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Biochemical role of wheat germ and grape seed oils on some organs function alteration induced by chlorpyrifos in rats

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Abstract

The purpose of this study was to assess the biochemical role of wheat germ and grape seed oils as well as avemar on the liver and kidney function tests and the oxidative stress alteration induced by chlorpyrifos in rats; moreover the haematological measurements and histological investigation were studied.

Chlorpyrifos (CPF) is an organophosphate insecticide widely used for a variety of agricultural and public health applications. Chlorpyrifos was added to the different experimental tested diets at two levels, low and high doses (25 and 50 mg/kg diet respectively). Wheat germ oil and grape seed oil were added to the experimental diets at a level of 200 mg/kg diet, while fermented wheat germ (avemar) was added at a level of 3g/kg diet for 30 days experimental period.

Results demonstrated that there were significant decrease in the total counts of RBC's, WBC's, erythrocyte indices, hemoglobin concentration and hematocrit level in experimental rats fed diets containing low and high levels of CPF.

Liver functions is impaired in rats administrated only chlorpyrifos and the results showed a significant increase in enzyme activities such as alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), gamma glutamyl transferase (γGT), while total proteins, albumin, and globulin showed a significant decrease at high and low doses of CPF treated groups but kidney functions results showed a significant increase in serum creatinine and urea levels.

Administration of CPF caused a significant increase in lipid peroxidation level, lipid profile while the activities of superoxide dismutase (SOD), catalase (CAT) and glutathione-s-transferase (GST) were decreased significantly. Also it caused a marker changes in the overall histopathology of liver which could be due to the toxic effect of CPF.

Wheat germ oil, grape seed oil or avemar supplementation caused significant improvement in all results in comparison with those groups administrated CPF.

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Introduction

Environmental pollution from pesticides is an important issue that attracts wide spread public concern. Among them, some pesticides such as organophosphorus compounds commonly used in agriculture for achieving better quality products also have brought tremendous benefits to mankind by increasing food production and controlling the vectors of man and animal diseases. At the same use of these pollutants has posed potential health hazards to the life are toxic substances and lead to generation of reactive oxygen species (ROS) which have harmful effects on human health. (***Tuzmen et al., 2008).***

Chlorpyrifos (CPF) is a broad-spectrum organophosphorus insecticide utilized extensively in agriculture ***(Saulsbury et al., 2009)*** and elicits a number of additional effects, including hepatic dysfunction, haematological and immunological abnormalities, embryotoxicity, genotoxicity, neurotoxicity and neurobehavioral changes ***(Mehta et al., 2009).***

Pesticides, are known to increase the production of reactive oxygen species (ROS), which in turn generate oxidative stress in different tissues ***(Rai and Sharma, 2007; Mehta et al., 2009).*** Chlorpyrifos also induces oxidative stress and the accumulation of lipid peroxidation products in different organs ***(Verma et al., 2007; Mansour and Mossa, 2009).***

ROS may interact with cellular proteins, lipids and DNA, causing alterations in cell function. Many insecticides are hydrophobic molecules that bind extensively to biological membranes, especially phospholipids bilayers ***(Ogutcu et al., 2008)***, and they may damage membranes by inducing lipid peroxidation (LPO) ***(Kalender et al., 2010 ; and Celik and Suzek, 2009).***

Cells have several ways to alleviate the effects of oxidative stress. They can either repair the damage or directly reduce the pro-oxidative state via enzymatic and non-enzymatic antioxidants. Non-enzymatic (vitamins E and C, flavonoids, etc.) and enzymatic (superoxide dismutase (SOD), glutathione peroxidase (GSH-Px) and catalase (CAT) antioxidants have been shown to scavenge free radicals and ROS ***(Uzun et al., 2010).***

Antioxidants have been shown to inhibit free radical formation ***(Durak et al., 2010).*** Human diets also contain phytochemicals, such as flavonoids, that are metabolized by the same pathway as toxic man-made chemicals, such as pesticides and other environmental pollutants ***(Panemangalore and Bebe, 2009).*** The antioxidant properties of flavonoids are due to their ability to directly scavenge some radical species and may also act as chain-breaking antioxidants and/or may recycle other chain-breaking antioxidants, such as alpha-tocopherol, by donating a hydrogen atom to the tocopheryl radical ***(Uzun et al., 2010).***

Grape (*Vitis vinifera*) is one of the world's largest fruit crops and grape seed extract is a complex matrix containing approximately 40% fiber, 16% oil, 11% proteins, and 7% complex phenols including tannins, in addition to sugars, mineral salts, etc. Grape seed oil (GSO) is a well-known dietary supplement, contains important vitamins, minerals, and polyphenols including flavonoids, proanthocyanidins and procyanidins. It has recently become clear that GSO has shown various beneficial pharmacological effects such as its chemoprotective properties against reactive oxygen species and oxidative stress as well as being anti-inflammatory, anti-bacterial, and anti-cancer. Moreover, epicatechin is able to scavenge hydroxyl radicals, peroxyl radicals, superoxide radicals. Procyanidins are reported to have potent antioxidant activity both in vitro and in vivo. ***(Suwannaphet et al., 2010).***

Wheat germ oil, that makes up only 7-12% of the seed, is an excellent source of natural vitamin E and tocopherols, the richest known source in nature. Organic cold-pressed wheat germ oil is a deep orange color, rich in beta carotene, and has a full balance of mixed tocopherols from which vitamin E is derived. Gamma, beta, and alpha tocopherols are all present in the oil making the vitamin E gamma tocopherols are free radical scavengers that give wheat germ oil its potent antioxidant qualities ***(Zhu et al .,2011)***. Wheat germ oil is also rich in unsaturated fatty acids, mainly oleic, linoleic and α-linoleic acids ***(Sjovall et al., 2000)*** and in functional phytochemicals, mainly flavonoids, sterols, octacosanols and glutathione (***Zhu et al., 2006)***. Animal studies show that intake of wheat germ oil results in a rapid increase in the content of vitamin E in the brain, liver, heart, lungs, kidneys, and spleen and gives powerful antioxidant protection to these organs and tissues ***(Mehranjani et al.,2007; and Field et al., 2008).*** Wheat germ oil has been attributed to reduced plasma and liver cholesterol in animals, improved physical endurance, and delayed aging ***(Megahed, 2011).***