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ORIGINAL ARTICLE

Physiological study on the influence of some plant oils in rats exposed to a sublethal concentration of diazinon

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Abstract The present study was aimed to evaluate the influence of olive, sesame and black seed oils on levels of some physiological parameters in male rats exposed to diazinon (DZN). Body weight changes, and levels of serum total protein, albumin, glucose, triglycerides, cholesterol, high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), very low density lipoprotein cholesterol (VLDL-C), atherogenic index (AI), atherogenic coefficient (AC), cardiac risk ratio (CRR), glutathione (GSH), superoxide dismutase (SOD) and malondialdehyde (MAD) were selected as physiological parameters. The experimental animals were distributed into nine groups. Rats group exposed to DZN and fed with normal diet resulted in pronounced severe changes including reduced body weight gain rate, significantly increase in levels of serum albumin, glucose, cholesterol, LDL-C, AI, AC, CRR and MDA while levels of HDL-C, GSH and SOD were decreased. In rats treated with DZN, the supplementation of the olive, sesame and black seed oils showed remarkable lowering influences of physiological alterations. Moreover, the present results confirmed that these oils possess antioxidative effects against DZN toxicity. Finally, the present findings suggest that these oils are safe and promising agents for the treatment of physiological disturbances induced by DZN and may be also by other pollutants, and toxic and pathogenic factors.

1. Introduction

Currently, the environment and people are continually exposed to numerous environmental pollutants. The majority of pollutants are potentially toxic for organisms, some being connected to disease development. In this context, the increase of chronic degenerative disease including cancer in humans, is of considerable concern (Gupta, 2006). Pesticides are a very important group of environmental pollutants used in intensive agriculture for protection against diseases and pests. The esti-

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mated annual application is more than 4 million tons, but only 1% of this reaches the target pests (Gavrilescu, 2005). Organophosphorus compounds make up about 70% of the pesticides used worldwide. High-level of exposure to these neurotoxins can result in death, while repeated or prolonged exposure can cause delayed cholinergic toxicity and neurotoxicity (Tuovinen et al., 1994). According to World Health Organization (WHO), 3 million cases of pesticide (mainly organophosphorus compounds) poisoning occur every year, resulting in an excess of 250,000 deaths (Banerjee et al., 2014). Of these, about 1 million are accidental, and 2 million are suicidal poisonings (Joshi et al., 2006). Organophosphate insecticides are widely used for the control of agricultural, industrial and domestic pests. However, the uncontrolled use of insecticides has diverse effects on ecological system and public health (Tuna et al., 2011). Diazinon (DZN) is an organophosphorous insecticide widely used in agriculture and pest control in the environment, which can be highly toxic (Poet et al., 2004; Sarabia et al., 2009). DZN is bioactived by cytochrome P450 enzymes through desulphurization to its corresponding oxon derivative (Sams et al., 2004). Additionally, experimental studies showed that the exposures to DZN induced physiological and histopathological changes in rats, mice and rabbits (Kalender et al., 2006; Al-Attar, 2009, 2015; Al-Attar and Al-Taisan, 2010; Sarhan and Al-Sahhaf, 2011; Al-Attar and Abu Zeid, 2013; Boroushaki et al., 2013; Abdel-Daim, 2016; Razavi et al., 2016).

