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Histological study of the effects of oral administration of *datura metel* on the visual system of male wistar rats

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ABSTRACT

This study was carried out in order to elucidate some of the effects of oral administration of *Cannabis sativa* on the visual system of male Wistar rats as marker of toxicity using neurohistochemical study. 12 adult male Wistar rats were used for this study. The rats were distributed into two groups (A and B). The rats in group A served as the treatment group and were administered with 300 mg/kg body weight of *Cannabis sativa* while the rats in group B which served as the control were administered with equal volume of phosphate buffered saline. The duration of administration was for 14d. The rats were sacrificed using cervical dislocation 24 hrs after the last administration. The brains were excised from the skulls of the animals and were completely fixed in 10% formol calcium. 72 hours after fixation, right occipital cortex, right lateral geniculate nucleus and right superior colliculus were excised separately for histological (H&E) processing. Microscopic observations made from the permanent photomicrographs revealed alterations in the histoarchitecture of the visual system of the rats in the treated group compared with the rats in the treated group with preserved histological outline. Oral administration of *Cannabis sativa* on the visual system of male Wistar rats caused neurodegeneration of the occipital cortex, right lateral geniculate nucleus and right superior colliculus of Wistar rats.

1. Introduction

Datura metel belongs to the family Solanaceae, the nightshade, which include some 2,400 species (Siegel, 1989). It is one of the most interesting plants with hallucinogenic property (Kirsten, 1986) and despite having this reputation as one of the darker hallucinogens, it has widely been used by societies historically in both old word and the new, and continues to be today (Heiser, 1969). Local findings have shown that all the different parts of the plants are, either in the fresh form or in the sun-dried powdered form, used for its psychoactive property in South-Western Nigeria. Literatures have also shown that *Datura metel* is one of the most commonly abused local plants all over the world. Report of Drug Abuse in Nigeria by the United Nations Office on Drugs and Crime in 2007, have been showed 0.4% use of *Datura metel* out of the various narcotic and psychotropic substances of use in Nigeria when Cannabis took the largest proportion- 28%.

The visual cortex, lateral geniculate body and superior colliculus constitute the intracranial visual relay centers. In mammals and Man the two strongest pathways linking the eye to the brain are those projecting to the LGB, and to the SC (Goodale, 2004). The primary visual cortex surrounds the calcarine fissure, a horizontal fissure in the medial and posterior occipital lobe (Carlson, 2007). Each primary visual cortex receives information directly from its ipsilateral lateral geniculate body and transmits information to two primary pathways called dorsal and ventral streams (Goodale 1992). The visual cortex detects the orientation of lines and borders (Hall 2006).

The LGB is the primary processing centre for visual information received from the retina of the eye. It is found inside the thalamus of the brain and receives information directly from the ascending retinal ganglion cells via the optic tract and from the reticular activating system. Neurons of the LGB send their axons through the optic radiation, a pathway directly to the primary visual cortex. In addition, the LGB receives many strong feedback connections from the primary visual cortex.

The general function of the superior colliculus is to direct behavioral response towards specific point in egocentric space. In primates, the superior colliculus has been studied mainly with respect to its role in directing eye movements. Visual input from the retina or "command" input from the cerebral cortex, create a "bump" of activity in the tectal map, which if strong enough induces a saccadic eye movement (Dean, 1999). Even in primates, however, it is also involved in generating spatially directed head turns, arm-reaching movements, and shift in attention that do not involve any overt movement(Huerta, 1984). This study critically examined the toxic effects of aqueous leaf extract of *Datura metel* administered orally on the visual system of male Wistar rats.

2. Materials and methods

Ten male Wistar rats with average weight of ±150 g were reared in the animal holdings of the College of Health Sciences of Osun State University, Osogbo, Osun State, Nigeria. They were fed with standard rat diet which was purchased from Sholashewa Feeds (Ede, Nigeria). They were kept in standard laboratory cages in two groups of five rats representing treatment (A) and control (B) groups. The rats were also given water *ad-libitum*. They were cared for under standard laboratory conditions of standard lighting, moderate temperature and adequate ventilation. They were weighed routinely everyday.

