International Journal of Biomedical and Health Sciences
Vol. 6, No. 1, June 30, 2010
Printed in Nigeria

0794-4748/2010 $12.00 + 0.00

http://www.asopah.org

IJBHS 2009159/6201

Histological effects of chronic consumption of Nutmeg on the superior colliculus of adult Wistar rats

J. O. Adjene

Department of Anatomy, School of Basic Medical Sciences, University of Benin, Benin City, Edo State, Nigeria

(Received December 31, 2009)

ABSTRACT: The effects of chronic consumption of nutmeg commonly used as a spice in various dishes, as components of teas and soft drinks or mixed in milk and alcohol on the superior colliculus of adult wistar rats was carefully studied. The rats of both sexes (n = 24), with average weight of 200g were randomly assigned into two treatment (A & B) (n=16) and Control (c) (n=8) groups. The rats in the treatment groups (A & B) received 1g and 2g of nutmeg thoroughly mixed with the feeds respectively on a daily basis for thirty-two days. The control group (c) received equal amount of feeds daily without nutmeg added for thirty-two days. The growers mash feeds was obtained from Edo Feeds and Flour Mill Limited, Ewu, Edo state, Nigeria and the rats were given water liberally. The rats were sacrificed by cervical dislocation on the thirty-three days of the experiment. The superior colliculus was carefully dissected out and quickly fixed in 10% formal saline for histological study.
The findings indicate that rats in the treated groups (A&B) showed some cellular degenerative changes, hypertrophy, sparse cellular population, mild edema and vacuolations in the stroma of the superior colliculus as compared to the control group. Chronic consumption of nutmeg may therefore have an adverse effect on the visual sensibilities by affecting the microanatomy of the superior colliculus of adult wistar rats. It is recommended for further studies aimed at corroborating these observations.

Keywords: Histological Effects, Nutmeg, superior colliculus, Wistar rats.

Introduction

The Nutmeg plant, *Myristica fragrans* Houtt, is a member of the small primitive family called Myristicaceae, taxonomically placed between the Annonaceae and Lauraceae[1]. At Present, Myristicaceae is considered as a member of Magnotiales or its taxonomical equivalents [2, 3], Nutmeg has long been known for its psychoactive properties (producing anxiety/fear, Hallucination), from as early as 16th century writings to current internet based site [4,5,6].

To whom correspondence should be addressed. E-mail: joadjene@yahoo.com
Telephone: +2348034084016, +2348053478526.

Nutmeg is widely accepted as flavoring agents, are used in higher doses for their aphrodisiac and psychoactive properties in male rat [7,8]. Nutmeg and its Oleoresin are used in the preparation of meat products, soaps, sauces, baked foods, confectioneries, puddings, seasoning of meat and vegetables, to flavour milk dishes and punches. Powdered nutmeg is rarely administered alone, but enters into the composition of numerous medicines such as aromatic adjuncts. Medicinally, nutmeg is known for its stimulative and carminative properties [9,10]. In pregnancy and lactation, traditionally Nutmeg has been used as an abortifacient. Although this use has been largely discounted, but it remains a persistent cause of nutmeg intoxication in women[11]. The active ingredient in nutmeg is called Myristicine and is a naturally occurring insecticide and acaricide with possible neurotoxic effects on dopaminergic neurons and a monoamine oxide [12, 13]. Cytotoxic and apotoxic effects of Myristicine have been reported such that cell viability was reduced by exposure to Myristicine in a dose and dependent manner [13].

The superior colliculus is concerned with ocular movement. Such movements can result from stimulation of a wide area in the pretectal and tegmental regions of the brain. The superior colliculus controls and regulates many movements of the eye and head. It acts as an integrative center subserving visual perception. Thus, it also has a role in certain aspects of vision. Its major role is to co-ordinate responses evoked by a variety of sensory signals with behavioural movements that directs the head, eyes and ear towards the environmental stimulus. Thus, the superior colliculus has a critical role in visual localization, orientation tracking movements, accommodation and papillary reflex. Its superficial layers are concerned with vision [14], and its deep layer has been implicated in eye movements and somesthetic input [15]. Cortical structures such as the medial and lateral geniculate bodies, inferior and superior colliculi have higher glucose utilization than other structures. There is also a correlation between functional activity and metabolic rate such as in the visual and auditory system [16].

