HEPATOPROTECTIVE EFFECT OF CINNAMON ON CHOLESTEROL INDUCED FATTY CHANGES IN ALBINO RATS

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ABSTRACT

OBJECTIVE: To evaluate the hepatoprotective effect of cinnamon powder in albino rats after inducing hyperlipidemia

STUDY DESIGN: Experimental study

PLACE AND DURATION: Department of Pharmacology, Al-Nafees Medical College, Islamabad and National Institute of Health (NIH), Islamabad, Pakistan, from 15th October 2012 to 15th March 2013.

METHODOLOGY: For this study 90 adult albino rats of either sex with average weight of 210 ± 11 grams were divided into three groups i.e. A (Untreated Control), B (Treated Control), C (Treated Group). Hyperlipidemia was induced in rats with cholesterol (400mg/Kg body weight of rat) mixed with the routine rat feed. All the groups received atherogenic feed for 0-15 days except group A, which was kept on atherogenic feed for the whole duration of the study. Cinnamon bark powder equivalent to 6gm/kg was administered to the rats of group C for 15-60 days. Simvastatin was administered to group B at the dose rate 0.6mg/Kg body weight for 15-60 days as a treatment control. Blood samples and liver tissue specimen were collected at 0, 15, 30, 45 and 60 days. Serum was separated and analyzed for lipid profile parameters using reagent kits. Histopathology of the liver specimen was done to observe the protective effect on liver tissue.

RESULTS: After the induction of hyperlipidemia, histological findings of the liver tissue showed hepatocyte fatty degeneration around central vein. Also intralobular vein congestion and accumulation of hepatic lipid droplets was seen with the use of atherogenic diet in group A. These fatty changes were significantly reversed by the Cinnamon treatment in Group C. The standard drug showed no effect on fatty changes in liver in group B. Commensurate to these histological findings, Cinnamon powder also improved the serum lipid profile in albino rats by reducing Total Lipids, Total Cholesterol, Triglycerides and LDL cholesterol and increasing HDL cholesterol levels in group C.

CONCLUSION: Cinnamon powder has curative effect against hepatic fatty changes. Also it is very useful to treat hyperlipidemia.

KEYWORDS: Cinnamon, Hepatoprotective effect, Fatty changes, Albino rats, Cholesterol

INTRODUCTION

Fatty liver is a condition in which triglyceride vacuoles appear inside the hepatocytes through steatosis (abnormal retention of lipids within a cell). This condition is also known as fatty liver disease (FLD) and is reversible. Although there are more than one causes which result in fatty liver, but it is considered as the disease with worldwide occurrence in obese individuals (with or without effects of insulin resistance) and those who take alcohol in excess. FLD is reported to have association with other diseases that affect fat metabolism. Accumulation of fat may also be accompanied by a progressive inflammation of the liver (hepatitis), called steatohepatitis1. According to World Health Organization (WHO) study 80% population of world believes in traditional methods of treatment that is the use of herbal treatment2. It is also reported that in comparison to synthetic drugs, herbal medications are safer3-4. Cinnamon is the inner stem bark of Cinnamomum cassiae of family Lauraceae. Despite of its culinary benefits, it has also been employed to treat various health conditions like as an antimicrobial, antioxidant, hypotensive anti diabetic and lipid lowering agent5-10. However, its hepatoprotective effect is still not well explored. Keeping in view its medicinal value, the present study was undertaken with the objective to evaluate the hepatoprotective effect of cinnamon powder in cholesterol induced liver fatty changes in albino rats.

METHODOLOGY

This experimental study was carried at the Department of Pharmacology, Al-Nafees Medical College, Islamabad and National Institute of Health (NIH), Islamabad, Pakistan from 15th October 2012 to 15th March 2013. Ninety adult albino rats of either sex with average weight of 210 ± 11 grams were procured from and maintained in clean, spacious, and well aerated plastic cages at National Institute of Health (NIH), Islamabad, Pakistan under hygienic laboratory environment. Before the initiation of experiments, the rats were acclimatized for 7 days. After that, they were divided into three groups i.e. A (Untreated Control), B (Treated Control), C (Treated Group). The rats had free access to standard rat feed and water. All the groups were fed atherogenic diet (Normal rat diet + Cholesterol) for first 15 days, as the cholesterol was mixed in their diet, except Group A which was kept on atherogenic diet for 0 to 60 days. Hyperlipidemia was induced in albino rats with cholesterol (Cholesterol 90% E, Applichem, Darmstadt, Germany). Cholesterol (400mg/Kg Body weight of rat) was mixed in the diet and kept on atherogenic feed for the whole duration of the study.
of rats. All the groups received atherogenic diet for 0-15 days except group A, which was kept on atherogenic diet for 0-60 days to induce hyperlipidemia. Simvastatin 10 mg, OBS Pharmaceutical, Karachi, Pakistan was used as standard lipid lowering drug. It was administered to group B at the dose rate 0.6mg/Kg body weight for 15-60 days. Group B was marked as treated control (Standard) group. Cinnamon bark was procured from the local spice shop of Rawalpindi, Pakistan. The bark was then milled. The resultant cinnamon powder was used to feed the animals. Cinnamon powder equivalent to 6gm/kg was administered to the rats group C for 15-60 days. Feed and drug administration protocol is shown in table I.

On each sampling day (0, 15, 30, 45 and 60 days), 6 albino rats from each group were anesthetized with chloroform. Blood samples were collected in sterile disposable syringe through direct heart puncture. Samples were centrifuged at 5000 rpm, plasma was isolated and preserved in refrigerator at 4C until analysis of lipid profile through reagent kits (Spinreact, Germany). After drawing blood samples on each sampling day, liver tissue specimen were collected after surgical opening of the abdominal cavity. Tissue samples were preserved in formalin filled plastic jars until histopathological studies in the histopathology laboratory. The liver tissue was fixed in 10% buffered formalin for twenty four hours. The specimen were further processed for paraffin embedding. From paraffin blocks, approximately 5µm thick sections were taken with a rotary microtome. Sections were mounted and stained with hematoxylin and eosin stain for routine histological study under microscope.