Fresh leaves of *Datura metel*, plucked along the bank of river Osun side in Ede, Nigeria. The plant was authenticated in the Biological Department of the Osun State University, Osogbo, Nigeria. The plant samples was sun-dried for 5 days to make 400 g of dried *Datura* leaves and were grinded with mortar and pestle into powdery form. 100g of the powdered plant sample was soaked in 100 mls of distilled water for 72 hours and filtered afterwards with Whatman's Nọ 1 filter paper. 800 mls of filtrate was obtained and the residue discarded. The filtrate was oven dried at a temperature of 40^0C for 10d to form a dark green paste of 14 g which was made to dissolve in 70 mls of phosphate buffered saline to make a 200 mg/ml aqueous solution of *Datura metel*.

Oral Acute Toxic Class method of Acute Toxicity Testing was employed in this research work (Scheddule, 2005) to determine the toxic dose of the aqueous extract. Three male animals of average weight of 150 g were first given aqueous extract of *Datura metel* at a dose of 750 mg/kg/day. The rats were observed for 48 hours and another dose was given at 1125 mg/kg/day when no animal died. Animals were also observed 48 hours after this second dose and a third dose was administered when no rat died after 48 hours, at a dose of 1687.5 mg/kg/day. Two of the rats died within 12 hours of administration of this third dose and the third rat died after 36 hours. Toxic dose of the aqueous extract of *Datura metel* was therefore taken to be 1687.5 mg/kg/day in this research work.

Rats in group A were treated with 300 mg/kg body weight/day of *Datura metel* for 14 days and those in group B received phosphate buffered saline in equal volume of the dose of each extract for 21 days. Administration of the extract and phosphate buffered saline was done orally daily with the aid of oro-gastric feeding tube at 09.00 hour each day. Rats were sacrificed by cervical dislocation 24 hours after the last administration. Brain tissues were carefully excised from the skull and fixed in 10% formol calcium for 72 hours, after which right occipital cortex, right lateral geniculate nucleus and right superior colliculus were excised separately for H&E staining. Slides were mounted on Olympus binocular light microscope (XSZ-107BN, No071771), critically studied and analyzed and their photomicrographs were taken with a Samsung Digital Camera (Digimax i6 PMP, Samsung #11 PMP).

3. Results

Histological sections of the visual cortex of the rats in the treated group showed vacuolations of the neuron signifying disruption in the histoarchitecture of the visual cortex (Fig. 1a) when compared with the histological section of the rats in group B which has no altered histological profile signifying a well preserved histological profile (Fig 1b). Sections of the LGB of rats in group A (Fig. 2a) showed vacuolations in the stroma of the cells. This may confer adverse effects on the functional integrities of the neurons in the LGB of the rats in the treated group. However, when this was compared with the sections of the LGB in group B rats, it was observed that the LGB in group B has a well preserved histological outlines (Fig. 2b). Furthermore, the sections of the superior colliculus of the rats in group A also showed vacuolations of the neurons (Fig 3a) while the section from rats in group B have intact neurons with well preserved cytoarchitectural profile (Fig. 3b).

4. Discussion

It has been reported that all parts of *Datura* genu has toxic effects if ingested by humans or livestock (Radford *et al,* 1964; Hasan and Kushwaha, 1987). Some of the effects of aqueous leaf extract *D. metel* on the visual system of male Wistar rats have not been studied. In this study, we investigated some of the effects of the aqueous leaf extract of *D. metel* on the histology of the visual system of male Wistar rats to elucidate some of the possible histological implications that could occur following its consumption.

The major outcome of this study revealed that oral administration of the aqueous leaf extract of *D. metel* has disruptive effects on the histological profile of the visual system of the rats treated with 300 mg/kg body weight of the aqueous leaf extract of *D. metel* for 14d as there were histological derangement, degenerative changes, vacuolations and progressive cell death of the cells within the histological sections of the visual system of treated rats when compared with the sections obtained from the control group. The result confirmed previous studies indicating that all part of *Datura* genu has toxic effects. The toxic effect of *D.* genu has been attributed to the antimuscarinic action of the alkaloids it contains. The histopathological alterations observed in this study is similar to those recorded in the study of Binev *et al* (2006).