Since the neurons of the central nervous system is affected by nutmeg, it is relevant to investigate its effect on the superior colliculus. It is probable that the adverse cytotoxic and apotoxic effects of myristicine reported may be due to direct effect of nutmeg on the superior colliculi. This present study is to investigate the histological effects of chronic consumption of nutmeg on the superior colliculus of adult Wistar rats.

Materials and Methods

ANIMALS: Twenty-four adult wistar rats of both sexes with average weight of 200g were randomly assigned into three groups: A, B and C of (n=8) in each group. Group A and B served as treatment groups (n=16) while group C (n=8) served as the control. The rats were obtained and maintained in the Animal Holding of the Department of Anatomy, School of Basic Medical Sciences, University of Benin, Edo State, Nigeria. The animals were fed with grower's mash obtained from Edo Feeds and Flour Mill Limited, Ewu, Edo State, Nigeria and given water liberally. The Nutmeg seeds were obtained from Oba Market, Benin City, Edo State. They were dried and graded into powder at the Department of Pharmacognosy, Faculty of Pharmacy, University of Benin, Benin City.

NUTMEG ADMINISTRATION: The rats in the treatment groups (A & B) were given 1g and 2g of Nutmeg thoroughly mixed with the growers mash respectively on a daily basis for thirty-two days. The control group (c) received equal amount of feeds without Nutmeg added for the same period of thirty- two days. The rats were sacrificed by cervical dislocation on the thirty- three day of the experiment. The skulls were opened using bone forceps to expose the brain of the rats. The superior colliculus was quickly dissected out and fixed in 10% formal saline for routine histological techniques.

HISTOLOGICAL STUDY: The tissues were dehydrated in an ascending grade of alcohol (ethanol), cleared in xylene and embedded in paraffin wax. Serial sections of 7 microns thick were obtained using a rotatory microtome. The deparaffused sections were stained routinely with haematoxyline and eosin [17]. Photomicrographs of the desired results were obtained using research photographic microscope in the Department of Anatomy, School of Basic Medical Sciences, University of Benin, Benin city, Edo State, Nigeria.

Results

The desired sections of the superior colliculus from the control animals showed normal histological features with the neurons appearing distinct and of various sizes. The neuron and glial cells appeared normal and no vacuolation in the stroma of the sections (fig.1& 2).

The superior colliculus of the treated groups revealed some cellular degenerative changes such as hypertrophy and sparse cellular population. The stroma of the treated sections showed some mild edema and vacuolations (fig. 3& 4)

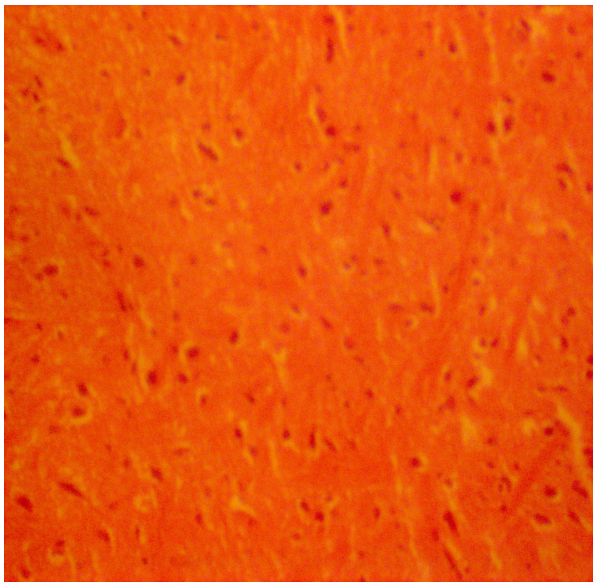

Fig.1: Control section of the superior colliculus (H & E method x100)

