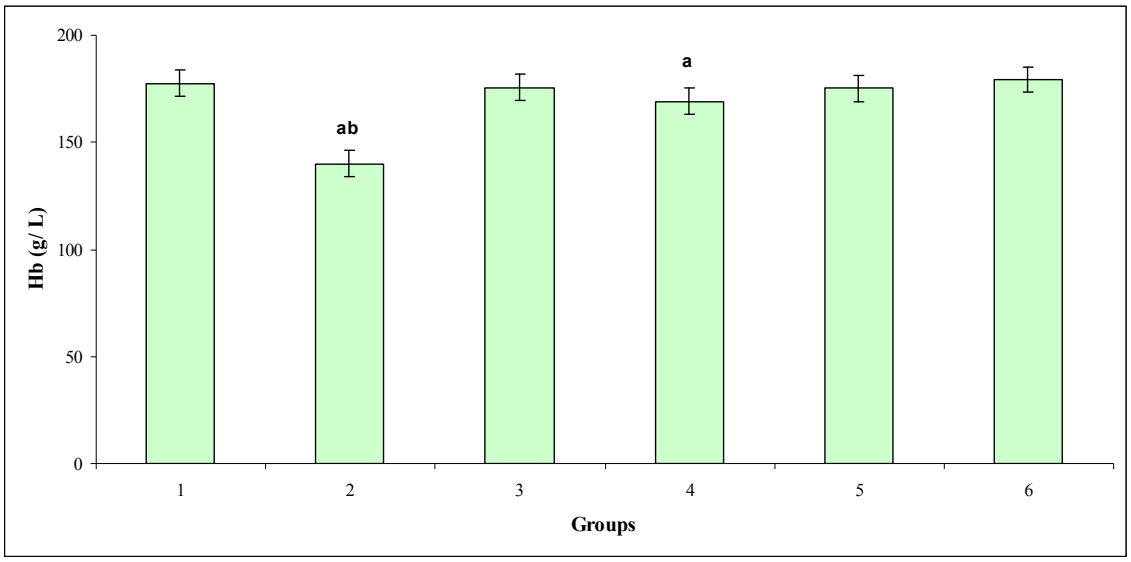

Fig. 3: The value of Hb after eight weeks in control (group 1), malathion (group 2), sesame oil plus malathion (group 3), canola oil plus malathion (group 4), sesame oil (group 5) and canola oil (group 6) treated rats. Data are shown as means ± SD of 8 animals per group. [a]Mean value was significantly different from that of normal control rats. [b]Mean value was significantly different between group 2 and groups 3, 4, 5 and 6.