The pathoanatomical observations recorded in this study suggest that the pattern of cell death within the visual system of the rats in the treated group could be as a result of deleterious effect(s) of the phytochemicals composition (tropane alkaloids) present in the leaf extract. The outcome of this study is in support of the study of Adekomi *et al* (2011), Oberndorfer *et al* (2002), Roblot *et al* (1995) and Ertekin *et al* (2005).

5. Conclusion

Oral administration of aqueous leaf extract of *Datura metel* to male Wistar rats on a daily basis for a duration of 14d produce varying degree of histological changes in the visual system of the rats. These histological changes are all indicative of necrotic process in the tissues with the involvement of lysosomal destruction. *Datura metel* is seen from the research work to be neurotoxic to the visual system in male Wistar rats.

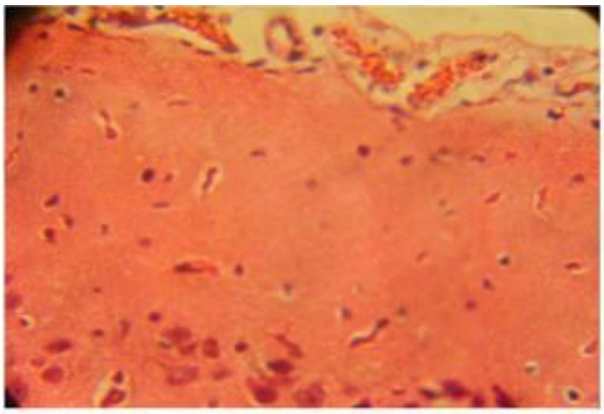

Fig 1a; Sections of the visual cortex in the animals treated with *Cannabis sativa* showing vacuolation of neurons, glial cells and pyramidal cells. The neurons appears sparsely stained (H&E x 520).

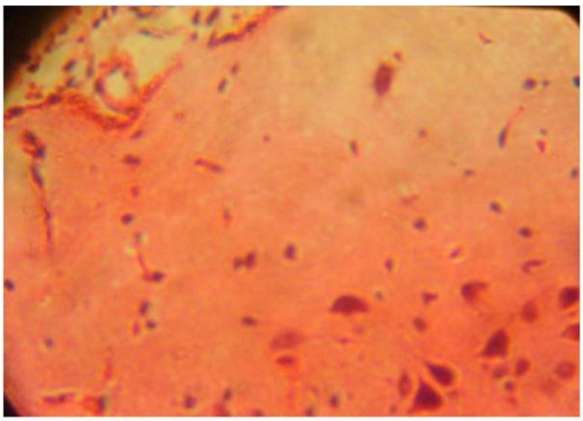

Fig 1b; Sections of visual cortex of the animals in the control group. There were no vacuolation in neurons, glial cells and pyramidal cells (H&E x520).

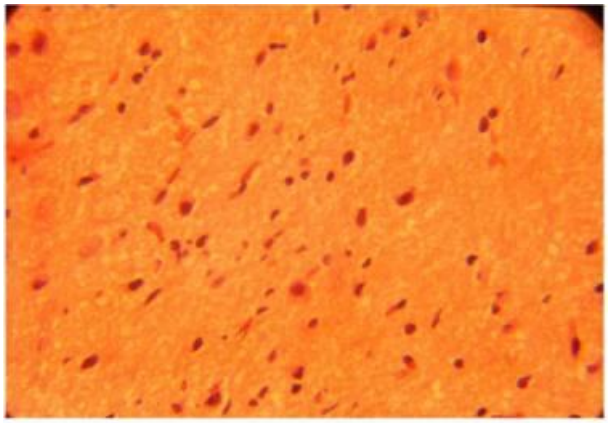

Fig 2a: Sections of lateral geniculate body of the animals treated with *Cannabis sativa* showing vacuolations in the stroma (H&E x520).

