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Cardiotoxic Effect of Aqueous Extract of Some Indigenous Plants on American Cockroach: *Periplaneta Americana* Linn

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Abstract: ***The Cardiotoxic effect of aqueous extract of some indigenous plants is evaluated on American cockroach, Periplaneta Americana Linn as an experimental animal in laboratory conditions. Toxicity of plant extract was determined in terms of LD_{50} value in the cockroach by tropical application. However, the Cardiotoxic activity was found to be higher in experimental animals as compared to control on exposure to plant extracts and it was dose dependent. Among the plants evaluated Balanites roxburghii Planch, Cestrum nocturnum Linn, Nicotiana tabecum Linn and Sapindus trifoliatus Linn showed highly Cardiotoxic activity causes significant reduction in heart rate. Whereas, Azadirachta indica A. Juss extract shows least activity than remaining experimental plants. This result therefore seems to support the claim that the plant extract contain saponin and glycoside as an active ingredients in them.***

Keywords: Cardiotoxic, American cockroach, Plant extract, Heart rate, Dose dependent.

I. INTRODUCTION

Many indigenous plant species have over the years constituted indispensable tools for research and development of new drugs and are used in folk medicine to manage hypertension due to their hypotensive properties (Caius, 1986; Salahdeen et al., 2004; Abudullah, 2012). The medicinal use of plant extracts date back to ancient times and now listed officially as herbal drugs in pharmacopoeias in many countries (Chang et al., 2002). There are thousands of plant species worldwide, but only very few were tested and used medicinally to treat cardiovascular disease (Bahorun et al., 2003). These studies showed that some of indigenous species increases contraction of the heart dilates peripheral blood vessel and improve blood supply to the heart, thereby help in treating heart disease and mitigating symptoms in early stage of heart failure (Rigelsky and Sweet, 2002). Some plant contains cardiac glycoside, its action include both beneficial and toxic effect on heart. It also used as heart tonic. The plant alkaloids are used as cardio-protective agent. A steroid in high doses seems to increase the risk of heart disease including heart attack, heart failure and stroke (Gyas Khan et al., 2014; Jayasinghe et al., 2020). Saponin decreases blood lipid and lower blood glucose response. While cardiac glycoside are believed to increase the force of cardiac muscle contraction by binding to and inhibiting the action of a membrane enzyme that extrude Sodium ions from the cell interior (Suarez et al., 1997; Afolabi and Ebenezer, 2014). These drugs also enhance the release of Calcium from internal store, resulting in a rise in intracellular calcium. Cardiac glycoside is a organic compound that increase the output force of the heart and decrease its rate of contraction by inhibiting the cellular Na^+ - K^+ ATPase pump (Bekalu et al., 2021). Most of plants used in present investigation are growing primarily during rainy season and some are cultivated. Their extracts have been reported to have various pharmacological effects like piscidial (Patole and Mahajan, 2006), larvicidal (Patole and Mahajan, 2007), insecticidal (Pavela, 2008) and antimicrobial (Patole et al., 2010). Traditionally, the local population as well as *Vaidus* uses the plant parts as treatment to reduce blood pressure. In extensive search of the literature, there is no much published reports on the hypotensive effect of these plants as far as many of us are aware. In view of the dearth of information in the literature evaluating the hypotensive property of plants, the present study was undertaken to investigate the effects of aqueous extracts of some indigenous plants on the heart rate in American cockroach to elucidate its mechanism of action.

II. MATERIALS AND METHODS

A. Preparation of Extract

The used plant material was locally collected in and around city and some is purchased from local market. The plant material was identified, dried at room temperature, powdered and extracted in water by using 30 g dried powder were individually Soxhlet extracted in 300 ml distilled water at 95 ^{0}C for 4 h. The extract was 5 folds concentrated in rotary vacuum evaporator at 50 - 60 ^{0}C and stored in airtight desiccators. From stock solution, 10 mg/L and 100 mg/L concentrations was prepared freshly in insect saline and used in this study.

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B. Experimental Animal

The cockroaches, Periplaneta Americana were reared and maintained in departmental laboratory. The adult healthy insect of irrespective sex were selected for experimental group of 4 cockroaches kept for both concentration of each plant extract and same number (4) of insect was kept as control.

C. Experimental Procedure

The living cockroach was dissected in insect saline from ventral side so as to expose the heart tube and alary muscles. The heart beats per minute of control animal were observed and counted under the binocular microscope. For experimental animal, adding few drops of aqueous extracts on heart and alary muscles and counted the beats per minute in similar manner of control animal. The effect of both concentrations i.e. 10 mg/L and 100 mg/L of aqueous extracts was noted.

