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Histopathological changes in the rat liver and kidney with references to nicotine toxicity

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ABSTRACT

Nicotine, the principal alkaloid in tobacco, induces a cellular damage on heart and cardiomyocyte culture. The present study was undertaken to investigate the effects of green tea and guduchi extracts on nicotine-induced alterations in some organs of adult male mice (liver and kidney) by using histopathological studies. A total of 36 mice were divided into six groups For histopathological studies. Liver and kidney were excised from both control and experimental mice sacrificed on 60th day. Statistical analysis was performed for comparison between the groups by using Dunnett's test. There was decreased inflammatory infiltration and intracellular edema in histology of renal tissue from green tea and guduchi extracts treated mice reflected a reduction in nicotine-induced renal damage. The histopathological examination of liver clearly revealed that the Hepatic Cells, Intact nucleus, and Central Vein, portal triad were almost normal in other groups in contrast to group which received inducer but with mild Kupffer cell hyperplasia.The results of present work suggested that green tea and guduchi extracts has a promising prophylactic effect against nicotine-induced oxidative damage of liver and kidney.

Keywords: Green tea, Guduchi extracts, Histopathology, Liver, Kidney, Toxicity, Mice.

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INTRODUCTON

Exposure to nicotine causes important risk factor in the induction and the progression of cardiovascular diseases, lung cancer and chronic obstructive pulmonary disease. Nicotine is a major toxic alkaloid compound present in smoke and smokeless tobacco [1]. Nicotine promotes oxidative stress and oxidative damage in various organs and tissues from experimental models [2, 3]. Short-term nicotine exposure induces myocardial contractile dysfunction and interstitial fibrosis through oxygen, reactive oxygen species (ROS) production and apoptosis [4]. Chronic nicotine treatment modulates the expression of cardiac genes involved in energy metabolism, signal transduction and oxidative cardiac infraction [5]. Oxidative stress seems to be an essential mechanism of nicotine toxicity. It occurs when the production of free radicals exceeds the scavenging effects of antioxidants, the depression of antioxidant status leading to peroxidation of lipids and the oxidation of proteins and DNA impairing both cardiac structure and function [2, 3]. Nicotine activates the apoptosis that induces ischemic lesions [4, 6]. Apoptosis has been shown to target mitochondria and endoplasmic reticulum. Green tea (*Camelia sinensis*) is one of the most commonly consumed beverages worldwide. It has been suggested that green tea polyphenol may inhibit cell proliferation and observational studies have suggested that green tea may have cancer-preventative effects [7]. Guduchi [*Tinospora cordifolia* (Willd.) Miers ex Hook. F. & Thoms] is a large, glabrous, deciduous climbing shrub belonging to the family Menispermaceae [8, 9]. Guduchi is widely used in veterinary folk medicine/ ayurvedic system of medicine for its general tonic, antiperiodic, anti-spasmodic, anti-inflammatory, antiarthritic, anti-allergic and anti-diabetic properties [9-13]. This has a good potency to increase RBCs and control WBC [14]. However, any study investigating the effects of green tea and guduchi extract on nicotine toxicity has not been published yet. Thus, the present study was designed to evaluate the effects of green tea and

guduchi extract on nicotine induced in mice by using histopathological studies.

MATERIALS AND METHODS

Extraction

The prepared whole plant materials of guduchi and leaf part of green tea (30 g) were extracted three times for 30 min with distilled hot water in separating funnel. The temperature was maintained at 37°C. Ratio of plant material and solvent was 1:10. The extracts were filtered through a paper filter (Whatman, No.1) and evaporated to dryness under reduced pressure by the rotary evaporator. The obtained crude extracts were stored in dark glass bottles for further processing.

Animals

Male albino Swiss mice (25–30 g) were used for the present study. The animals were maintained under standard environmental conditions and were fed with standard pellet diet and water *ad libitum*. The study was approved by Institutional Animal Ethics Committee. The guidelines of CPCSEA, India, were strictly followed during the maintenance and experiment.

Experimental model

Experimental design and treatment protocol

The animals were divided into six groups of six animals each and as follows:

Group I: Normal control group mice received saline;

Group II: Nicotine treated group mice (NIC) received nicotine at a dose of 1 mg/kg/p.o.