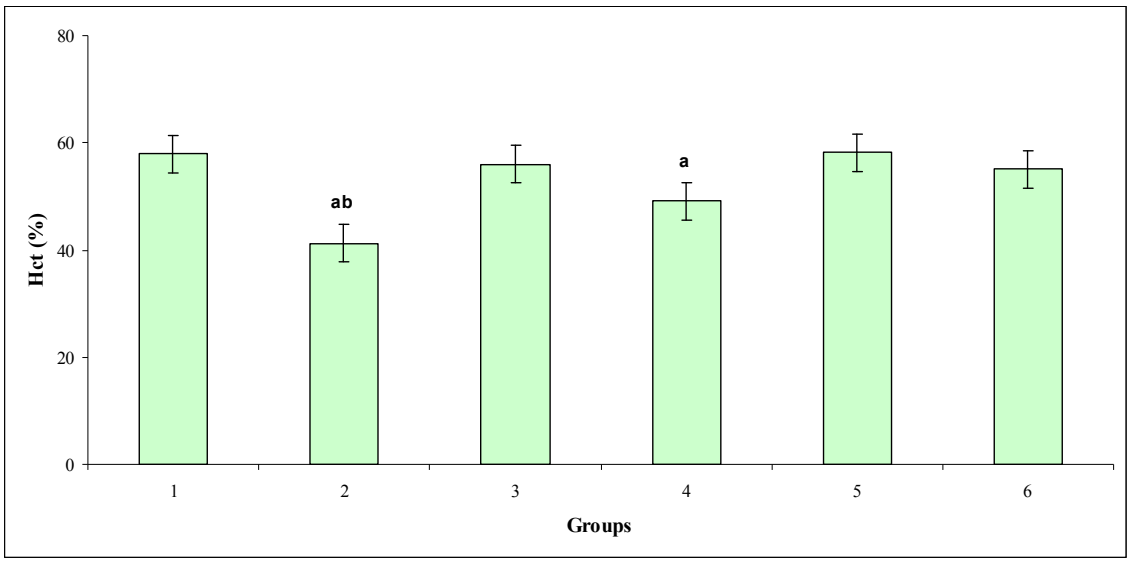

Fig. 4: The value of Hct after eight weeks in control (group 1), malathion (group 2), sesame oil plus malathion (group 3), canola oil plus malathion (group 4), sesame oil (group 5) and canola oil (group 6) treated rats. Data are shown as means ± SD of 8 animals per group. [a]Mean value was significantly different from that of normal control rats. [b]Mean value was significantly different between group 2 and groups 3, 4, 5 and 6.

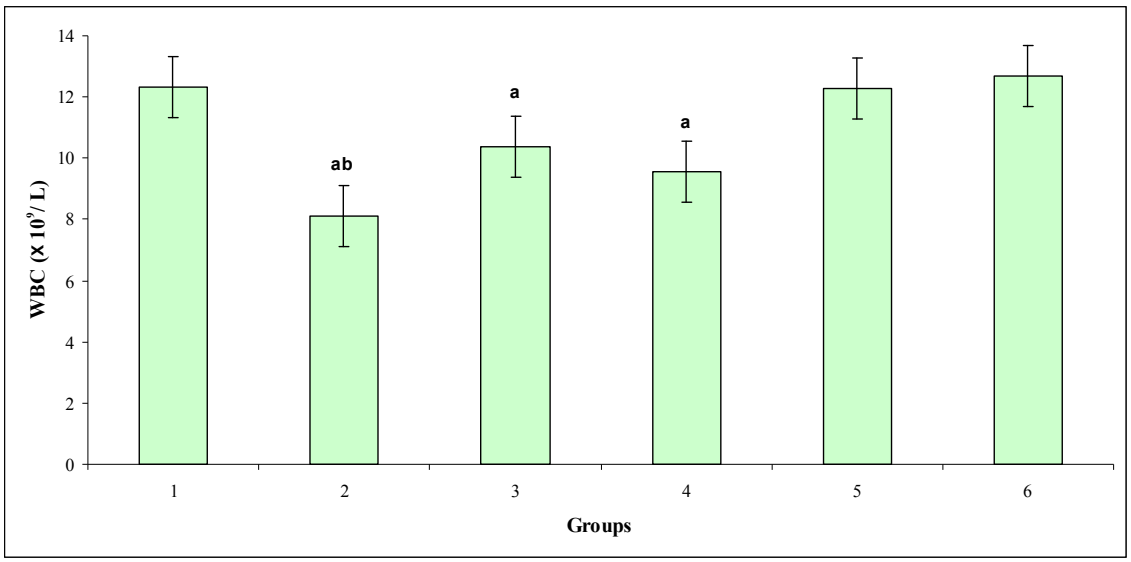

Fig. 5: The value of WBC after eight weeks in control (group 1), malathion (group 2), sesame oil plus malathion (group 3), canola oil plus malathion (group 4), sesame oil (group 5) and canola oil (group 6) treated rats. Data are shown as means ± SD of 8 animals per group. [a]Mean value was significantly different from that of normal control rats. [b]Mean value was significantly different between group 2 and groups 3, 4, 5 and 6.

