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Brief communication

Opuntia ficus indica extract protects against chlorpyrifos-induced damage on mice liver

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Abstract

This original study investigates the role of *Opuntia ficus indica* (cactus) cladodes extract against liver damage induced in male SWISS mice by an organophosphorous insecticide, the chlorpyrifos (CPF). Liver damage was evaluated by the measure of its weight and the quantification of some biochemical parameters, such as alanine amino transferase (ALAT), aspartate amino transferase (ASAT), phosphatase alkaline (PAL), lactate dehydrogenase (LDH), cholesterol and albumin in serum by spectrophotometric techniques. The experimental approach lasted 48 h and consisted of 6 treatments of six mice each one; (1) control, (2) 10 mg/kg (b.w) CPF, (3) 10 mg/kg (b.w) CPF with 100 mg/kg (b.w) cactus, (4) 150 mg/kg (b.w)CPF, (5) 150 mg/kg (b.w) CPF with 1.5 g/kg cactus, (6) 1.5 g/kg cactus. Both chlorpyrifos and cactus were administrated orally via gavages.

Our results showed that CPF affects significantly all parameters studied. However, when this pesticide was administrated associated to cactus, we noticed a recovery of all their levels. In the other hand, cactus alone did not affect the studied parameters. These results allow us to conclude firstly that CPF is hepatotoxic and secondly that *Opuntia ficus indica* stem extract protects the liver and decreases the toxicity induced by this organophosphorous pesticide.

Keywords: Liver; Weight; Biochemical parameters; Chlorpyrifos; *Opuntia ficus indica* cladodes

1. Introduction

Liver is a major site for metabolism of exogenous chemicals (pesticides, drugs, metals), resulting in the formation of metabolites which may be more or less toxic than the parent compound. It is also, apart from the gastrointestinal-tract, the first major organ to be exposed to ingested toxins due to its portal blood supply and toxins may be, at least partially, removed from the circulation during the first pass, providing protection to other organs while increasing the likelihood of hepatic injury (Zimmermann, 1978; Miyai, 1991; Moslen, 1996). For these reasons, observation and interpretation of xenobiotics effects on liver should be studied, besides, solutions and ways to protect liver from these intoxications should be investigated. Liver toxicity is monitored in standard toxicity studies by a range of investigations including clinical biochemistry parameters (enzymes, proteins, lipids, etc.). According Solecki et al., 2005 the following endpoints are considered to be mainly related to liver toxicity: its relative weight, Clinical

Abbreviations: ALAT, alanine aminotransferase; ASAT, aspartate aminotransferase; b.w, body weight; CPF, chlorpyrifos; G, group; LDH, lactate dehydrogenase; LD_{50}, lethal dose 50; PAL, phosphatase alkaline; ROS, reactive oxygen species; STEC, Société Tunisienne des Engrais Chimiques (Tunisian Society of Chemical fertilizer).

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biochemistry (total cholesterol and albumin) and more than two enzymes indicative of hepatocellular effects such as (alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase and lactate dehydrogenase).

Chlorpyrifos, abbreviated CPF, C9H11Cl3NO3PS is the active molecule of wide range of organophosphorous insecticides. These pesticides are usually used both in agriculture (Sánchez-Santed et al., 2004) to fight many crops ravagers and in domestic use against harmful insects (Cuany et al., 1993). Follow-up this use, we can be exposed to this chemical as residues in agricultural products (Sun et al., 2006; Atif Randhawa et al., 2007) or by it's inhalation from the air (Cattani et al., 2001). This exposure is known to be harmful for many species, it can cause many damages for human and animal health (Zhao et al., 2005). Its effects on nervous system are well known through the inhibition of the acetylcholinesterase enzyme, which plays an important role in neurotransmission at cholinergic synapses by rapid hydrolysis of neurotransmitter acetyhlcholine in choline and acetate (Garcia et al., 2005). However, its hepatotoxicity is not very explored.

In the other hand, the desertic plant *Opuntia ficus indica* cactus is often pointed out on numerous traditional medicine applications (Park et al., 2001; Kuti, 2004). It can be used as anti-inflammatory, analgesic, hypoglycemic, antiviral and anti-oxidant. For that reason, it can be applied in different pharmacological fields (Mobhammer et al., 2005). This plant is known by the high quality of its fruit. Since, it is very rich in vitamins, carotenoides, fatty acids and essential oil (Felker et al., 2005). The stem of this plant is used in animal (Le Houérou, 1996) and human food (Yasseen et al., 1996) and also in therapeutic use (Saenz, 2000). The polyvalence of this plant enhances us to test its effect against chlorpyrifos effects on liver.

