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Histopathologic Study of *Satureja hortensis* Extract on Cadmium Induced Hepatic Lesion in Rat

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Abstract: Cadmium is an ubiquitous environmental and occupational toxic metal concened with a variety of adverse effect. The present study was undertaken to evaluate the role of *Satureja hortensis* in alleviating the Cd induced biochemical cghanges in male rat. During the experiment, rats injected with Cd (3 mg kg^{-1}) subcutaneously alone or with administration extract at different doses (100 and 200 mg kg^{-1}) for 8 weeks. In Cd treated rats, the activities of Aspartate Transminase (AST), Alanine Transaminase (ALT) were significantly increased in serum. Administration of satureja extract along with cadmium significantly decreased the serum. Satureja extract at a dose of 200 mg kg^{-1} was highly effective when compared to other dose (100 mg kg^{-1}).

Key words: Cadmium, *Satureja hortensis*, ALT, AST, variety, Iran

INTRODUCTION

Cadmium is an extremely toxic metal commonly found in industrial workplaces. Due to its low permissible exposure limit, overexposures may occur even in situations where trace quantities of cadmium are found. Cadmium is used extensively in electroplating, although the nature of the operation does not generally lead to overexposures (Syers *et al*., 1986).

Cadmium and its compounds are highly toxic and exposure to this metal is known to cause cancer and targets the body's cardiovascular, renal, gastrointestinal, neurological, reproductive and respiratory systems (Goyer, 1991).

Cd shows various mechanisms of toxicity in particular species under different experimental conditions (Jarup *et al*., 1998). Cadmium is an extremely toxic metal which has no known necessary function in the body. Cadmium toxicity contributes to a large number of health conditions including the major killer diseases such as heart disease, cancer and diabetes. Cadmium displaces zinc in many metallo-enzymes and many of the symptoms of cadmium toxicity can be traced to a cadmium-induced zinc deficiency. Cadmium concentrates in the kidney, liver and various other organs and is considered more toxic than either lead or mercury. It is toxic at levels one tenth that of lead, mercury, aluminum or nickel.

Cadmium toxicity is increasing in incidence today for several reasons. One of the primary reasons is a zinc deficiency in many commonly eaten foods. Zinc which is protective against cadmium is becoming increasingly deficient in the soil and consequently in foods. Food processing and eating of refined foods further reduces zinc intake (Kuhnert *et al*., 1987).

Parenteral administration of cadmium in rats causes a rapid accumulation of cadmium in the liver and at sufficient doses can give rise to severe hepatic injury in the form of hepatocellular necrosis (Andersen and Andersen, 1988).

Apoptosis seems to be a major mechanism for the removal of damaged hepatic cells and constitutes the major type of cell death in nonparenchymal liver cells. Apoptosis of nonparenchymal cells is the basis of the pathogenesis of peliosis hepatis. The first peaks of necrosis and parenchymal cell apoptosis seem to evolve as a result of direct cadmium effects whereas the latter ones result from ischemia.

In recent decades, a large number of plant products Diet composition has been studied as a liver protector (Bernard and Lauwerys, 1984). *Satureja hortensis* L. is an annual, herbaceous aromatic and medicinal plant belonging to the family Lamiaceae. It is known as Summer savory, native to Southern Europe and naturalized in parts of North America. This plant is traditionally used as carminative, digestive, antispasmodic and antitussive in Iran (Zargari, 1990). The aerial parts of some Satureja plants have been widely used in foods for herbal tea and flavor component and in folk and traditional medicine to

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treat various ailments such as cramps, muscle pains, nausea, indigestion, diarrhea and infectious diseases (Zargari, 1990).

Literature review: On essential oil composition in *Satureja* species rich in phenolic components such as carvacrol, terpinene, thymol, p-cymene, aryophyllene, linalool and other terpenoids. Carvacrol (2-methyl-5-(1-methylethyl-phenol) is a predominant Labiatae monoterpenic phenol which occurs in many essential oils of the family including Origanum, Satureja, Thymbra, Thymus and Corydothymus species. So, this study designed to investigate the hepatoprotective properties of carvacrol on induced hepatotoxicity and oxidative damage caused by cadmium in male rats.

MATERIALS AND METHODS

In this study, 30 rats of the same sex, same breed and almost the same weight were selected and randomly divided into 5 groups of 6 each of 5 cages are distributed. Temperature, lighting and environment control, maintenance of rats at 8 weeks of feeding rats through the plates. containing food is done.