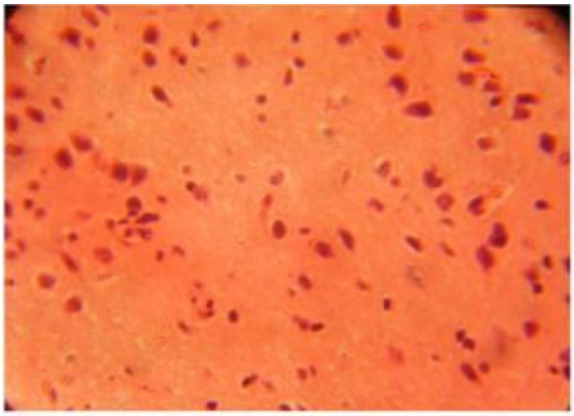

Fig 2b: Section of lateral geniculate body of the animals in the control group with well preserved histological outlines (H&E x520).

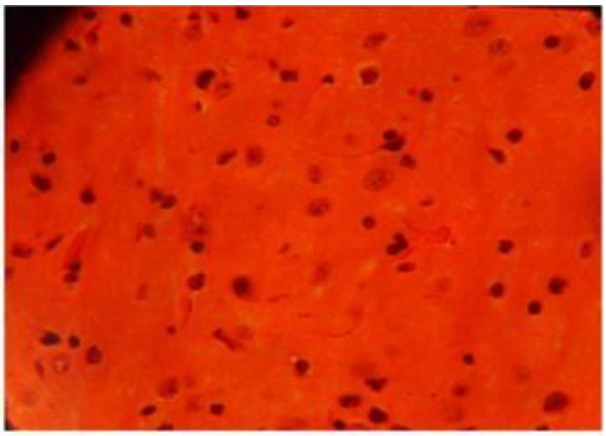

Fig 3a: Sections of superior colliculus of the animals treated with *Cannabis sativa* showing vacuolation of neurons (H&E x520).

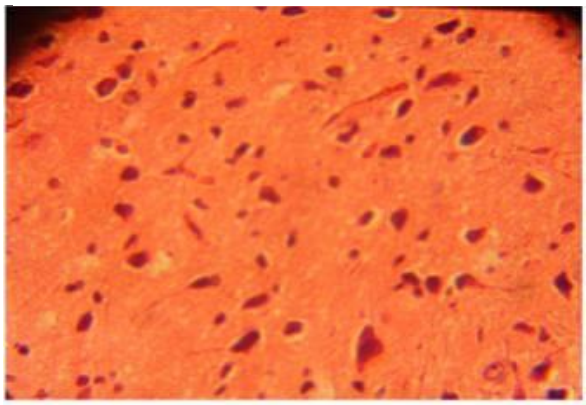

Fig 3b: Sections of superior colliculus of the animals in the control group showing intact neurons with preserved cytoarchitectural profile (H&E x520).

References

Allyn, C.H., 2004. Efficacy in CB1 receptor-mediated signal transduction. Br. J. Pharmacol. 142, 1209-1218.

Carlson, N.R., 2007.Physiology of Behavior, ninth edition. Boston, Allyn & Bacon, 752 pages.

Cooper, M.R., Johnson, A.W., 1984. Poisonous plants in Britain and their effects on animals and man. Her Majesty's Stationery Office, London, England 1984. 305 pp.

Dean, P., Redgraer, P., Weshy, G.W., 1989. `Event or Emergency` Two response systems in the mammalian superior Colliculus` Trendsn Neusic 12 (4).

Farber, J.L., Chein, K.R., Mittnacht, S., 1981. The pathogenesis of Irreversible cell injury in ischemia; Amer. J. Pathol. 102:271-281

Goodale, M.A., Milner, A.D., 1992. Separate visual pathways for perception and action. Trends Neurosci. 15(1), 20-25.

Hall, W., Solowij, N., 1998. Adverse effects of *Cannabis*. Lancet. 352, 1611 – 1616.

Hasan, S.S., Kushwaha, A.K., 1987. Chronic effect of datura (seed) extract on the brain of albino rats. Jpn. J. Pharmacol. 44, 1-6

Hayatghaibi, H., Karimi, I., 2007. Hypercholesterolemic Effect of Drug-Type *Cannabis sativa* L. seed (Marijuana seed) in Guinea Pig. Pakistan J. Nutr., 6(1), 59-62.