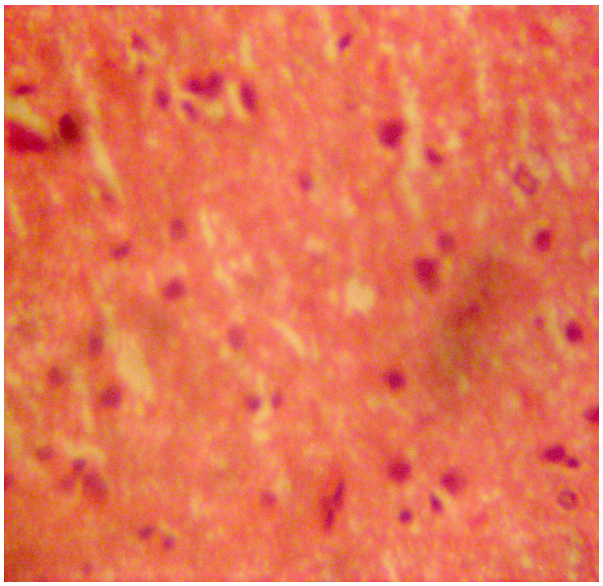

Fig.2: Control section of the superior colliculus (H & E method x400)

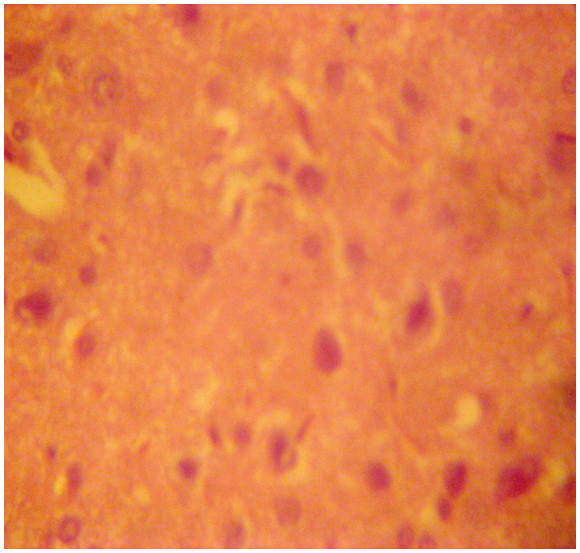

Fig.3: Treated section of the superior colliculus With 1g Nutmeg (H & E method x400)

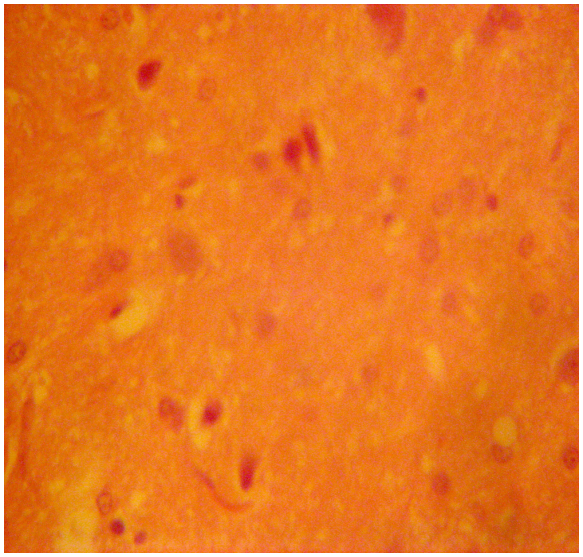

Fig.4: Treated section of the superior colliculus With 2g Nutmeg (H & E method x400)