Recently, more attention has been paid to the natural antioxidants owing to its protective effects against the toxicity of various pollutants and pathogenic factors, especially whenever reactive oxygen species (ROS) are involved. Currently, there is a strong interest in developing new therapeutic agents from natural products (Fujimori et al., 2010). Olive oil is an integral ingredient in the Mediterranean diet. Olive oil appears to be a functional food with various components such as monounsaturated fatty acids (MUFA) that may have nutritional benefits. It is also a good source of phytochemicals, including polyphenolic compounds (Visioli and Galli, 1998; Lavelli, 2002). The increasing popularity of olive oil is mainly attributed to its antioxidant and antiinflammatory effects which may help prevent disease in humans (Tuck et al., 2001; Tuck and Hayball, 2002; Covas, 2007). Sesame oil has been employed in the food and pharmaceutical industries due to the high lipids and protein content and its distinctive flavor (Abou-Gharbia et al., 1997, 2000). Sesame oil contains sesamin, sesamolin and sesaminol lignan fractions, which are known to play an important role in its oxidative stability and antioxidative activity (Elleuch et al., 2007). Sesame seeds and sesame oil have long been used as health foods and display multiple physiological functions against different pathological factors and symptoms (Matsumura et al., 1995; Namiki, 1995; Sacco et al., 2008; Philip, 2010; Sharif et al., 2013; Hsu et al., 2016). Black seed has been used in many Middle Eastern countries as a natural remedy (Swamy and Tan, 2000). Black seed is most extensively investigated for therapeutic purposes (Aggarwal et al., 2008). Recently, clinical and animal studies have shown that extract of the black seeds have many therapeutic effects (Al-Attar and Al-Taisan, 2010; Boskabady et al., 2011; Parhizkar et al., 2011; Babazadeh et al., 2012; Hamed et al., 2013; Imam et al., 2016). Therefore, the present study was undertaken to evaluate the effectiveness of olive, sesame and black seed oils as protective factors against DZN-induced physiological alterations in male rats.

2. Materials and methods

2.1. Animals

The experiments were done using male rats of the Wistar strain, weighing 92.8–133.3 g. Rats were obtained from the Experimental Animal Unit of King Fahd Medical Research Center, King Abdulaziz University, Jeddah, Saudi Arabia. The experimental animals were allowed to acclimatize for one week before starting the experimentations. Rats were maintained in controlled temperature (20 ± 1 °C), humidity (65%) and a 12 h dark-light cycle, with balanced food and free access to water. The principles of laboratory animal care were followed throughout the duration of experiment and instruction given by the King Abdul Aziz University ethics committee was followed regarding experimental treatments.

2.2. Experimental protocol

Rats were randomly distributed into nine groups of ten each. The first group was untreated and served as control. The second group was orally treated with 50 mg/kg body weight of DZN in corn oil, daily for 6 weeks. The third group was orally supplemented with olive oil at a dose of 600 mg/kg body weight and after 4 h exposed to DZN at the same dose given to the second group, daily for 6 weeks. The fourth group was orally supplemented with sesame oil at a dose of 600 mg/kg body weight and after 4 h subjected to DZN at the same dose given to the second group, daily for 6 weeks. The fifth group was orally supplemented with black seed oil at a dose of 600 mg/kg body weight and after 4 h treated with DZN at the same dose given to the second group, daily for 6 weeks. The sixth, seventh and eighth groups were orally supplemented with olive, sesame and black seed oils respectively at a dose of 600 mg/kg body weight, daily for 6 weeks. The ninth group was orally supplemented with corn oil at the same dose given to the second group, daily for 6 weeks. The body weights of rats were determined at the start of the experimental period and after six weeks using a digital balance. These weights were measured at the same time during the morning (Al-Attar and Zari, 2010). Moreover, the experimental animals were observed for signs of abnormalities throughout the period of study.

At the end of the experimental period, rats were fasted for 12 h, water was not restricted, and then anaesthetized with diethyl ether. Blood samples were collected from orbital venous plexus in non-heparinized tubes, centrifuged at 2500 rpm for 15 min and blood sera were then collected and stored at −80 °C. The level of serum total protein was measured according to the method of Peters (1968). The level of albumin was estimated using the method of Doumas et al. (1973). The level of glucose was determined using the method of Trinder (1969). To estimate the triglycerides level, Fossati and Prinicip method (1982) was used. The method of Richmond (1973) was used to determine the level of cholesterol. The method of Warnick et al. (1983) was used to measure the level of high density lipoprotein cholesterol (HDL-C). The level of serum low density lipoprotein cholesterol