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Preliminary Study on Hepatoprotective Activity of Tomato (*Solanum lycopersicum* L.) Pulp Against Hepatic Damage in Rats

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Abstract: Tomato was evaluated for its liver protective role against carbon tetrachloride (CCl_4) induced liver damage in Wister albino rats. Animals were orally treated with tomato pulp (20 and 40 mL/kg body weight) for seven days followed by intraperitoneal injection (2 ml/kg) of 50% v/v $CC1_4$ on the last day. The degree of protection was determined by measuring levels of serum biochemical parameters such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP) and total bilirubin. A hepatotoxic dose of CCl_4 (2 mL/kg) significantly raised ($P<0.05$) the serum AST, ALT, ALP and total bilirubin levels to 345.8 ± 17 U/L, 243.0 ± 13 U/L, 814.0 ± 12 U/L and 1.75 ± 0.56 mg/dL (n = 5), respectively, compared to respective control values of 193.2 ± 15 U/L, 122.5 ± 16 U/L, 449.0 ± 50 U/L and 0.78 ± 0.20 mg/dL. Pretreatment of rats with tomato pulp (40 mL/kg) significantly ($P<0.05$) lowered the respective serum AST, ALT and ALP levels to 281.8 ± 15 U/L, 187.4 ± 6.2 U/L and 613.0 ± 42 U/L. In conclusion results revealed that tomato pulp significantly reduced the CCl_4 induced hepatotoxicity.

Key words: Hepatoprotective · CCl_4 · Liver damage · Tomato pulp · AST · ALP · ALT

INTRODUCTION

The liver plays an essential role in the metabolism of foreign compounds entering the body. Human beings are exposed to these compounds through environmental exposure, consumption of contaminated foods or exposure to chemical substances in the occupational environments. In addition human beings consume a lot of synthetic drugs during disease conditions which are alien to the body organs. All these compounds produce a variety of toxic manifestations. The liver is the most common site of damage as it is the first major organ to be exposed to ingested chemicals due to its portal blood supply. Although chemicals are delivered to the liver to be metabolized and excreted, this frequently leads to the activation of the chemical, causing liver injury.

In spite of tremendous scientific advancement in the field of hepatology in recent years, liver problems are on the rise. Jaundice and hepatitis are two major hepatic disorders that accounts for a high death rate [1]. Conventional medicines that are used in the treatment of liver diseases are often not adequate and also do not provide many remedies. It is therefore necessary to search for alternative drugs for the treatment of liver diseases to replace the currently used drugs which are of doubtful efficacy and safety.

Tomato (*solanum lycopersicum* L.) is one of the most important vegetables worldwide because of its high consumption, year round availability and large content of health related components. The consumption of tomatoes has been proposed to reduce the risk of several chronic diseases such as cardiovascular diseases and certain types of cancer and especially prostate cancer [2, 3]. In addition, tomato consumption leads to decreased serum lipid levels and low density lipoprotein oxidation [4]. These health protective effects have been widely attributed to the presence of key antioxidants such lycopene, β-carotene, vitamin C, quercetin glycosides, naringenin chalcone and chlorogenic acid. All of these are known to contribute significantly to the antioxidant activity of tomato fruit [3, 5]. This preliminary was therefore designed to study the hepatoprotective activity of tomato in carbon tetrachloride induced – liver damage in rats.

MATERIALS AND METHODS

Extract Preparation: Fresh ripe tomato fruits (500g) were washed, seeds removed and the pulp homogenized using a blender. The homogenate was then stored in a refrigerator at 4°C until used.

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Animal Treatment: Wister albino rats, weighing between 150-170g were acclimatized to conditions in the laboratory for 2 weeks prior to the commencement of the treatment, during which they received food and tap water ad libitum. The rats were then divided into four groups of eight rats each. The normal group (group 1) was given distilled water orally at 10 ml/kg body weight once daily for 7 days in succession followed by olive oil by intraperitoneal injection (i.p) at 2 ml/kg on the last day, 1 hour after distilled water administration. The control group (group 2) was administered distilled water similarly followed by 50% v/v $CC1_4$ in olive oil i.p. at 2 ml/kg on the 7th day, 1 hour after distilled water administration. Experimental groups (groups 3 and 4) were treated orally with 20 and 40 ml/kg of tomato pulp respectively once daily for 7 days in succession followed by a single administration of 50% v/v $CC1_4$ in olive oil i.p. at 2 ml/kg on the last day, 1 hour after tomato pulp treatment.

