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Modulatory effects of Alcoholic Bark Extract of *Terminalia arjuna* on Serum Lipid Profile in Cigarette Smoke Exposed Male Albino Rats

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ABSTRACT: The present study is conducted to observe the modulatory effects of alcoholic bark extract of *Terminalia arjuna* on serum lipid profile in cigarette smoke exposed male albino rats. The male albino rats grouped into three sets. One control set (1) was unexposed to cigarette smoke. Experimental set (2) was exposed to cigarette smoke for 30 days and experimental set (3) was exposed to cigarette smoke along with oral administration of alcoholic bark extract of *Terminalia arjuna* for 30 days. A significant decrease in serum cholesterol, serum triglyceride, Low density lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL) with a significant increase in High Density Lipoprotein (HDL) level after oral administration of alcoholic bark extract of *Terminalia arjuna* in comparison to cigarette exposed rats.

Keywords: Cigarette smoke, albino rat, lipid profile, alcoholic extract, *Terminalia arjuna.*

I. INTRODUCTION

Smoking considers being wide public health problem, which reached to day to the level of global epidemic [1]. Consumption of tobacco has been established as a number one preventable cause of death and disease in the countries worldwide [2].

Smoking is one of the modifiable risk factor for cardiovascular disease (CVD) and the risk of CVD death increases with increases exposure to cigarette smoke daily. Cigarette smoking adolescent can be gate way to other types of drug abuse and can cause various health problems [3]. Smoking also cause cancer, stroke and also have close relationship with gastric ulcer, periodontal disease, sudden infant death syndrome, and metabolic syndrome [4].

The main additive component of cigarette smoke are nicotine, hydrogen cyanide, methanol, butane and about more than 400 other chemicals. These chemicals induced the rate of Reactive Oxygen Species (ROS), which is a part of free radicals. Free radicals are highly unstable and capable of undergoing complex interaction is biological system, make oxidative stress [5]. Cigarette smoking is associated with a more atherogenic lipid profile [6]. Free radicals from tar phase and gas phase of cigarette smoke imposes an oxidative stress, promotes lipid peroxidation and consequently perturbs the anti oxidant defense system and alter the level of lipids. It contains approximately 10^{17} oxidant molecules per puff that can cause damage to lipids, proteins, DNA, carbohydrates and other biomolecules [7]. Cigarette smoking increases the concentration of serum cholesterol, triglyceride, LDL-C, VLDL-C and decreases the level of good cholesterol-HDL [8]. Increased oxidative stress and generation of free oxygen radicals from cigarette smoke can result in the modification of LDL to oxidized LDL that Could lead to atherosclerosis lesions [9].

Terminalia arjuna which is used as an antioxidant in the present study is commonly known as 'arjuna'. It is a large tropical woody tree distributed throughout the subtropical regions of India. It is a traditional Indian medicinal herb which has many therapeutic applications in Ayruvedic, Unani, Homeopathic and allopathic system of medicine [10]. Bark of *Terminalia arjuna* tree contains calcium salts, magnesium salts, and glucosides. It has antioxidant, anti-inflammatory, antibacterial and antihyperlipidemic properties.

Thus the aim of the present study was to investigate the modulatory effect of alcoholic bark extract of *Terminalia arjuna* on serum lipid profile in cigarette smoke exposed male albino rats.

II. MATERIALS AND METHODS

The wistar male albino rats, *Rattus norvegicus* (Berkenhout) have been selected for the present study. Healthy and adult male albino rats (150-200 g) were kept in polypropylene cages and maintained at standard laboratory conditions of temperature 21±0.5℃ and relative humidity 60±5% with a photoperiod 12 hr/day. The experimental protocol is in accordance with Institutional Ethics Committee. The rats were fed on commercial food pellets (Golden Feed, New Delhi) and water *ad libitum*. The experimental animals were acclimatized for one week prior to experiment.

Selection of Cigarette: The Capston Pilot (a filtered cigarette of 64 mm length), ITC Limited, Kolkata was selected for the present study.

Plant Material and Extraction: The fresh bark of *Terminal arjuna* was collected from the Botanical Garden University Campus, Dr. Bhim Rao Ambedkar University, Agra. The shade dried *Terminalia arjuna* bark was coarsely powdered and 200 g of coarse powder was refluxed with 50% v/v ethanol for three hours using soxhlet apparatus. The extract was filtered and evaporated in a vacuum evaporator. The amount of residue remained (20% w/w) was obtained and stored in glass bottle at 4℃ and was redissolved in distilled water when used [11].

Experimental Design: The albino rats were grouped into three sets one control (1) and two experimental sets (2 and 3) each set containing five rats.

