Hepatoprotective Effects of Coriandrum Sativum Essential Oil Against Acute Hepatotoxicity Induced by Carbon Tetrachloride on Rats

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ABSTRACT

The aim of this study was to evaluate effect of *Coriandrum sativum (CS)* essential oil in rat model of carbon tetrachloride (CCl_4) induced liver toxicity. Experimental groups were formed as follows: isotonic saline solution (ISS), silibinin, CS-1 (0,3ml/kg), CS-2 (0,6 ml/kg). Agents were administered intraperitoneally. Blood and liver tissues were collected at the end of the study ended. Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels were measured. Liver tissues were evaluated histopathologically. One-way analysis of variance (ANOVA) was used for statistical analyses.As a result silibinin and CS-2 decreased blood AST and ALT levels of their groups and these biochemical results were supported by histopathological results. In conclusion this study has provided evidence that *Coriandrum sativum* essential oil has significant hepatoprotective effect on carbon tetrachloride induced liver toxicity in rats.

Keywords: *Coriandrum sativum*, hepatoprotective activity, carbon tetrachloride, rats, essential oil.

INTRODUCTION

Taking advantage of plants to treat diseases is becoming a popular and widespread topic. Also in Turkey, studying pharmacological and toxicological activity of plants is an increasing trend. Although Turkey has limited economic resources and drug production facilities through the synthesis could not come to an adequate level, it has a wide flora. It would be a rational approach for countries like Turkey to use natural sources for medicine development and encourage the society to utilize them[1].

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Coriandrum sativum L. (CS) (kişniş, aşuti) belongs to Apiaceace (Umbelliferae) family[2,3]. It is a herbaceous plant which grows annually and has a 20-60 cm height. Spice of CS contains volatile oil, tanin, resin and sugar. The volatile oil is colorless liquid with light-yellow color which is obtained by water vapor distillation with 0.3-0.4% yield. Major ingredients of the volatile oil are: 60-70% linalool, 6% γ-terpinen, α-pinene, camphor, geraniol, p-cymene, geranyl acetate, limonene, aldehydes, esters and alcohols. It is useful in food industry as spice, tincture and alcoholic/non-alcoholic beverages beside this perfumery and cosmetics industries use CS too[3]. It helps flatulence and indigestion[2]. In Turkish folk medicine, it is reported to be used as hepatoprotective and analgesic (head and tooth ache). Additionally the usage of this genus plants against dizziness, pharyngitis, glossitis, urinary tract infections, hemorrhoids, dysentery, urticaria and apht have been recorded[4].

According to literature CS is a very effective anxiolytic in mice[5], has antibacterial effect against *Escherichia coli*, *Bacillus megaterium* and *Salmonella choleraesuis*[6,7], can reduce cholesterol and triglyceride levels in rats[8]. In addition CS has a potent antioxidant activity (more potent than ascorbic acid) [9], effective in the treatment of inflammatory bowel diseases[10], has insulin-like activity in streptozotocin-induced diabetic rat model[11]. Lastly CS can cause abortus in pregnant rats related with the significant decrease in the progesterone levels in the 5th day of the pregnancy[12].

There is not sufficient data about hepatoprotective activity of CS in the literature. In current study CS was investigated for the potential hepatoprotective activities on carbon tetrachloride induced liver toxicity in rats.

METHODOLOGY

Plant materials

Coriandrum sativum L., was collected from different parts of Turkey. The taxonomic identification of the plants was confirmed by a botanist. Voucher specimens are kept in the laboratory (sample number: B-17). Seeds of the plant were boiled in the Clevenger apparatus. Essential oil which was collected from apparatus was stored in the laboratory tubes. Yield of the essential oil was 0.2%.

Chemicals

Carbon tetrachloride (CCl_4) obtained from Merck KgA (Darmstadt-Germany) and silibinin was provided from Sigma (Steinheim, Germany). CCl_4 was dissolved in the olive oil (v/v, 1:1) which was obtained from Fluka (Steinheim-Germany).

Animals

Male and female Sprague–Dawley rats (200-300 g) were used in this experiment and they were obtained from the Animal House. The animals were housed in standard plastic cages at room temperature (22±2 °C), with artificial light from 7.00 am to 7.00 pm, and provided with pelleted food and water *ad libitum*. The study protocol was approved by the Ethical Committee.

Hepatoprotective activity assay

Animal groups were designed as follow (n=6): Control group 1 received isotonic saline solution (ISS) 0.2 mL, Group 2 received CCl_4(0.8 mL/kg), Group 3 received silibinin (50 mg/kg) + CCl_4 (0.8 ml/kg), Group 4 received CS-1 (0.3 ml/kg)+CCl_4(0.8 mL/kg), Group 5 received CS-2 (0.6 ml/kg) + CCl_4(0.8 ml/kg) i.p. daily for seven days. Doses of CS were determined according to the study of Ozbek et al.[13]. Blood and liver samples were collected after seven days treatment and the serum was used for the assay of the marker enzymes aspartate aminotransferase (AST) and alanine aminotransferase (ALT).

Histopathological examination of the liver

The livers of the experimental animals were extracted after scarifying the animals and fixed in 10% neutral buffered-formalin prior to routine processing in paraffin-embedded blocks. Sections (4 μm thick) were cut and stained using Hematoxylin-eosin (HE). Histological damage was expressed using the following score system; 0:absent; +:mild; ++:moderate; +++:severe[14].

Statistical Analyses

Results are reported as mean±SEM (standard error of mean). One-way analysis of variance (One-way ANOVA; post-hoc Dunnett t ad LSD) was used for statistical analyses. Probability levels of less than 0.05 ($P<0.05$) were considered significant.