The results are presented as mean standard error of the mean (SEM). The difference of means values were assessed for statistical significance by using students 't-test' value of 'p' equal or less than 0.05 were taken to imply statistical significance.

III. RESULTS AND DISCUSSION

The Cardiotoxic effect of aqueous extract of used indigenous plants is presented in table-1. This table also shows part used and active ingredients of plants. The heartbeat of control cockroach was counted to be within range of 60 to 67 beats /minutes. Whereas decreases in heart beats were found in experimental animals those exposed to aqueous extract and it was directly proportional to the concentration of dose used. In most of plants used in present investigation contains saponin, alkaloid, glycoside etc as an active ingredient, which are responsible for reduction in heartbeats. Among the plant used *Acacia concinna, Acorus calamus, Balanites roxburghii, Cestrum nocturnum, Nicotiana tabecum, Sapindus trifoliatus* etc shows higher Cardiotoxic activity, causes significant reduction in cockroach heart rate. The highest Cardiotoxic activity was found in cockroach exposed to aqueous extract of *Sapindus trifoliatus* plant. It was followed by animal exposed to extract of *Nicotiana tabecum, Balanites roxburghii, Acorus calamus* and so on. These results are corroborated with earlier workers viz., Roy and Chatterjee, 1968; Jawale and Mahajan, 1998.

The rhythm of the insect heart appears to be purely myogenic (Miller, 1974) though the frequency and amplitude of the heart are influenced by nervous stimuli. The rate of heart beat is greatly affected by temperature, activity and physiological state of the insect (Richard and Devis, 1979). In addition to these many factors affect the heart beat of insect under experimental conditions). They include light, the secretion of carpora cardiac and carpora allata, various tissue extracts and pharmacological active substances (Jones, 1974). The plant used in present investigation contains saponin and glycosides, which has Cardiotoxic and cardiotonic effect (Roy and Chatterjee, 1968). This has been proved in present study. The heart beats of cockroach opened in insect saline seems to have a noticeable response to very low concentration i.e. 1mg/ L of aqueous extracts of plants.

The results of present investigation showed that the aqueous extracts of used indigenous plants lowers heart rate in cockroach. The dose dependent nature of the effects of extract suggests a cumulative action of the active substance(s) present in plants. This observation agrees with the earlier reports of Abdul and Amin (1997) and Salahdeen et al., 2004.

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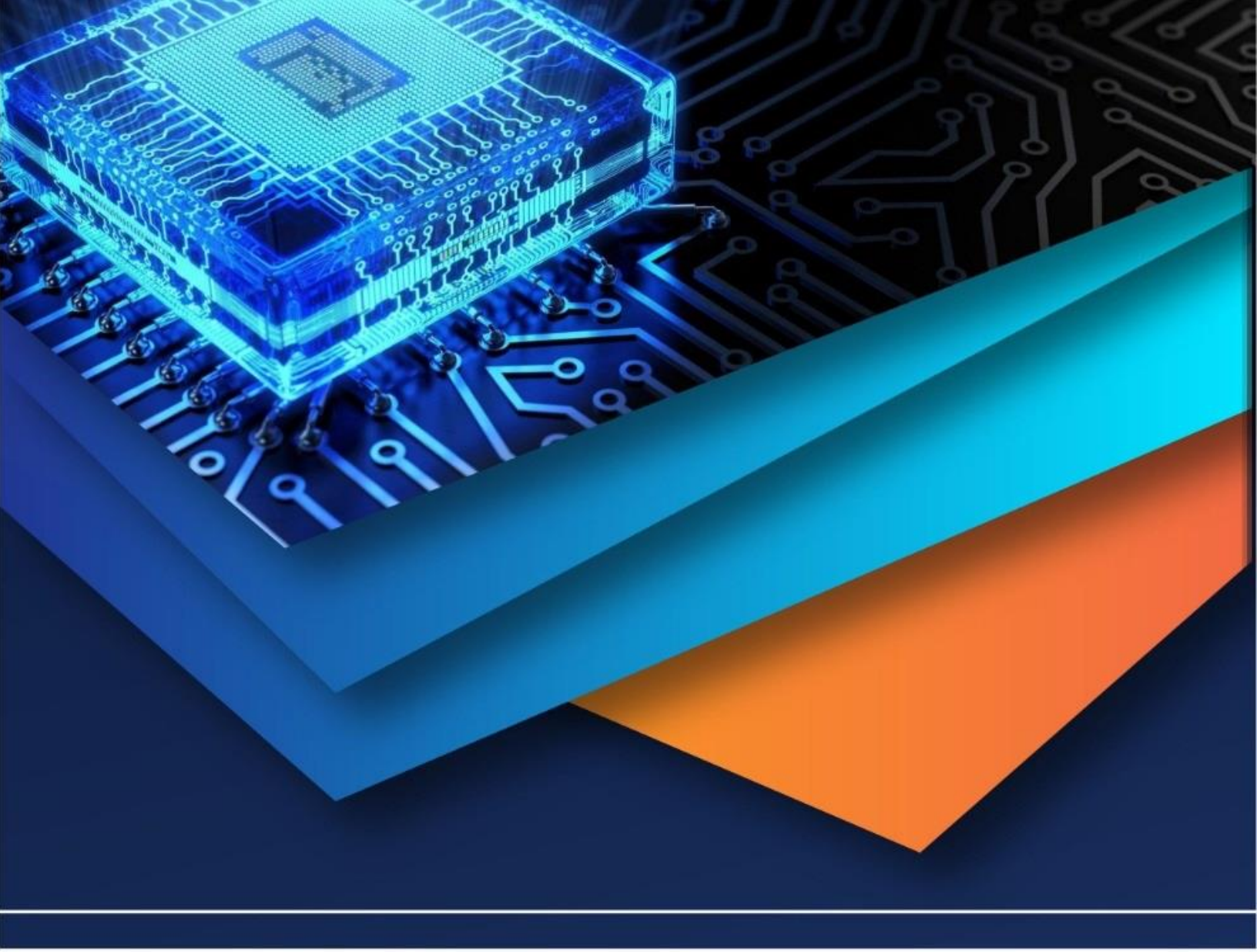
Table-1: Effect of aqueous extract of some indigenous plants on heart of American Cockroach: *Periplaneta Americana* Linn.