According to the data shown in Table 2, significant decreases in the levels of serum total protein ($P < 0.05$) and glucose ($P < 0.05$), and statistically enhancement in the levels of serum triglycerides ($P < 0.001$) and cholesterol ($P < 0.000$) were detected in rats exposed to only malathion (group 2). The level of serum total protein was remarkable decreased ($P < 0.05$) and the level of cholesterol was increased ($P < 0.05$), while the levels glucose and triglycerides were unchanged in rats subjected to canola oil plus malathion. In comparison with normal control rats of group 1, the levels of total

protein, glucose, triglycerides and cholesterol were statistically unchanged in rats treated with sesame oil plus malathion (group 3), sesame oil (group 5) and canola oil (group 6).

Statistically, the treatment of rats with only malathion (group 2) showed increases on the level of serum creatinine ($P < 0.000$) and uric acid ($P < 0.001$), while these parameters were significantly unchanged in the rats of groups 3, 4, 5 and 6 as compared with control rats (Table 3). Noticeably increases of serum MDA were observed in rats treated with malathion ($P < 0.000$), sesame oil plus malathion ($P < 0.05$), canola oil plus malathion ($P < 0.001$). Significant decreases in the level of serum CAT were observed in rats treated with malathion ($P < 0.000$), sesame oil plus malathion ($P < 0.05$), canola oil plus malathion ($P < 0.001$). In comparison with control rats, there were no significant alterations were noted in the levels of serum creatinine, uric acid, MDA and CAT in normal rats treated with sesame oil (group 5) and canola oil (group 6) (Table 3).

Table 1: Serum ALT, AST, ALP and total bilirubin levels in control (group 1), malathion (group 2), sesame oil plus malathion (group 3), canola oil plus malathion (group 4), sesame oil (group 5) and canola oil (group 6) treated rats after eight weeks.

Parameters / Groups	ALT (U/L)	AST (U/L)	ALP (U/L)	Total bilirubin (µmol/L)
Group 1	55.20±8.11	95.22±7.42	177.11±12.33	2.12±0.55
Group 2	99.31±12.61[ab]	154.43±11.60[ab]	266.88±13.12[ab]	7.34±1.08[ab]
Group 3	66.70±8.81[a]	112.44±6.76[a]	201.66±10.98[a]	3.33±0.95[a]
Group 4	78.65±7.74[a]	133.60±7.48[a]	233.51±9.78[a]	4.78±1.10[a]
Group 5	53.11±7.54	98.47±6.91	175.33±9.90	2.09±0.43
Group 6	54.23±6.11	92.31±10.70	180.55±7.66	2.14±0.41

Data are shown as means ± SD of 8 animals per group. [a]Mean value was significantly different from that of normal control rats. [b]Mean value was significantly different between group 2 and groups 3, 4, 5 and 6.

Table 2: Serum total protein, glucose, triglycerides and cholesterol levels in control (group 1), malathion (group 2), sesame oil plus malathion (group 3), canola oil plus malathion (group 4), sesame oil (group 5) and canola oil (group 6) treated rats after eight weeks.

Parameters / Groups	Total protein (g/L)	Glucose (mmol/L)	Triglycerides (mmol/L)	Chloesterol (mmol/L)
Group 1	58.44±3.21	4.81±0.88	0.53±0.08	1.11±0.10
Group 2	49.88±4.93[ab]	3.76±0.67[ab]	1.17±0.23[ab]	2.33±0.45[ab]
Group 3	59.11±4.22	5.01±0.58	0.50±0.03	1.01±0.20
Group 4	51.11±2.13	4.71±0.54	0.58±0.11	1.45±0.30[a]
Group 5	59.66±2.48	4.92±.41	0.51±0.04	1.08±0.09
Group 6	60.11±3.17	5.14±0.78	0.49±0.10	1.014±0.12

Data are shown as means ± SD of 8 animals per group. [a]Mean value was significantly different from that of normal control rats. [b]Mean value was significantly different between group 2 and groups 3, 4, 5 and 6.