Group III: received green tea at a dose of 200 mg/kg/p.o;

Groups IV: received guduchi at a dose of 200 mg/kg/p.o;

Groups V: received nicotine (1 mg/kg/p.o.) and green tea at a dose of 200 mg/kg/p.o;

Groups VI: received nicotine (1 mg/kg/p.o.) and guduchi at a dose of 200 mg/kg/p.o.

Histopathological studies

For histopathological studies, liver, kidney were excised from both control and experimental mice sacrificed on 60^{th} day, rinsed in physiological saline solution and fixed in neutral buffered formalin for 48 hours. They were subsequently washed in distilled water and processed through graded series of alcohol, cleared in xyline and embedded in paraffin wax. Sections of 10 micron thickness were cut; stained with Harris haematoxylin and eosin and mounted in DPX. Stained sections were examined with light microscope for histopathological changes 15.

RESULTS AND DISCUSSIONS

Histopathological Alterations in kidney

Effect of green tea and guduchi extracts on nicotine-induced alterations in kidney histology in mice. Photomicrograph of sections of the different group of kidney was taken. Kidney tissue from normal mice showed intact (G) glomerulus basement membrane and tubules without any congestion, necrosis and inflammatory infiltration (Fig. 1). Administration of nicotine resulted in renal damage reflected by the presence of intrinsic lesions within the glomeruli and epithelium, glomerular hypertrophy along with intracellular edema and inflammatory infiltration (Fig. 2). Renal tissue from green tea and guduchi extracts treated mice showed the presence of normal glomerulous and kidney tubules without any congestion and inflammatory infiltration (Fig. 3,4). There was decreased inflammatory infiltration and intracellular edema in histology of renal tissue from green tea and guduchi extracts treated mice reflected a reduction in nicotine-induced renal damage (Fig. 5, 6).

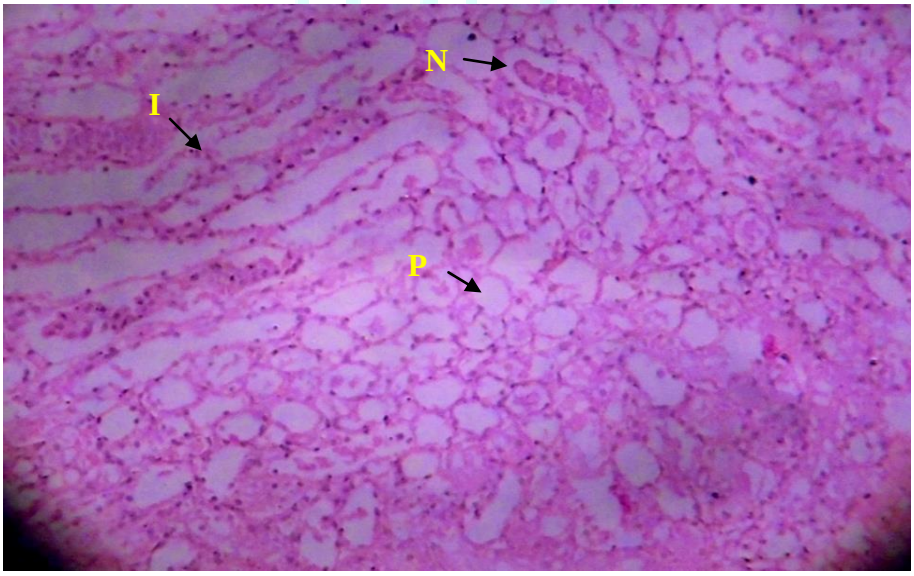

Fig.1: Photomicrograph of the histopathological examination of the liver samples of control group