Savory herb farm '*Satureja hortensis* families prepared using 70% ethanol solution and soaking and finally concentrated using rotary vacuum to extract and separate the solvent. Animals were randomly divided into 5 groups:

- Group I: only physiological serum levels of 2 mL per kg body weight subcutaneously received
- Group II: with savory extract 200 mg kg^{-1} daily received an subcutaneously
- Group III: which controls the dose of cadmium chloride 3 mg kg^{-1} received a daily subcutaneous
- Group IV: about 3 mg cadmium chloride per kg body weight subcutaneously and 100 mg^{-1} kg savory extract daily received
- Group V: about 3 mg cadmium chloride per kg body weight sub cutaneously and 200 mg kg^{-1} savory received

After 8 weeks the rats by cervical dislocation and their hearts blood samples were taken for biochemical analysis. Complete form of non-Heparinized blood sampling tubes are used. Blood samples were transported to the laboratory immediately following the cold cycle and aspartate Aminotransferase (AST) and alanin Amino Transferase (ALT) were determined from serum samples byusing standard kit.

Statistical analysis: The value are presented as mean±SEM. Differences between group means were estimated using a one way ANOVA followed by Tukey test. Result were considered statistically significant when ($p<0/05$).

RESULTS AND DISCUSSION

The functional marker of liver in serum such as ALT and AST was significant between group 1 and 3. Comparison group 2 and 4 showed a significant relationship between the levels of these two enzymes AST and ALT. Also, a significant relationship between the level of 0.09 between the 1st and 4th group was seen.

By comparing the results of enzyme AST and ALT in group 5 with group 1, this will result in group 5 because of the use of high doses of cadmium and savory highest inhibitory effects were observed in this group. The enzymatic results showed a significant relationship between group 3 and group 5 ($p<0.05$) (Table 1).

Histopathological assement: The liver tissues of rat intoxicated with $CdCl_2$ alone showed cell swelling and necrotic hepatocyte that replaced by inflamatory cells (Fig. 1a and b). The microscopic examination of the liver in rats treated with *Satureja hortensis* showed no characteristic histological changes except their normal architecture or pattern (Fig. 2).

Rat treated with $CdCl_2$ and low dose of *Satureja hortensis* extract showing near normal architecture with very mild inflammatory cells (Fig. 3). Cadmium and high dose *Satureja hortensis* extract treated rat showing rather normal structure of liver tissues (Fig. 4).

Cadmium is a very toxic metal and an important environmental pollutant which is present in the soil, water, air, food and in cigarette smoke. Cadmium causes poisoning in various tissues (Liver, kidneys and testes) of humans and animals (Stohs *et al*., 2000).

Active radical such as superoxide, hydroxyl and hydropraxil ability to remove hydrogen atoms from saturated fatty acid chain and production of biological membrane damage and lipid peroxidation. Enzymatic and non-enzymatic mammalian cells have the ability to bind to the free radicals are. Ability of other enzymes including vitamin a, vitamin C and beta-carotene (ATSDR, 1999).

Also, cadmium chloride induces a significant elevation of the levels of transaminases, urea and creatinine that indicates dysfunction of both liver and kidneys in addition to testes. The damages caused by

Table 1: Effect of ethanol extract of satureja hortensis on liver tissues of cadmium toxicity in rat

Groups	1	2	3	4	5
AST	56.12±4.42	58.33±5.92	78.26±8.08	70.43±6.56	65.61±5.60
ALT	26.16±2.04	27.08±2.60	36.44±2.13	32.42±2.41	28.61±1.42

Values are mean±SE from each group; Group indicated with different number (1-5) in the same line statistically significant ($p<0.05$)

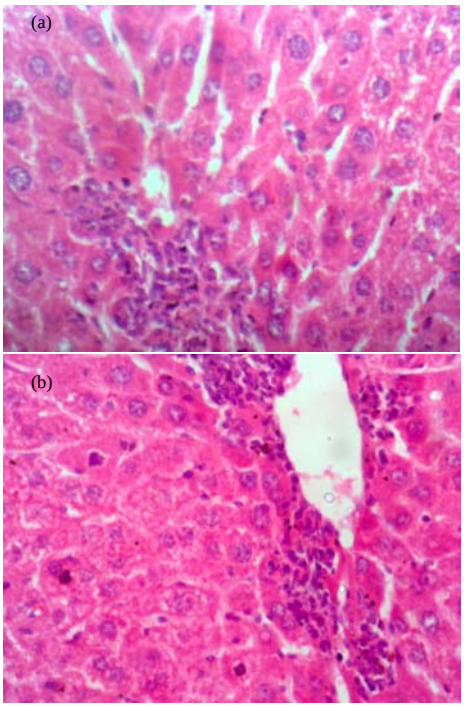

Fig. 1: Intoxicated with cadmium chloride alone showing cell swelling and infiltration of inflammatory cells