Control Set (1)	:	Unexposed to cigarette smoke
Experimental Set (2)	:	Exposed to cigarette smoke 6 cigarettes/hr in a day (1 cigarette/10 minutes) for 30 days
Experimental Set (3)	:	Exposed to cigarette smoke alongwith oral administration of alcoholic bark extract of *Terminalia arjuna* (5 mg/rat/day) for one hr/day for 30 days

Table 1: Effect of cigarette smoke on lipid profile and its modulation by alcoholic bark extract of *Terminalia arjuna* after 30 days exposure.

Sets	Treatment	30 days (Mean ± S.Em.)				
		Cholesterol	Triglyceride	HDL	LDL	VLDL
Control set-1 (5)	Ambient air	90.550±0.430	87.50±0.212	43.50±0.667	34.50±0.33	17.634±0.299
Experimental set-2 (5)	Cigarette smoke	98.122±0.588↑**	98.00±0.50↑**	30.33±0.557↓**	45.56±2.934↑*	24.50±0.044↑**
Experimental set-3 (5)	Cigarette smoke + aqueous extract	92.81±0.226↑* ↓••	89.38±0.629↑** ↓•	42.26±1.41↓** ↑•••	35.00±0.320↑** ↓••	18.814±0.141↑* ↓••
(5) = No. of albino rats exposure		Difference from control * - Non significant ** - Significant			Difference from cigarette smoke • - Non-significant •• - Significant	

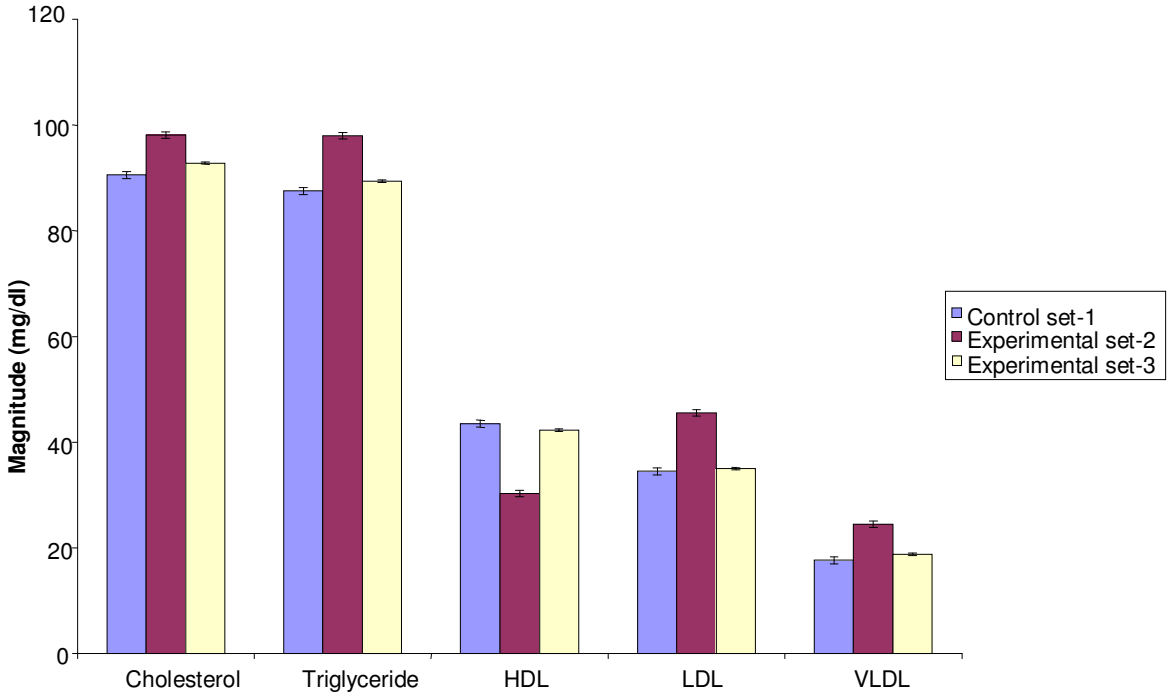

Fig. 1. Effect of cigarette smoke on lipid profile and its modulation by alcoholic bark extract of *Terminalia arjuna* after 30 days exposure.

Exposure to Cigarette Smoke: Mini exposure cabinet (60 cm × 30 cm × 30 cm) manufactured by Precision Instrument, Varanasi is used for the cigarette smoke exposure. The experimental rats were kept in an isolated smoke chamber with their cages for whole body exposure to cigarette smoke of a filtered cigarette (6 cigarettes/hr in a day) for 30 days.