This study aimed firstly to examine the chlorpyrifos effect on liver through its relative weight and some serum biochemical parameters: alanine aminotransferase (ALAT), aspartate aminotransferase (ASAT), phosphatase alkaline (PAL), lactate dehydrogenase (LDH), cholesterol and albumin. Secondly to evaluate the safety and efficacy of cactus stem extract to ameliorate the deleterious effects of this insecticide.

2. Materials and methods

2.1. Chemicals

Chlorpyrifos CPF was purchased as an agricultural product used in our country (Duracid) from STEC (Tunisian Society of Chemical fertilizer, Homologation: 1.01/004). The activities of liver enzymes: alanine aminotransferase (ALAT), aspartate aminotransferase (ASAT), phosphatase alkaline (PAL), lactate dehydrogenase (LDH), and the quantification of cholesterol and albumin were measured by standard kits provided by BioMaghreb.

Young cactus cladodes of *Opuntia ficus indica* (2–3 weeks of age) collected from the local area were washed with water, chopped into small pieces, dried at 37 °C, powdered in and stored at 4 °C until use.

2.2. Animals

During the experiment, 36 male SWISS mice (5–6 weeks old) were used. They were provided from Pasteur institute of Tunisia. These animals were given standard pellets and water ad libitum. They were housed in acclimatized room (22 °C) with a dark/light cycle of 12 h. Animals were divided into 6 groups as follow:

1. Mice given granulated chow and drinking water ad libitum = control group (G1)
2. Mice given CPF at 10 mg/kg (bw) (G2)
3. Mice given 10 mg/kg (b.w) CPF with 100 mg/kg (b.w) cactus (G3)
4. Mice given 150 mg/kg (b.w) CPF (G4)
5. Mice given 150 mg/kg (b.w) CPF with 1.5 g/kg cactus (G5)
6. Mice given 1.5 g/kg cactus (G6)

Both CPF and cactus were dissolved in water and given to animals by gavages. After 48 h of treatment, blood samples were collected from the retro orbital sinus in tubes containing heparin as anti-coagulant in order to determine enzymes activities in serum by spectrophotometric techniques. After, animals were dissected to take theirs livers.

2.3. Statistical analysis

All data were analysed statistically by ANOVA test following by appropriate post hoc tests using STATISTICA software. Statement of significance was based on probability of $p \leqslant 0.05$. Results are given as means ± standard deviation (SD).

3. Results

3.1. Animal survival, body weights and liver relative weight

During experiment, the weights of animals treated only with CPF decreased. However, when cactus stem extract was administrated with CPF, this body weight loss was not observed. Concerning lethality assays, within G4, half of animals died after treatment. But no death occurred in groups treated with chlorpyrifos and cactus. Also, in groups treated only with cactus (G6) we did not notice death.

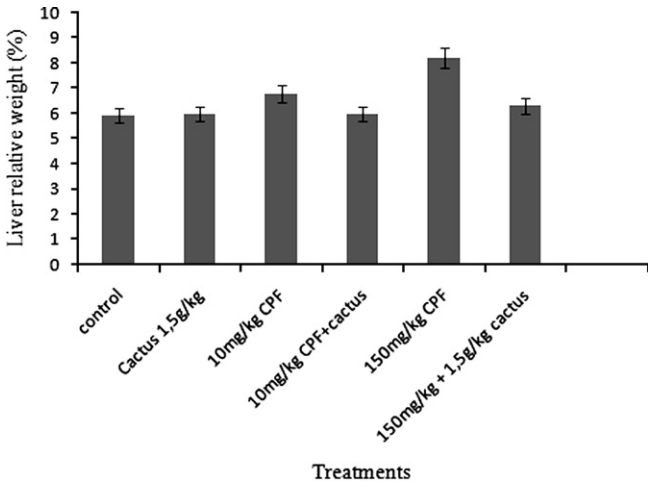

Fig. 1. Variation of liver relative weight with different treatments of CPF and *Opunita ficus indica* extract.