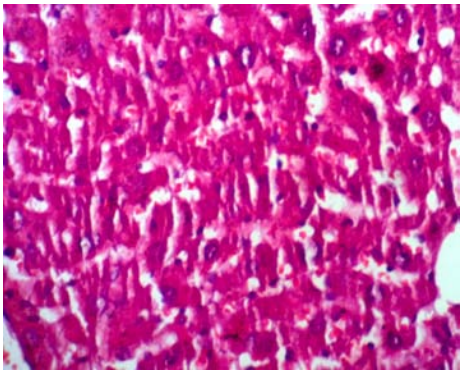

Fig. 2: Liver of rat, treated with garlic extract alone showing, normal structure of liver tissues

cadmium were histologically in the form of vacuolar hydropic as well as fatty changes of the hepatocytes, renal tubular and testicular cells that finally, showed sloughed. These results were coincide with those reported by many investigators (Gunn *et al*., 1963).

A possible explanations for cadmium toxicity are cadmium induced damage via production of free radicals that alter mitochondrial activity and genetic information. The cellular damage showed in liver, kidneys and testes in the present study results from cadmium binding to SH the production of lipid peroxides group in tissues and the

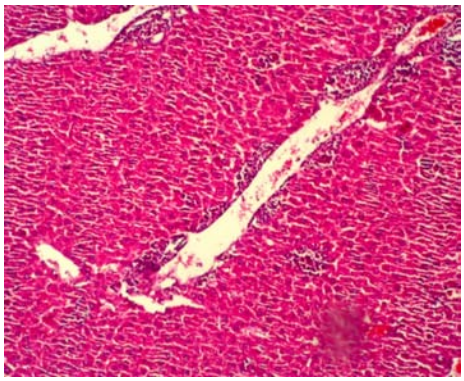

Fig. 3: Cd and low dose *Satureja hortensis* treated rat showing mild inflammatory cells and not effectively useful

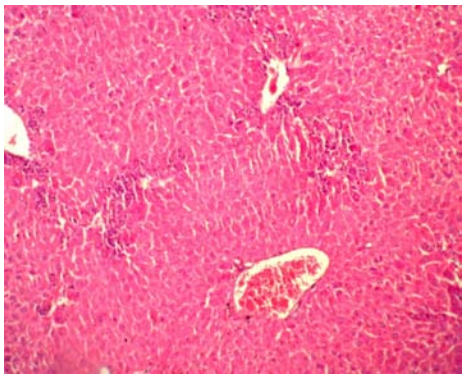

Fig. 4: Cd and high dose *Satureja hortensis* extract showing normal structure of liver tissues

depletion of the glutathione besides inhibition of the activity of antioxidant enzymes (Sarkar *et al*., 1995).

In the present study protective effect of *Satureja hortensis* with different doses on camium toxicity in liver were examined. ALT and AST comparison showed that the enzyme levels were higher in group 3 than in group 4. This difference was due to the degeneration and destruction of hepatocytes enzyme by cadmium in group 3. A comparison of groups 1 and 3 showed significant enzyme changes between the two groups. The difference between the enzyme is due to of cells in degeneration and destruction group 3.

By comparing the results in group 5 with group 1 enzymes suffering that will result in group 5 because of the use of high doses of savory savory inhibitory effects were most evident. Research has shown that phenolic compounds in medicinal plants can reduce toxic effects of the drug on the liver and preventing the release of enzymes glutamic pyruvic acid and transaminase and

alkalin phosphatase into blood. Marchishin (1983) efficasy of the blood compounds of Arnica in to in toxicelesion of the liver.

Satureja hortensis are edible in the raw and cooked foods to be consumed. There are four chemical composition analgesic. It also has proven anti-oxidant effects. There are numerous reports that the anti-inflammatory effects of the herb to treat burns and its inhibitory effect on tumor growth have been published (Abdollahi *et al*., 2003).

Gulcan and collegues showed that essential oil of *S. cilicica* could be used as both natural antioxidant and aroma agent in butter (Ozkan *et al*., 2007). Antioxidant and antimicrobial activity of *Satureja montana* L. extracts was determined in 2011. The findings indicate that the bioactive extracts of *S. montana* have strong potential for use as natural antimicrobials and antioxidants in the preservation of processed food (Serrano *et al*., 2011).

CONCLUSION

It can be interpreted that *Satureja hortensis* extract can be protect cadmium toxicity in rat liver.

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