Sr. No.	Plant name	Part used	Active ingredients	Heart beats per minute		
				With saline Control	Experimental animals Treated with aqueous extract	
					10 mg/L	100 mg/ L
01	*Acacia concinna* D. C.	F	Saponin, Alkaloid	63 ± 2.0	58 ± 1.0 (7.93) *	51 ± 1.5 (19.04) **
02	*Acorus calamus* Linn	R	Acorin, Glycoside, Essential oil	66 ± 1.0	60 ± 1.5 (9.09) *	52 ± 2.5 (21.21) **
03	*Anagallis arvensis* Linn	WP	Saponin, Glycoside	66 ± 1.5	62 ± 2.5 (6.06) *	53 ± 2.5 (19.69) **
04	*Azadirachta indica* A. Juss	L	Azadirachtin, Salanin, Meliantriol	67 ± 0.5	65 ± 2.0 (2.98) NS	59 ± 1.0 (11.93) *
05	*Balanites roxburghii* Pla.	F	Saponin, Steroid and Sapogenin	60 ± 2.5	52 ± 3.0 (13.33) **	47 ± 2.5 (21.67) **
06	*Cestrum nocturnum* Linn	L	Saponin, Glycoside	62 ± 2.2	55 ± 2.5 (11.29) **	50 ± 3.5 (19.35) **
07	*Citrullus colocynthis* S.	F	Saponin, Colocynthine	61 ± 2.5	56 ± 2.0 (8.19) *	51 ± 2.5 (16.39) **
08	*Duranta rapens* Linn	L	Saponin, Alkaloid	63 ± 2.0	58 ± 3.0 (7.93) *	54 ± 3.5 (14.28) **
09	*Nicotiana tabecum* Linn	L	Alkaloid, Nicotine, Anabasine	60 ± 3.0	51± 2.5 (15.0) **	46 ± 2.5 (23.33) ***
10	*Sapindus trifoliatus* Linn	F	Saponin	65 ± 1.5	49 ± 3.0 (24.61) ***	45 ± 3.5 (30.76) ***
11	*Sphaeranthus indicus* Linn	WP	Sphaeranthine, Glucoside	64 ± 2.0	58 ± 2.5 (9.37) *	53 ± 3.5 (17.18) **
12	*Tephrosia purpurea* Pers	R	Glycoside, Rotenone	64 ± 1.5	59 ± 2.0 (7.81) *	56 ± 2.0 (12.50) **

Part used - F= Fruit, WP= Whole plant, L= Leaves, R = Root

Values represent mean ± (n=4); NS = Non significant, *p < 0.05, ** p < 0.01.
Values in the parenthesis are per cent change over control.

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