Huerta, M.F., Harting, J.K., 1984. Venegas H. ed. Comparative Neurology of the Optic Tectum. New York: Plenum Press. 687-773. ISBN 9780306412363.

Inderbir, S., Textbook of Human Neuroanatomy` Seventh Edition, PP 136 – 137, ISBN 81 – 8061 – 833 – 1

Ito, U., Sparts, M., Walker, J.R., Warzo, I., Experimental Cerebral Ischemia in Magolian Gerbils (1). Light microscope observations. Acta Neurophatology. USA. 32:209-223.

John, E.H., 2006. Guyton and Hall: Textbook of Medical Physiology, 11th Ed. Pp 641-642.

Margaret, G.A., modern herbal. Botanical.com (internet). © 1995-2011. Available from http://www.botanical.com/botanical/mgmh/mgmh.html

Martins, L.J., Al-Abdulla, N.A., Kirsh, J.R., Sieber, F.E., Portera-Cailliau, C., 1978. Neurodegeneration in excitotoxicity, global cerebral ischemia and target Deprivation: A perspective on the contributions of apoptosis and necrosis. Brain Res. Bull. 46(4), 281-309.

Muktar, A.H., Elbagir, N.M., 2011. Effect of *Cannabis sativa* on Hematological Indices in Man and Rats. Pakistan J. Nutr. 20(4), 313-316

National Institutes of Health Guide for the Care and Use of Laboratory Animals: DHEW Publication (NIH), revised. Office of Science and Health Reports, DRR/NIH, Bethesda, USA, 1985.

Nava, F., Carta, G., Battasi, A.M., Gessa, G.L., 2000. D_2 dopamine receptors enable Δ^9-tetra hydrocannabinol induced memory impairment and reduction of hippocampal extracellular acetylcholine concentration. British J. Pharm. 130, 1201–1210.

Radford, A.E., Ahles, H.E., Bell, C.R., 1964. Manual of the Vascular Flora of the Carolinas. University of North Carolina Press, Chapel Hill.

Ramesh, T., Mahesh, R., Begum, V.H., 2007. Effect of Sesbania grandiflora on Lung Antioxidant Defense System in Cigarette Smoke Exposed Rats. Inter. J. Biol. Chem. 1, 141-148.

Sarne, Y., Keren, O., 2004. Are cannabinoid drugs neurotoxic or neuroprotective. Med. Hypoth. 63, 187-192.

Satarug, S., Ujjin, P., Vanavanitkun, P., Nishijo, M., Baker, J.R., Moore, M.R., 2004. Effects of cigarette smoking and exposure to cadmium and lead on phenotypic variability of hepatic CYP2A6 and renal function biomarkers in men. Toxicol. 204, 161-173.

Smith, C.J., Livingstone, S.D., Doolittle, D.J., 1997. An international literature survey of IARC Group I carcinogens. Reported in mainstream cigarette smoke. Food. Chem. Toxicol. 35, 1107-1130.

Sulochana, K.N., Ramakrishnan, S., Punitham, R., Biju, J., 1998. Cadmium and superoxide dismutase in tobacco chewers with cataract. Ind. J. Pharmacol. 30, 413-413.

Tehranipour, M., Ebrahimpour, **S**., 2009. Evaluating the Effect of Aquatic Extract of *Cannabis sativa* Seed on Spatial Memory Consolidation in Rats. J. Biol. Sci. 9, 884-888.

Thefreedictionary.com (internet), 2011. New York: The Free Dictionary, Farlex Inc. (Cited April 18, 2011). Available from http://www.thefreedictionary.com/

Waters, C.M., 1994. Glutamate induced apoptosis of striatal cells in rodent model for Parkinsonism. Neurosci. 63, 1-5.

Wyllie, A.H., 1980. Glucocorticoid-induced thymocyte apoptosis in associated and endogenous endonuclease activation. Nature: London. 284, 555-556.