RESULTS AND DISCUSSION

Plasma AST and ALT levels of the groups were given in Table 1.

Histopathological examination results were exhibited in Table 2, Figure 1 and Figure 2.

This study provided evidence that CS essential oil has significant hepatoprotective effect on CCl_4induced liver toxicity in rats.

According to the Kumar et al. water-extract of CS leafs has hepatoprotective activity in mice model of profenofos induced liver toxicity[15]. Furthermore, in a study which was conducted by Pandey et al. ethanol extract of CS provided protective activity against carbon tetrachloride induced liver toxicity on rats[16]. Results of

these studies which were performed with different CS extracts supported our study which was conducted with CS essential oil. Beside these, Cioanca et al. stated that CS essential oil has antioxidant activity[17]. Hence, hepatoprotective activities can be related with the antioxidant properties of CS.

According to Samojlik et al. oral administration (0.03 g/kg) of CS essential oil to mice with CCl_4 induced liver toxicity did not produce hepatoprotective activity[18]. This result is in conflict with our findings and the findings of other studies mentioned above. This dilemma may be related with the species of the animals (Samojlik et al. used mice whereas we used rat). Samojlik et al. only administered a single dose which was 0.03 g/kg CS which may be inadequate for the activity. In accordance with this view, in our study although hepatoprotective activity in 0.3 mL/kg was not significant, the effective dose was 0.6 mL/kg. Additionally Samojlik et al. administered CS extract not intaperitoneally which may also change the results. Since, in oral route CS extract may be changed chemically in gastric acid, and also elimination in liver after duodenal absorption may be possible. However pharmacokinetics in i.p. is similar to i.v. route since there is no gastrointestinal absorption period and first pass effect.

Linalool, γ-terpinen, α-pinene, camphor, geraniol, p-cymene, geranyl acetate are reported as the major molecules of CS essential oil. Hepatoprotective effect of CS can be related with one or more molecules that are mentioned above. In further studies, all chemical molecules that are mentioned above should be studied separately to detect the molecule(s) which is/are responsible from the hepatoprotective effect.

Table 1: Effects of CS essential oil on serum levels of AST and ALT.

Uygulama	ALT		AST	
	Serum (U/L)	95 % CI	Serum (U/L)	95 % CI
Control (ISS)	48.8±2.9	41.43 – 56.24	164.5±10.8	136.67 – 192.33
CCl_4	[a] 1068.3±55.3	937.40 – 1199.10	[a] 1682.6±96.1	1455.29 – 1909.97
Silibinin	[ab] 406.5±56.5	261.21 – 551.79	[ab] 732.0±64.8	565.57 - 898.43
CS-1 (0.3 mL/kg)	[a] 992.2±294.4	235.32 – 1749.91	[a] 1619.7±456.8	445.43 – 2793.91
CS-2 (0.6 mL/kg)	[ab] 663.0±84.0	429.85 – 896.15	[ab] 765.0±58.4	602.93 – 927.07
F/p	9.983/0.001		10.125/0.001	

a: $p<0.05$ compared to control (ISS)
b: $p<0.05$ compared to CCl4

Table 2: Histopathological changes in the liver of rats.

Groups	Microscopic Observation			
	Ballooning degenerations and steatosis	Apoptosis and/ or necrosis	Bridging necrosis	Average score*
Control (ISS)	0	0	0	0/6=0.00
CCl_4	15	14	13	42/6=7.00
Silibinin	7	8	4	19/6=3.17
CS-1	12	12	10	34/6=5.67
CS-2	10	9	7	26/6=4.33

* Average score = Total score / n

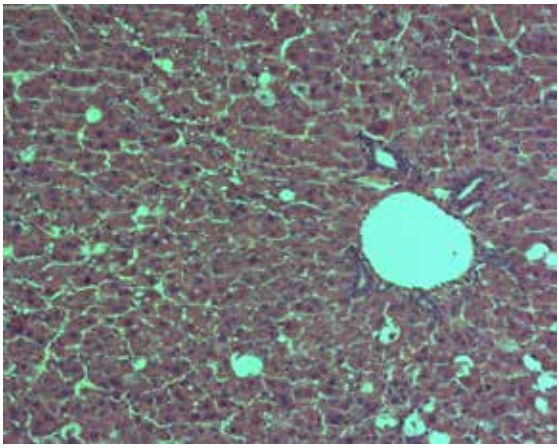

Figure 1: CS-1 0.3 mL/kg (HE x 20)

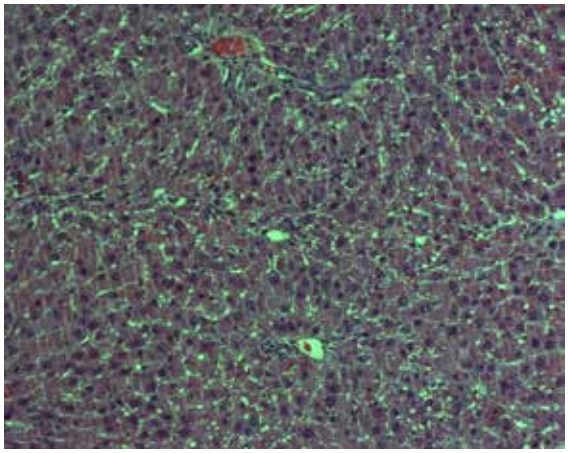

Figure 2: CS-2 0.6 mL/kg (HE x 20)

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