Table 3: Serum creatinine, uric acid, MDA and CAT levels in control (group 1), malathion (group 2), sesame oil plus malathion (group 3), canola oil plus malathion (group 4), sesame oil (group 5) and canola oil (group 6) treated rats after eight weeks.

Parameters / Groups	Creatinine (µmol/L)	Uric acid (µmol/L)	MDA (nmol/ml)	CAT (U/ml)
Group 1	31.22±1.87	66.14±3.51	14.37±1.54	2.15±0.16
Group 2	55.66±3.95[ab]	93.07±6.61[ab]	27.42±5.12[ab]	1.35±0.08[ab]
Group 3	30.83±2.08	65.71±4.11	18.11±2.78[a]	1.76±0.03[a]
Group 4	33.22±3.41	80.24±3.97	21.70±4.65[a]	1.54±0.05[a]
Group 5	30.44±2.47	62.77±5.10	13.77±1.21	2.21±0.12
Group 6	32.55±2.91	67.83±4.79	15.06±1.80	2.17±0.18

Data are shown as means ± SD of 8 animals per group. [a]Mean value was significantly different from that of normal control rats. [b]Mean value was significantly different between group 2 and groups 3, 4, 5 and 6

Discussion

Pesticides are among the most extensively used chemicals in the world today and they are also among the most hazardous compounds to the human being as well. As pesticides are toxic by nature, they are also potentially hazardous to human, animals, other organisms as well as the environment. A report from World Health Organization (WHO) indicated that over 200,000 people are killed due to the toxicity of these dangerous chemicals every year. Although pesticides are intended to harm only the target pest, if not used correctly, they can also harm to the people or the environment. Pesticide intoxication may be caused either by swallowing accidently, or by inhalation of fumes or by skin contact or accidental eye exposure (Dawson *et al*., 2010; Lee *et al*., 2011; Mostafalou and Abdollahi, 2012; Makris *et al*., 2019). Medicinal plants have been the basis for medicinal treatment through much of human history, and such traditional medicines are still widely practiced today where many people across the world are resorting to these products for treatment of various health challenges in different healthcare settings (Begaa and Messaoudi, 2019).

The present study showed that malathion induced a significant reduction of body weight gain. This result is in agreement with previous studies who demonstrated morphologic and symptomatic modifications in morphometric parameters following exposure to malathion. These changes were characteristic of acetylcholinesterase inhibition including accumulation of acetylcholine and subsequent activation of cholinergic, muscarinic and nicotinic receptors as well as the neurological deficits in experimental animals exposed to malathion (Campana et al., 2008). All these disturbances can lead to various toxic effects in animals, including their feeding ability, and therefore, their metabolisms performances (Farag *et al*., 2000). Moreover, the reduction of body weight may be attributed to the effect of insecticides on gastrointestinal tract resulting in decreased appetite and absorption of nutrients from gut or might due direct toxicity (Venkateshwarlu *et al*., 1997; Sankar *et al*., 2012).

The present study showed that the exposure of rats to malathion caused extensive changes in hematological and biochemical parameters. The obtained data showed that the exposure to malathion caused highly decrease in RBC and WBC counts, and Hb and Hct values. Hematological characteristics have been widely used in the diagnosis of variety of diseases and pathologies induced by different toxicant including pesticides. Previous studies showed that RBC and WBC counts, and Hb and Hct values were significantly decreased in experimental rats exposed to malathion and different pesticides (Moallem *et al*., 2014; Aroonvilairat *et al*., 2018; Kasmi *et al*., 2018; Mohi El-Din *et al*., 2018; Khalifa and Alkhalf, 2019). Shakoori *et al*. (1990) suggested that the decrease in RBC count is either indicative of excessive damage to erythrocytes or inhibition of erythrocyte formation. Reduction in Hb concentration may be due to increased rate of breakdown of red cells and/or reduction in the rate of RBC formation. The present decrease in Hct is attributable to the reduction in RBC count caused either destruction or reduction in size. Decreased WBC was probably due to harmful effects of malathion on bone marrow and hematopoietic organs. Low WBC count (Leukopenia) is usually caused by bone marrow problems especially when exposed to certain chemicals like pesticides which can hurt the bone marrow's ability to make WBC (Okonkwo *et al*., 2019).