The data was collected on specified proforma in MS Excel 2007 sheets. Using SPSS version 17, the student t-test was applied to check the significance for interpretation of results. The value of P< 0.05 was considered as significant while P> 0.05 as non-significant.

**RESULTS**

Hepatoprotective and antihyperlipidemic effect of Cinnamomum cassiae bark powder, equivalent to 6gm/kg body weight was evaluated in hyperlipidemic albino rats. Cinnamon powder equivalent to 6 gm/kg significantly decreased the lipid profile indicators i.e., total lipids by 150.1 ± 9.13, total cholesterol by 84 ± 6.43, triglyceride by 86 ± 7.34 and LDL by 15.20 ± 8.02 respectively at post medication day 60. Moreover, it elevated the HDL levels by 51.6 ± 5.01 at post medication day 60 (Fig. 1). Similarly, Cinnamon powder significantly reversed cholesterol induced fatty changes in the liver tissue of the rats of Treatment Group (C). The rats fed on high cholesterol diet showed hepatocyte fatty degeneration around central vein, intralobular vein congestion and accumulation of hepatic lipid droplets was seen after induction of atherogenic diet in group A. Lipid droplets were visible in 60% of the livers in group A. Necrotic foci were also visible in 20% of the livers. Phagocytic debris were seen in one or two livers. Fibrosis was seen in 60% of the slides mainly in periportal areas. The collagen fibres were seen in large numbers in 30% of the slides. Lipid droplets were accumulated in cytoplasm of many hepatocytes. Cinnamon significantly reversed hyperlipidemic changes in the liver of rats. In treatment group (C) the lipid droplets disappeared or very small droplet were observed occasionally. Surprisingly one or two giant cells were still present. The portal area was normal in appearance. Phagocytic debris was not seen. The standard drug showed no effect on hyperlipidemic changes in liver in group B.

**TABLE I: FEEDING AND DRUGS ADMINISTRATION SCHEDULE IN ALBINO RATS DURING THE EXPERIMENTAL PERIOD OF 0 TO 60 DAYS**

<table>
<thead>
<tr>
<th>Group</th>
<th>Feeding Schedule</th>
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<tbody>
<tr>
<td>Group A</td>
<td>Untreated control: Atherogenic feed (Normal rat feed + cholesterol 400mg/kg body weight) 0 to 60 days</td>
</tr>
<tr>
<td>Group B</td>
<td>Treated control: Atherogenic feed 0 to 15 days</td>
</tr>
<tr>
<td></td>
<td>Atherogenic feed + simvastatin (0.6 mg/kg body weight) 15 to 60 days</td>
</tr>
<tr>
<td>Group C</td>
<td>Treated group: Atherogenic feed 0 to 15 days</td>
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<tr>
<td></td>
<td>Atherogenic feed + Cinnamon powder (6gm/kg body weight) 15 to 60 days</td>
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</tbody>
</table>

**FIGURE-1: EFFICACY OF C. CASSIAE POWDER EQUIVALENT TO 6 GM/KG BODY WEIGHT AND SIMVASTATIN AGAINST LIPID PROFILE PARAMETERS IN HYPERLIPIDEMIC ALBINO RATS**

**DISCUSSION**

In this study we observed hepatoprotective effects of Cinnamon powder on cholesterol induced fatty changes in liver. These type of fatty changes in liver are commonly known as non-alcohol induced fatty liver disease (NAFLD). NAFLD is a condition in which triglyceride vacuoles appear inside the hepatocytes through steatosis (abnormal retention of lipids within a cell) and is reversible. Although there are more than one causes which result in NAFLD, but it is considered as the disease with worldwide occurrence in obese individuals (with or without effects of insulin resistance). NAFLD is reported to have association with other diseases that affect fat metabolism. Accumulation of fat may also be accompanied by a progressive inflammation of the liver (hepatitis), called steatohepatitis. Our findings are similar to a Chinese study on induced FLD in rat
model, in which wolfberry (a fruit of plant Lycium barbarum) very effectively reversed the fat accumulation, fibrosis, oxidative stress, inflammation, and apoptosis. Its long term use did not show any adverse effects on the rat health. In our study the dose of cinnamon was higher (6 gm/kg) as compared to 1 mg/kg dose of wolfberry used in this study. Regardless of the dose used, the results were almost comparable. Another study demonstrated protective effect of whole green tea extract (GTE) on induction of hepatocyte fibrosis, necrosis and other changes by NAFLD like lipid accumulation in mice model. This study demonstrated that administration of GTE for six weeks reduced mice body weight also. Findings of our study were similar to these findings except that we did not calculate the weight of the rats at the time of sacrifice. However, physically rats seemed to be less in weight as compared to the day one of the experiment. In a study by Xio and his colleagues, they demonstrated the hepatoprotective effect of Garlic-derived S-allylmercaptocysteine (SAMC) in NAFLD in animal model. They found that after eight weeks of feeding SAMC along with high fat diet, typical NAFLD signs like steatosis, oxidative stress, inflammation and fibrosis were significantly reversed which was principally similar to the results of our study. Also they additionally discovered that SAMC could be very beneficial in inhibiting apoptosis while promoting hepatic macro autophagy which gave more protection against NAFLD induce chronic liver injury.

CONCLUSION

From the results of the present study, it is concluded that Cinnamon powder has curative effect against hepatic fatty changes. Also it is found to be very useful to treat hyperlipidemia.

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