Where NS= Normal sinusoids, IN= Intact nucleus and PV=Portal vain

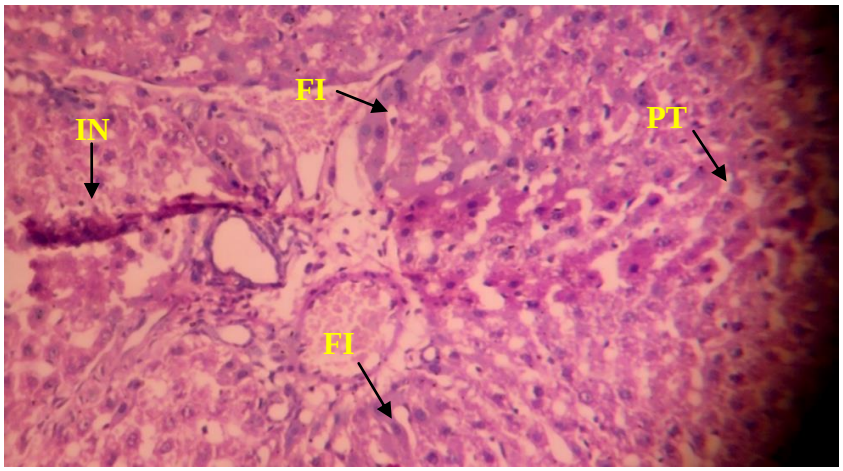

Fig.2: Photomicrograph of the histopathological examination of the liver samples of Nicotine treated group

Where IN= Intact nucleus, FI=Fatty Infiltration and PT=Portal Triad

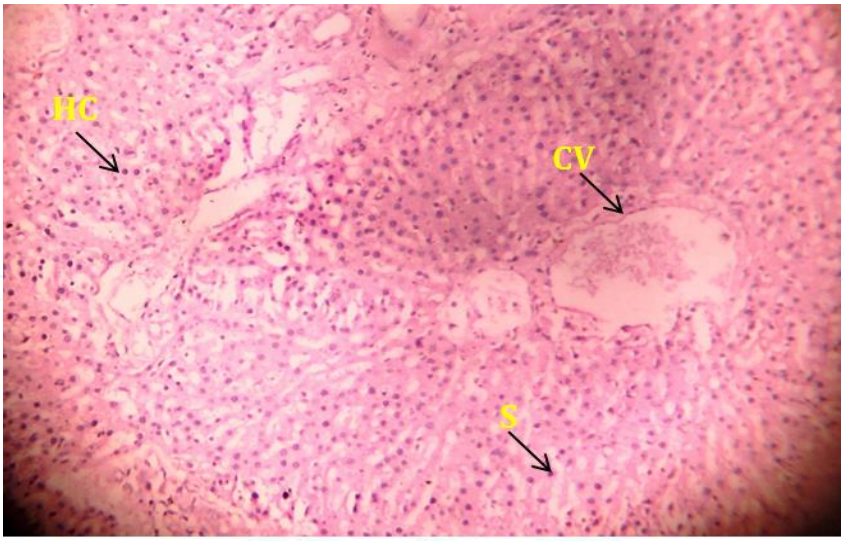

Fig.3: Photomicrograph of the histopathological examination of the liver samples treated group with green tea

Where CV=Central vein, HC = Hepatic Cell and S= Sinusoids

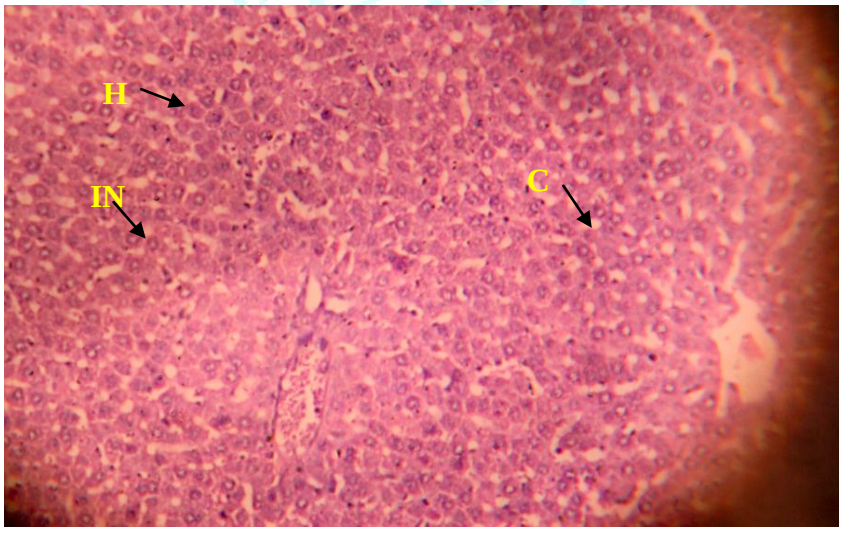

Fig.4: Photomicrograph of the histopathological examination of the liver samples treated group with Guduchi