Discussion

The results (H&E) of this experiment revealed some cellular degenerative changes such as hypertrophy and sparse cellular population. The stroma of the treated sections showed some mild edema and vacuolations in the treatment groups as compared to the control section of the superior colliculus. Neuronal degeneration has been reported to result in cell death, which is of two types, namely apoptotic and necrotic cell death. These two types differ morphologically and biochemically [18]. Pathological or accidental cell death is regarded as necrotic and could result from extrinsic insults to the cell such as osmotic, thermal, toxic and traumatic effects [19]. It was reported that cell death in response to neurotoxins might trigger an apoptotic death pathway within brain cells [20]. Cell death in response to neurotoxins occurs as a controlled event involving a genetic programme in which caspase enzymes are activated [20].

The process of cellular necrosis involves disruption of the membranes structural and functional integrity. Cellular necrosis is not induced by stimuli intrinsic to the cells as in programmed cell death (PCD), but by an abrupt environmental perturbation and departure from the normal physiological conditions [21]. There is the need to further investigate the actual mechanism by which nutmeg induced neuronal degeneration in the superior colliculus of adult Wistar rats in this study.

Extensive cell death in the central nervous system is present in all neurodegenerative diseases [20].The type of nerve cell loss and the particular part of the brain affected dictate the symptoms associated with an individual disease [20]. In this study nutmeg may have acted as toxin to the cells of the superior colliculus, affecting their cellular integrity and causing defect in membrane permeability and cell volume homeostasis.

In cellular necrosis, the rate of progression depends on the severity of the environmental insults. The greater the severity of the insults the more rapid the progression of neuronal injury [22]. The principle holds true for toxicological insult to the brain and other organs [21]. The prime candidates for inducing the massive cell destruction observed in neurodegeneration are neurotoxins[20]. These may be substances present in small amounts in the environment, or even naturally occurring chemicals such as glutamate used by the brain as transmitter's substances [20]. The latter when present at a critical level can be toxic to the brain cells they normally excite [20]. It could be inferred from this results that prolonged and high dose of nutmeg resulted in increased toxic effects on the superior colliculus. The decrease in cellular population observed in this study may have been as a result of cell death caused by the toxic effect of nutmeg. In the same way, it has been reported that chronic administration of chloroquine resulted in the cellular degenerative changes, sparse cellular population and vacuolation appearing in the stroma with some autophagic vacuoles in the inferior colliculus and medial geniculate body of adult Wistar rats [23,24].

The vacuolations observed in the stroma of the superior colliculus in this experiment may be due to nutmeg interference, since it has been reported that myristicine obtained from the nutmeg may have a cytotoxic and apotoxic effects on the body. The cellular hypertrophy observed in this experiment may be due to the adverse effects of nutmeg on the superior colliculus.

Since the neurons of the central nervous system is affected by nutmeg, it is probable that the results obtain in this experiment may have been due to the neurotoxic effect of nutmeg on the neuronal cells of the superior colliculus of adult wistar rats.

Conclusion and Recommendation

This study revealed that vary doses and long term consumption of nutmeg causes some cellular degenerative changes such as hypertrophy and sparse cellular population, mild edema and vacuolations in the stroma of the superior colliculus of adult Wistar rats. These results may probably affect the visual sensibilities functions of the superior colliculus in the adult wistar rats.