Serum ALT, AST, ALP, and total bilirubin are useful biomarkers of liver injury. Scientific reports confirm that, when liver tissues are injured, additional of these parameters were released into the bloodstream and raise their levels. As a result, the amount of these parameters in the blood is directly associated with the amount of liver injured. The results reported in this study are in agreement with previous studies, which indicated that exposure to malathion and other pesticides induced severe adverse biochemical alterations that affect the functional and structural integrity of the liver tissues in experimental animals (Al-Attar, 2010; Al-Attar, 2015; Kasmi *et al*., 2018; Selmi *et al*., 2018; Aboubakr *et al*., 2019; Jalili *et al*., 2019; Khalifa and Alkhalf, 2019).

The present results revealed that the exposure to malathion led to the decline of serum total protein level, while the levels of serum glucose, triglycerides and cholesterol were significantly enhanced. These results are consistent with previous studies which indicated that exposure to malathion and other pesticides induced severe disturbance of proteins, carbohydrates and lipids metabolism (Al-Attar, 2015; El-Beih *et al*., 2017; Selmi *et al*., 2018; Khalifa and Alkhalf, 2019). The decline of serum total protein indicates the presence of para proteins or decreased antibody production. Moreover, this change of serum total protein level may be due an alternation in the

intracellular protein synthesis mechanism and the level of oxidative enzymes in liver. The increase of serum glucose might have been due to the lesser availability of insulin and an inhibition of glycogenolysis and stimulating gluconeogenesis in liver (Petersen *et al*., 2017). The present hyperlipidemia may be attributed to the stimulation of catecholamines, which stimulate lipolysis and increase fatty acid production. The elevation in total serum triglycerides and cholesterol levels that observed in present investigation could be due to blockage of liver bile ducts causing reduction or cessation of its secretion to the duodenum subsequently causing cholestasis. Furthermore, this could be attributed to increased hepatic synthesis and/or diminished hepatic degradation of lipids due to reduced lipoprotein lipase activity (Hassan *et al*., 2010; Kalender *et al*., 2010).

The present study evaluated the kidney function by measuring the levels of serum creatinine and uric acid. These parameters were significantly increased in rats exposed to malathion. The kidney is one of the target organs of experimental animals attacked by pesticides (Al-Attar, 2010; Mansour and Mossa, 2010; Karimani *et al*., 2019). A disorder of kidney function reduces excretion of creatinine, resulting in increased blood creatinine levels. Thus, creatinine levels give an approximation of the glomerular filtration rate. However, it is known that increase of creatinine occurred with renal failure (Hayes, 1994). Previous investigations showed a significant enhancement of blood creatinine, urea and uric acid levels, and renal histological changes in experimental animals exposed to malathion and other pesticides (Al-Attar, 2015; Baiomy *et al*., 2015; Kanbur *et al*., 2016; Li *et al*., 2016; Kaya *et al*., 2018; Muhammad *et al*., 2019).