Where HC=Hepatic Cells, IN= Intact nucleus, and CV= Central Vein

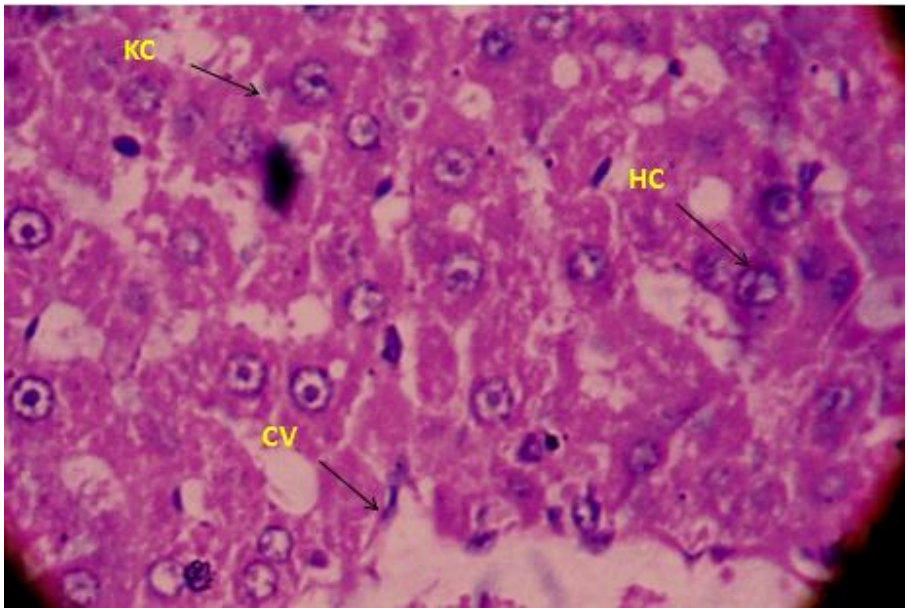

Fig.5: Photomicrograph of the histopathological examination of the liver samples treated group with Nicotine and Green Tea

Where HC= Hepatic Cell, CV= Central Vain, PT=Portal Tract and KC= Kupffer Cells

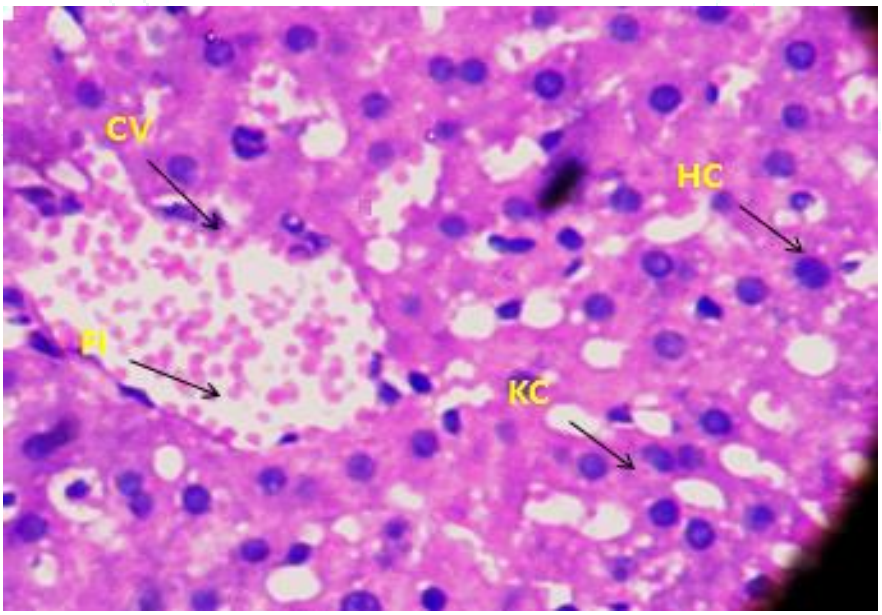

Fig.6: Photomicrograph of the histopathological examination of the liver samples treated group with Nicotine and Guduchi