Blood Collection: At the end of exposure duration of 30 days, all the rats of control set (1) and experimental sets (2 and 3) were sacrificed under light anesthesia (diethyl ether). The blood samples were collected by cardiac puncture of the dissected albino rats with the help of 5.0 ml sterilized disposable syringe, fitted with (22 SWG) hypodermic needle and transferred into sterilized glass centrifuge tubes for separation of serum.

Separation of serum: For serum separation, blood samples were allowed to strand for one hour undisturbed and were centrifuged at 300 rpm for 20 minutes. The supernatant serum was separated with the help of rubber bulb pipette the serum samples were analyzed for the estimation of lipid profile in control and experimental sets.

mechanisms [16]. Cigarette smoking cause of the increased level of total cholesterol, triglyceride, LDL-C and VLDL-C due to a decrease in lipoprotein lipase

Estimation of Serum Lipid Profile : Serum cholesterol was estimated by Roeschalu *et al.*, [12], serum triglyceride by Schelter and Nussel [13] method, HDL by Wybenga and Pilegge method [14], LDL and VLDL were calculated by Friedwald *et al.*, [15] methods.

The data were expressed as mean ± S.Em. They were signified by using 't' test by kp ky plot (Version 3.0).

III. RESULTS AND DISCUSSION

Data obtained for serum lipid profile in control and experimental sets are given in (Table 1 and Fig. 1). The results indicate significant alterations in aforesaid parameters after cigarette smoke exposure. They are significant to very highly significant. The results obtained from this study, there was a significant increase in serum cholesterol, serum triglyceride, Low Density Lipoprotein (LDL) and very low density lipoprotein (VLDL) with significant decrease in High Density Lipoprotein (HDL) level in cigarette smoke exposed albino rats in comparison to control rats. Cigarette smoke contains substantial amounts of ROS and other chemicals that diminish the intracellular antioxidant activity [17]. Nicotine is a major component of cigarette smoke from cigarette smoking stimulates sympathetic adrenal system leading to increased secretion of

catecholamine resulting in increased lipolysis and increased concentration of plasma free fatty acids (FFA) which further result in increased secretion of hepatic FFAs and hepatic triglycerides along with VLDL-C in the blood stream [18]. Nicotine increases the circulatory pool of at herogenic LDL via accelerated transfer of lipids from HDL and impaired clearance of LDL from plasma compartment therefore it increase the deposition of LDL cholesterol in the arterial wall [19]. Increased level of LDL is associated with increased risk of coronary heart disease [20]. Cigarette smokers routinely displays decreased antioxidant capacity and increased oxidized lipids [21]. Oxidative pathway appears to be one important mechanism for modifying LDL. Oxidative modified LDL contributes to the pathogenesis of atherosclerosis [22]. After oral administration of alcoholic bark extract of *Terminalia arjuna* the serum lipid profile viz. Serum cholesterol, serum triglyceride LDL and VLDL significantly decrease with increase in HDL level.

Terminalia arjuna is a deciduous and evergreen tree found throughout India. Its stem bark possesses glycosides, large quantities of flavonoids, tannins and minerals. *Terminalia arjuna* bark acts as a hypolipidemic, hypocholesterolemic and oxidative stress lowering agent [23]. Its cardio protective activity is due to its free radical scavenging activity [24]. Alcoholic bark extract of *Terminalia arjuna* decrease in the cholesterol levels and increase in HDL level due to increase the activity of lipoprotein lipase and plasma LCAT [25]. The alcoholic bark extract of *Terminalia arjuna* shows multi targeted action of sitosterol as well as flavonoids action on the intestinal absorption of cholesterol and inhibiting HMG CoA enzyme [26].

IV. CONCLUSION

It concluded from the results of the present study that cigarette smoking causes an alteration of lipid profile which includes increasing the levels of serum cholesterol, triglyceride, LDL-C,VLDL-C with decrease in HDL-C level. Alcoholic bark extract of *Terminalia arjuna* favourably modify lipid profile. It possess remarkable hypolipidemic and antioxidant activity due to presence of various bioactive components such as phenols, flavonoids, tannins, glycosides, arjunolic acids which reduced the toxicity caused by cigarette smoke.

V. FUTURE SCOPE

Lipid profile is very important to give estimation of the cardiovascular diseases. cigarette smoke induced change in lipid profile and cause several heart diseases. *Terminalia arjuna* is very beneficial herbal plant. The huge number of phytochemical and pharmacological properties also medicinally chemicals important. This study can be helpful for researchers to increase the awareness of the health risk of smoking. Thus this research can review be made for human beneficial source for the researchers to carry out systematic knowledge of herbal and poly–herbal drugs from *Terminalia arjuna*.

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Conflict of Interest. No conflict of interests.

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