References

1. Joseph, J (1980): The Nutmeg, its Botany, Agronomy, Production, Composition and Uses. 2: 61-67
2. Cronquist A (1983): An integrated system of classification of flowering plants. Columbia University press. New York
3. Dahlgren R (1983): General aspect of antiosperm evolution and macro systematics. Nordic Journal botany, 3:119 -149
4. Brenner, N; Frank O.S; Knight, E (1993): Chronic Nutmeg Pschosis. 86:179-180.
5. Kelly, B.D; Gavin, B.E; Clarke, M; Lane, A Larkin, C (2003): Nutmeg and Psychosis. Schizophr Res, 60: 85 – 96.
6. Forrester, M.B (2005): Nutmeg Intoxication in Texas, 1998 – 2004. Hum Exp. Toxicol 24: 563-566.
7. Tajuddin, S; Ahmad, S; Latif, A; Qasmi, I.A (2003):Aphodisiac Activity of 50% Ethanol extract of myristica fragrans Houtt (Nutmeg) and Syzygium Aromaticum (L) Merr andPerry. (Clove) in male mice. A Comparative study. BMC Complement Altern Med. 3:6
8. Tajuddin, S; Ahmad, S; Latif, A; Qasmi, I.A; Amin, K.M (2005): An Experimental Study Of Sexual Function Improving Effect of Myristica fragrans . Houtt. BMC Complement Altern Med. 5:16

9. Madsen, H.L and Bertelsen, G (1996): Spices as antioxidants.rends Food Sci. Technol 6: 271- 277
10. Lagouri, V. and Boskou, D (1995): Screening for Antioxidant Activity of Essential Oils obtained from spices. In food flavors: Generation, analysis and process influence (ed Charalambous G), Amsterdam, Elsevier, pp. 869–79.
11. De Milto, L; Frey R.J (2005): Nutmeg. In: Longe J.L, Project editor, Gale Encyclopedia of Alternative Medicine. Vol.3 2nd ed. Detroit, ML:Thomson Gale 1461-1463
12. Truitt, E.B; Duritz, G; Ebersberger E.M (1963): Evidence of Mondamine Oxidase Inhibition by Myristicin and Nutmeg.Proc.Soc. Exp.Biol.Med.112: 647-650.
13. Lee, B.K; Kim J.H; Jung, J.W (2005): Myristicin-induced Neurotoxicity in Human neuroblastoma SK-N-SH Cells. Toxicol Lett. 157: 49- 56.
14. Reczkowski, D., and Diamond (1978): cells of origin of several efficient pathways from the superior colliculus in *Galago senegalerisis*. Brain research 146: 351-357.
15. Altman A.S, Bayer C.S (1981): Time of Origin of neurons of rat superior colliculus in relation to other components of the visual and visuomotor pathways. Experimental Brain Research., 42: 424-434.
16. Siesjo B.K (1978): Utilization of substrates by brain tissues. Brain energy metabolism. John Wiley and Sons, USA.101-130.
17. Drury, R.A.B; Wallington, E.A and Cameron, R (1967): Carleton's Histological Techniques: 4th ed., Oxford University Press NY. U.S.A. 279-280.
18. Wyllie, A.H (1980: Glucocorticoid-induced thymocyte apoptosis in associated and endogenous endonuclease activation. Nature: London.284:555-556.
19. Farber,J.L; Chein, K.R and Mittnacht, S (1981): The pathogenesis of Irreversible cell injury in ischemia; American Journal of Pathology 102:271-281
20. Waters, C.M (1994): Glutamate induced apoptosis of striatal cells in rodent model for Parkinsonism. Neuroscience 63:1-5
21. Martins LJ, Al-Abdulla NA, Kirsh JR, Sieber FE, Portera-Cailliau C (1978): Neurodegeneration in excitotoxicity, global cerebral ischaemia and target Deprivation: A perspective on the contributions of apoptosis and necrosis. Brain Res. Bull. 46(4): 281-309.
22. Ito, U, Sparts, M, Walker,J.R, Warzo, I (1975): Experimental Cerebral Ischemia in Magolian Gerbils(1). Light microscope observations. Acta Neurophatology. USA. 32:209-223.
23. Adjene J.O, Adenowo T.K (2005): Histological studies of the effect of chronic administration of Chloroquine on the inferior colliculus of adult Wistar rat JMBR 4(1): 83-87
24. Adjene J.O, Caxton-Martins A.E (2006): Some histological effect of chronic administration of Chloroquine on the medial geniculate body of Adult Wistar rat Afri. J. Med. Sci. 35: 131-135.