Where HC= Hepatic Cell, CV= Central Vain, , FI=Fatty Infiltration and KC= Kupffer Cells

Histopathological changes in liver

Histology of the liver sections of normal control animals showed normal liver architecture with well brought out central vein well-preserved cytoplasm and Normal sinusoids, Intact nucleus and Portal vain (Fig. 7). The liver samples of nicotine treated animals showed feathery degeneration, Intact nucleus, Fatty Infiltration, Portal Triad fatty changes inflammatory cells around portal tract (Fig. 8). The histopathological examination clearly revealed that the Hepatic Cells, Intact nucleus and Central Vein, portal triad were almost normal in other groups in contrast to group which received inducer but with mild Kupffer cell hyperplasia (Fig. 9-12).

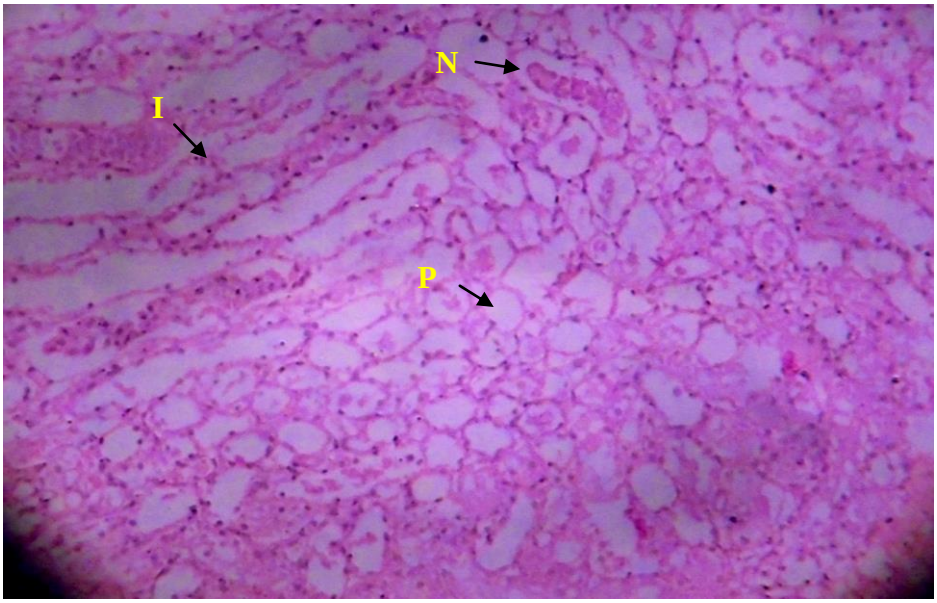

Fig.7: Photomicrograph of the histopathological examination of the liver samples of control group

