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Amelioration of liver and kidney functions disorders induced by sodium nitrate in rats using wheat germ oil

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ABSTRACT

The purpose of this study was to evaluate the effect of sodium nitrate administration on some biochemical parameters and to explore the ability of Wheat germ oil (WGO) as a natural source of antioxidants to minimize the deleterious effects of sodium nitrate.

The results showed significant increase in alanine transaminase (ALT), aspartate transaminase (AST), alkaline phosphatase (ALP) and significant decrease in butyryl cholinestersea (BChE) content in hepatic tissue in nitrate group as compared to control and wheat germ oil groups through the experimental period. Furthermore, there was a significant increase in thiobarbituric reactive substances (TBARS) accompanied by significant decrease in reduced glutathione (GSH) content in rat renal tissue after 28 and 42 days of treatment with drinking water containing sodium nitrate. Significant decrease was also observed in serum estradiol (E2) in group treated with nitrate through the experimental period. In addition, microscopically examination of renal tissue showed atrophy of glomerular tuft and congestion of renal blood vessels in nitrate treated group. Administration of WGO to rats with sodium nitrate suggesting role of WGO as a natural protective antioxidant agent in hepatic and renal tissues. WGO also stimulates estrogen secretion and inhibits oxidative damage that may be attributed to the presence of biologically active components (unsaturated fatty acids, unsaponifible matters and sterols matters) as antioxidant and cyto-protective activities.

It can be concluded that WGO offers a great advantage for therapeutic purpose to minimized sodium nitrate free radical induced cell damage.

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1. Introduction

In recent years, considerable attention has been paid to the problem of nitrate due to the intensive use of nitrates as agricultural fertilizers which reach to humans and animals by different routs (Manassaram, Backer, & Moll, 2006; Mande et al., 2012). Nitrate is a naturally occurring form of nitrogen and is an integral part of the nitrogen cycle in the environment. It is formed from fertilizers, decaying plants, manure and other organic residues. Nitrate is found in air, soil, water, and vegetables food and is produced naturally within the human body (Ogur et al., 2005). In fact certain foodstuffs such as maize, guinea corn, carrots, potatoes, sunflower, pumpkins and cabbage are known to accumulate large quantity of nitrates even at the normal fertilizer application rate of 150 kg/ha (Awodi, Ayo, Nwude, & Dzenda, 2005; Manassaram et al., 2006). It is also used as a food additive, mainly as a preservative and antimicrobial agent (Speijers & van den Brandt, 2003). Due to the increased use of synthetic nitrogen fertilizers and livestock manure in intensive agriculture, vegetables and drinking water may contain higher concentrations of nitrate than in the past (Manassaram et al.,2006).

The major source of nitrate in the human body is through intake of food and water (IPCS, 1999). Vegetables may account for more than 70% of the nitrates in a typical human diet (ATSDR, 2001). Drinking water may contain variable amounts of nitrates which accounts for up to 21% of total nitrates intake in a typical human diet (Manassaram et al., 2006). The presence of nitrate in vegetable as in water and generally in other foods is a serious threat to man's health. Nitrate per se is relatively non toxic (Mensinga, Speijers, & Meulenbelt, 2003), but approximately 5% of all ingested nitrate is converted by microflora in the gastrointestinal tract to the more toxic nitrite (Pannala et al., 2003). Nitrite and N- nitroso compounds which form when nitrite binds to other substances before or after ingestion are toxic and can lead to severe pathologies in humans (Speijers & van den Brandt, 2003). The ability of animals to resist the toxic effects of environmental agents is dependent on the detoxication and antioxidant systems. Recently, several nutrients and other chemicals are effective antioxidants, such as vitamins, trace elements, amino acids and their derivatives, fatty acids and plant phenolics (Ayo, Minka, & Mamman, 2006; Son, Mo, Rhee, & Pyo, 2004; Suteu et al., 2007).

WGO is extracted from the germ of the wheat kernel and is particularly high in policosanol contents specially octacosanol (Irmak & Dunford, 2005) which has been shown to increase physical performance (Kim, Park, Han, & Park, 2003) to be helpful in cholesterol management, chronic inflammatory reactions and neurological disorders (Reddy et al., 2000). Therefore, in recent decades WGO has received much attention in treatment of diseases involving oxidative damage (Blommers, Elisabeth, Deklerk, Piter, & Maiyer, 2002). WGO is a valuable source of essential fatty acids including linoleic acid and alpha lionlenic acid which may be beneficial by increasing endurance, lowering cholesterol levels, and assisting muscular dystrophies and other neuromuscular disorders. WGO may be also changed the intensity of lipid peroxidation processes by stimulating the tocopherol redox-system (Leenhardt, Fardet, Lyan, Gueux, & Remesy, 2008).

WGO is a rich source of natural antioxidant toco-pherols and sterols and also is a rich source of B complex vitamins which may have significant implications in chemoprevention (Jensen, Koh-Banerjee, Hu, Franz, & Sampson, 2004; Lui, 2007). In addition, WGO is a source of easily assailable vitamin E which acts as an inhibitor of oxidation processes in body tissues and protects cells against the effects of free radicals which are potentially damaging by products of the body's metabolism. It is well know that free radicals can cause cell damage that may contribute to the development of cancer (Traber, Vitamin, Shil, Olson, & Shike, 1999). Moreover, WGO not only prevents autoxidation of unsaturated fatty acids but also, generates DNA protective properties (Gelmeza, Kineal, & Yener, 2009).

In view of this consideration, the current study has been designed to investigate the effect of nitrate in a short term experiment (for 42 days i.e 6 weeks) on albino rats and the role of WGO as an antioxidant to counteract the toxic effect of nitrates was taken into consideration.

2. Material and methods

2.1. *Experimental animal*

Forty eight female albino rats weighing 130 ± 10 g obtained from the animal house of Biological Applications Department, Nuclear Research Center, Atomic Energy Authority, Cairo, Egypt were used in experiment. Animals were maintained under normal requirement ventilation, illumination conditions and adequate stable balanced diet and water.

2.2. *Wheat germ oil preparation*

Wheat germ oil (WGO) was packaged as a liquid and was purchased from Arab company for Pharm-Medicinial plants, (MEPACO) Egypt. WGO was given to animals by gavages using stomach tube and was prepared as water emulsion (1.0 ml emulsion 900 mg wheat germ oil/Kg body weight/rat).

2.3. *Experimental design*

Animals were randomly divided into 4 equal groups ($n = 12$)

1 Group 1: Control group: rats received 1.0 ml tap water through stomach tube (placebo treatment) through the experimental period.
2 Group 2: Wheat germ oil group: rats received WGO orally (900 mg WGO/Kg body weight/rat) for five consequence days per week through the experimental periods (28 and 42 days) (Mohamed & Anwar, 2010).
3 Group 3: Sodium nitrate group: rats were supplied with 500 mg sodium nitrate/L in drinking tap water every day through the experimental period (Mohamed & Anwar, 2010; Zaki et al., 2004). Sodium nitrate (NaNo3) was produced from Sigma Chemicals Company, Egypt.
4 Group 4: Wheat germ oil plus sodium nitrate group: rats were supplied with 500 mg sodium nitrate/L in drinking tap water and treated with 900 mg WGO/Kg body weight/rat for five consequence days per week through the experimental periods.