The present study showed that malathion induced oxidative stress which confirmed by the increase of serum MDA level and the decrease of CAT level. These findings are generally in agreement with previous experimental investigations on animals exposed to malathion and other pesticides (Avci *et al*., 2018; Selmi *et al*., 2018; Uchendu et al., 2018; Aboubakr *et al*., 2019; Jalili *et al*., 2019; Khalifa Alkhalf, 2019). MDA is an end product of lipid peroxidation, and therefore increased concentrations indicate an increase in reactive oxygen species (ROS) concentration and resulting oxidative damage. The enzyme CAT catalyzes the decomposition of H_2O_2 to the much less reactive products oxygen and water. It is a highly conserved enzyme found in nearly all living organisms that are exposed to oxygen. CAT is also an incredibly effective enzyme, having one of the highest turnover numbers known. CAT neutralizes ROS and is therefore considered to be antioxidant enzymes. Cellular antioxidant defense system consists of enzymes such as CAT, superoxide dismutase (SOD), glutathione peroxidase (GPx) and glutathione-S-transferase (GST) and non-enzymatic antioxidants such as MDA. These endogenous antioxidants play an essential role in the direct elimination of free radicals including reactive oxygen and nitrogen species (RONS) which are known to induce oxidative injury in biological components (Sánchez-Valle *et al*., 2012; Li *et al*., 2015). Multiple studies provide evidence of the tendency of pesticides to disturb oxidative balance, which leads to oxidative stress. When an imbalance between free radical production and detoxification occurs, RONS production may overwhelm antioxidant defenses, leading to the generation of a noxious condition called oxidative stress and overall to the impairment of the cellular functions. This phenomenon is observed in many pathological cases. The balance between the production of free radicals and antioxidant defenses in the body has important health implications: if there are too many free radicals or too few antioxidants for protection, a condition of oxidative stress develops, which may cause chronic and permanent damage (Harman, 1999; Grimm *et al*., 2016; Liguori *et al*., 2018).

The present results of this study indicated that sesame oil and canola oil given orally attenuated the extensive alterations in hematological and biochemical parameters in malathion intoxicated male rats. Furthermore, the antioxidant activities of sesame oil and canola oil were confirmed by the present evaluations of oxidative stress markers in rats subjected to malathion toxicity. The protective effects of sesame oil against several chemical toxicants associated with inhibition of the oxidative stress in experimental animals were reported by previous investigations (Liu *et al*., 2015; Soliman *et al*., 2015, Al-Attar *et al*., 2017; 2018). Al-Attar *et al*. (2017; 2018) showed that the sesame oil attenuated the physiological disturbances and histopathological alterations induced by diazinon intoxication in male rats. Moreover, the antioxidant properties of sesame oil support the bioactive role of its protective effects on diazinon toxicity. They suggested that sesame oil could be used as preventive factors against the toxicity of diazinon due to its antioxidant properties. Papazzo *et al*. (2011) showed that canola oil ingestion mediated life span shortening of stroke-prone spontaneously

hypertensive (SHRSP) rats leads to changes in oxidative status. The plasma lipids were reduced after canola oil ingestion highlighting the health benefits of canola oil intake. Despite the improvement in the plasma lipids, canola oil was detrimental to the SHRSP rat as their life span is reduced. Han *et al*. (2017) investigated the effects of canolol (a phenolic compound isolated from crude canola oil) on hydrogen peroxide (H_2O_2)-induced oxidative stress in AGS cells. The pretreatment of AGS cells by canolol resulted in a reduction in ROS and MDA levels. They concluded that canolol effectively protected AGS cells against H_2O_2-induced oxidative stress and its antioxidative effect was significant. Kumar *et al*. (2019) reported that canola oil exerted protective effect against $AlCl_3$-induced neuronal damage, marked by improved spatial memory and improved brain antioxidant status. Canola oil treatment also exerted protective effects toward CAT levels in both hippocampus and frontal cortex. However, it can not excluded that the possibility that sesame oil and canola oil offer protection against ROS-mediated damage by enhancing cellular antioxidant defense and reducing severe hematological and biochemical changes in male rats treated with malathion. From the results of the present study, it can be concluded that sesame oil and canola oil could be used as safe potential natural products in the treatment of malathion toxicity due to their antioxidant properties. Collectively, the most protective effects were observed in rats treated with sesame oil followed by canola oil. Additionally, further hematological and biochemical studies will be required to investigate the effects of different concentrations and doses of sesame oil and canola oil against malathion toxicity.

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