Where NS= Normal sinusoids, IN= Intact nucleus and PV=Portal vain

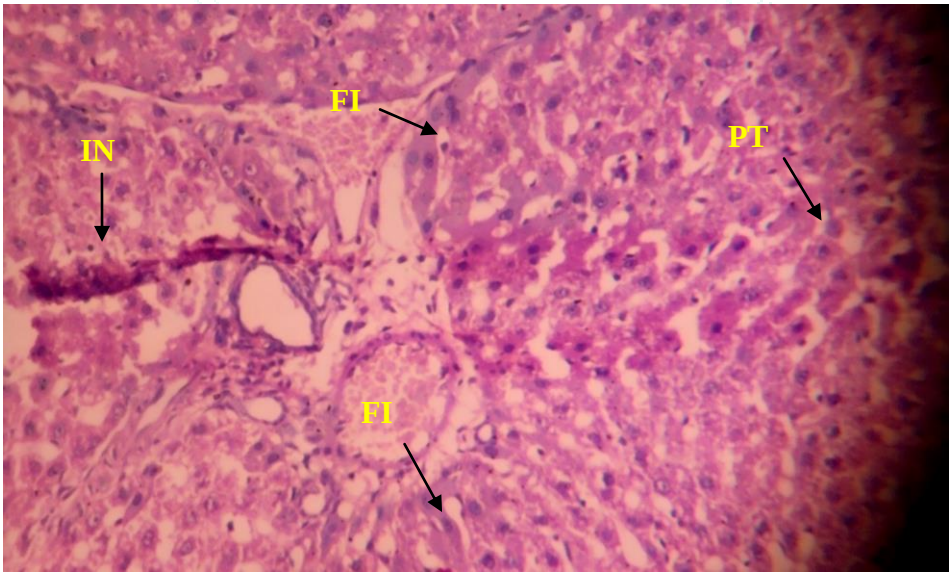

Fig.8: Photomicrograph of the histopathological examination of the liver samples of Nicotine treated group

Where IN= Intact nucleus, FI=Fatty Infiltration and PT=Portal Triad

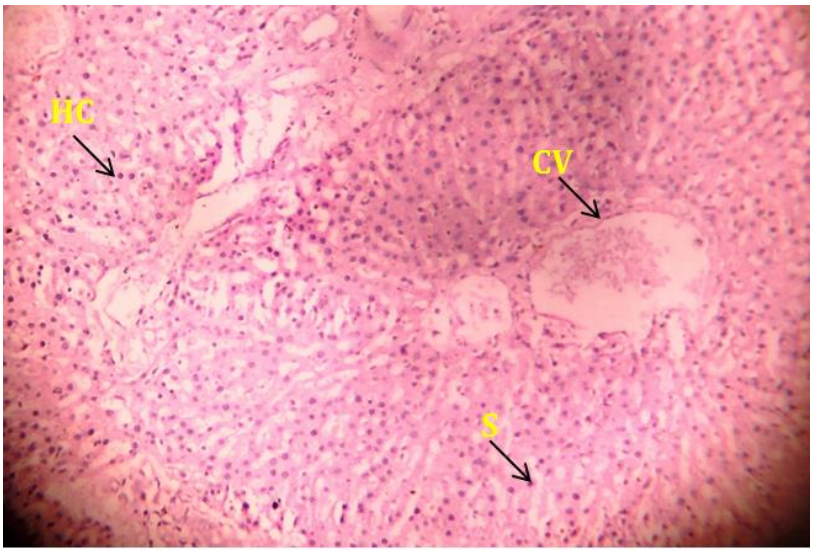

Fig.9: Photomicrograph of the histopathological examination of the liver samples treated group with green tea
Where CV=Central vein, HC = Hepatic Cell and S= Sinusoids

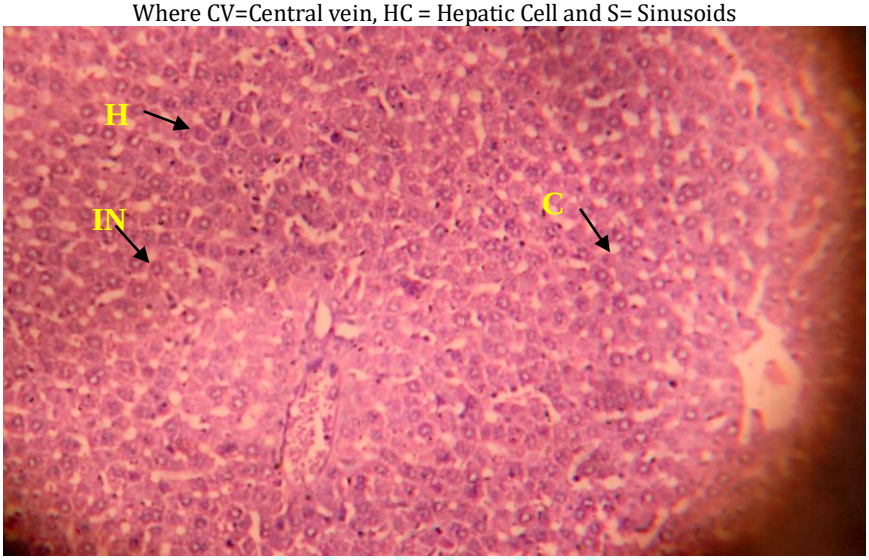

Fig.10: Photomicrograph of the histopathological examination of the liver samples treated group with Guduchi
Where HC=Hepatic Cells, IN= Intact nucleus, and CV= Central Vein

