INTRODUCTION

Humans are potentially exposed to pesticides either directly, as workers in green-houses and in agriculture, or indirectly, via food consumption. In addition, it is likely that a significant amount of these pesticides and their metabolites reach rivers and estuaries via run-off from farmland that are potentially toxic to wildlife (El-Shenawy, 2010).

Bacillus thuringiensis (*Bt*) is an aerobic, Gram-positive, spore-forming bacterium that produces a number of insect toxins including protein crystals formed during sporulation (Whiteley and Schnepf, 1986). These crystalline inclusions, or δ-endotoxins, are efficient insecticides that act by disrupting the cell membrane of insect midgut (Gill *et al*., 1992). Other biotechnological studies developed a greater use of *B. thuringiensis* toxins in genetically transformed pest-resistant crops (McGaughey and Whalon, 1992). Maize and several other crops have been bioengineered into transgenic maize hybrids, known as *B. thuringiensis* maize hybrids, to protect the crop against corn borers (Huang *et al*., 1999).

Aerobic organisms generate superoxide anion radical, hydrogen peroxide and hydroxyl radical of which the latter initiates lipid peroxidation in tissues (Oruc and Uner, 2000). The sensitivity of cells to oxidants can be prevented to some extent by antioxidant enzymes such as superoxide dismutase, glutathione peroxidase, catalase, glutathione reductase and glucose-6-phosphate dehydrogenase. These antioxidant enzymes allow only a relatively low rate of production and propagation of the reactive and harmful hydroxyl radical (Shaban *et al*., 2003).

Formulations with *Bacillus thuringiensis* (*Bt*) have been widely used as controlling agents of pests for more than 40 years, which no evidence of harm to humans (Siegel, 2001). The protein crystals are an excellent alternative for pests in agriculture as well as for important vectors of human diseases (Bravo *et al*., 2007). However, there are case reports on allergenic effects as well as asthma, nausea and abdominal pain in workers and nearby residents following crop dusting with biological insecticides made with the subspecies *B. thuringiensis kurstaki* and *B. thuringiensis israelensis* (Levin *et al*., 2005; Tayabali and Seligy, 2000).

Carbamate insecticides are widely used in agriculture and home gardening. They are derivatives of carbamic acid and like organophosphates, their mechanism of action is that of inhibiting the vital enzyme acetylcholinesterase which is reversible as compared to organophosphates which is irreversible (Meister, 1991). Exposure to cholinesterase inhibiting agents is considered a major health problem for the farm workers throughout the world. Methomyl [IUPAC: S-methyl N-(methylcarbamoyloxy) thioacetimidate] is a commonly used monomethyl carbamate insecticide (Clive, 2001) to control a wide range of insects and spider mites through direct contact and ingestion (WHO, 1996). Methomyl is the most common residue found in various food stuffs as a contaminant (Constantinos *et al*., 2005). Several studies indicate that the pesticide intoxication produces oxidative stress by the generation of free radicals and induces tissue lipid peroxidation in mammals and other organisms (El-Demerdash *et al*., 2004; El-Demerdash, 2011; Oruc and Uner, 2000).

The aim of this study:

The present study aimed to investigate the ability of methomyl, the biopesticide; *bacillus thuringiensis* and their combination to induce oxidative stress, biochemical perturbations and histological changes in male rats through determination of:

1. Lipid peroxidation (thiobarbituric acid reactive substances level).
2. Enzymatic and non-enzymatic antioxidant including superoxide dismutase, catalase and glutathione S-transferase activities and reduced glutathione content.
3. Liver function biomarkers including alanine amino transferase, aspartate amino transferase, lactate dehydrogenase, alkaline phosphatase activities in addition to protein and albumin contents.
4. Kidney function biomarkers including urea and creatinine levels.
5. Lipids profile including total cholesterol, triglycerides, high density lipoprotein-cholesterol, low density lipoprotein- cholesterol and very low density lipoprotein-cholesterol levels.
6. Acetylcholinesterase activity.