Assessment of Liver Functions: Twenty-four hours after the intraperitoneal administration, all the rats were sacrificed under light ether anesthesia, blood was collected in sterile centrifuge tube and allowed to clot. Serum was separated by centrifuging at 5000 rpm for 10 min and used for the estimation of biochemical parameters such as serum AST, ALT, ALP and total bilirubin [6-8].

Statistical Analysis: The results are expressed as mean ± S.E.M. and all statistical comparisons were made by means of Student's t-test. $P < 0.05$ was regarded as significant.

RESULTS

As shown in Table 1, the results of biochemical parameters revealed elevation of serum total bilirubin level and enzyme activities in CCl_4 treated group, indicating liver damage. The tomato pulp (40 ml/kg) significantly reduced ($P<0.05$) the activities of AST, ALT and ALP as compared to the control group. There was also a significant reduction in the level of total bilirubin in the serum of rats treated with tomato pulp (40 mL/kg) as compared to the control group.

DISCUSSION

Carbon tetrachloride is one of the most commonly used hepatotoxins in the experimental study of liver diseases since the changes associated with CCl_4-induced liver damage is similar to that of viral acute hepatitis. In the liver, CCl_4 is activated by microsomal oxidizing systems to form trichloromethyl radical (CCl_3) which cause lipid peroxidation and subsequent hepatocellular damage [9,10]. When liver cell plasma membrane is damaged, a variety of enzymes normally located in the cytosol are released into the blood stream. Measurement of the activities of serum marker enzymes, like AST, ALT and ALP, as well as level of serum total bilirubin has provided a powerful tool for the assessment of liver function [10, 11]. The enhanced serum levels of ALT, AST, ALP and total bilirubin observed in CCl_4-treated rats in this study is an indicative of liver damage induced by the toxin.

Tomato pulp (40 ml/kg) significantly reduced the hepatospecific enzyme levels ($P<0.05$) compared to the control group (CCl_4 treatment alone). The reduction in the levels of AST and ALT by tomato pulp toward their respective normal values is an indication of stabilization of plasma membrane as well as repair of hepatic tissue damage caused by CCl_4. This is in agreement with the commonly accepted view that serum levels of transaminases return to normal with the healing of hepatic parenchyma and regeneration of hepatocytes [12]. ALP is the prototype of the enzymes that reflects the pathological alteration in the biliary flow [13]. CCl_4 induced elevation of this enzymatic activity in serum is in line with high level of serum bilirubin content. The extract mediated suppression of the increased ALP activity with the concurrent depletion of raised bilirubin level suggests the possibility of the extract being able to stabilize biliary dysfunction in rat liver during chronic hepatic injury with CCl_4.

Table 1: Effect of tomato pulp on serum biochemical parameters in CCl_4-induced hepatotoxicity in rats

			Experimental groups (CCl_4 + tomato pulp)	
Biochemical parameters	Normal (vehicle)	Control (vehicle + CCl_4)	20 ml/kg	40 ml/kg
ALT (U/L)	122.5 ± 16.0	243.0 ± 13.0 *	215.0 ± 9.0	187.4 ± 6.2[a]
ALP (U/L)	449.0 ± 50	814.0 ± 12.0 *	724.40 ± 20.0	613.0 ± 42.0[a]
AST (U/L)	193.2 ± 15.0	345.8 ± 17.0 *	304.6 ± 17.0	262.8 ± 15.0[a]
BILIRUBIN	0.78 ± 0.20	1.75 ± 0.56 *	1.36 ± 0.40	1.12 ± 0.70[a]

(mg/dL) Results are expressed as mean ± S.E.M. of 8 animals. *$P < 0.05$ compared to normal group; [a]$P < 0.05$ compared to control group

Tomato has high contents of lycopene and bioflavonoids which have the potential to minimize the deleterious effects of free radicals and thereby can be ranked among hepatoprotective agents. In conclusion, the preliminary results of this study suggest that the pulp extract of tomato possess hepatoprotective activity against CCl_4 induced liver damage. This hepatoprotective action of tomato pulp may be due to its membrane stabilizing effect on hepatic cells. Further studies on different types of extracts to identify the specific active principle responsible for the hepatoprotective action is been conducted.

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