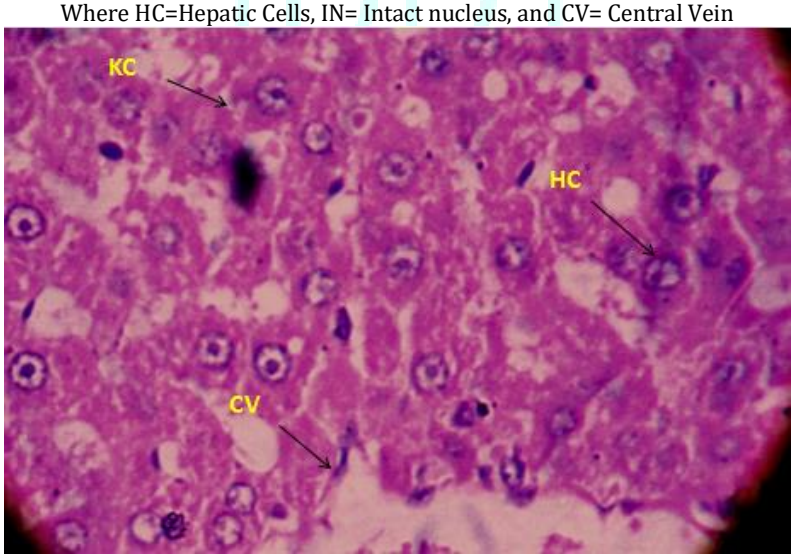

Fig.11: Photomicrograph of the histopathological examination of the liver samples treated group with Nicotine and Green Tea
Where HC= Hepatic Cell, CV= Central Vain, PT=Portal Tract and KC= Kupffer Cells

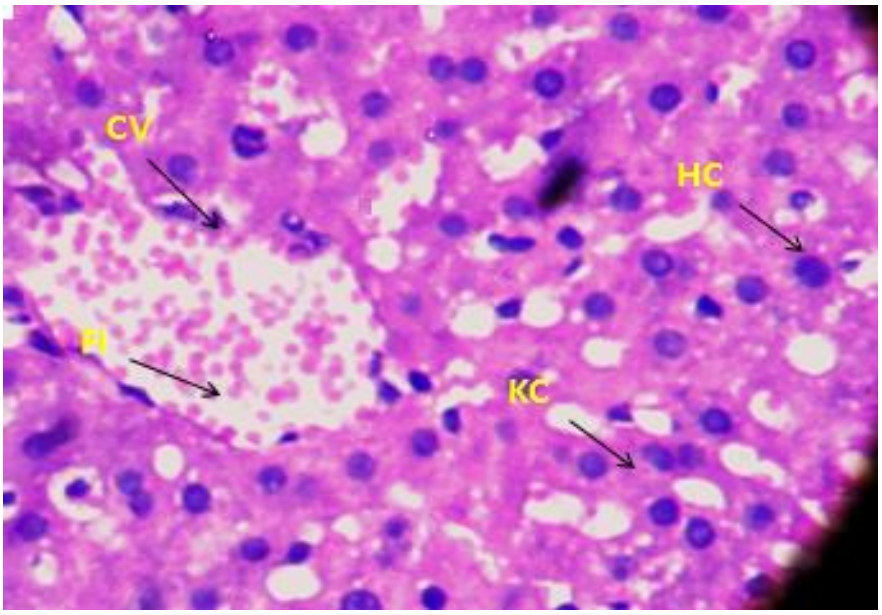

Fig.12: Photomicrograph of the histopathological examination of the liver samples treated group with Nicotine and Guduchi

Where HC= Hepatic Cell, CV= Central Vain, , FI=Fatty Infiltration and KC= Kupffer Cells

CONCLUSION

It is concluded that nicotine administration in mice resulted in toxic effects in the liver and kidney of mice. The present findings clearly demonstrate that Green tea and guduchi is capable of inducing dose dependent histopathological changes in the liver and kidney of the exposed mice. Green tea and guduchi helps more to improve the immune system and boost immune system even in the body. We plan to conduct further studies to better understand the mechanisms.

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