

## BASIC NEUROPHARMACOLOGY RESEARCH IN NIGERIA

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**SUMMARY**

From antiquity to date, the nervous system, unarguably the most complex system in living organisms has remained an area on intense research. Often regarded as the final frontier of science, discoveries relating to the nervous system are among the most spectacular discoveries in the history scientific research. In 1901, John Newport Langley (1852 – 1925) showed that an extract from the adrenal glands produced responses similar to those elicited when sympathetic nerves are stimulated. At about the same period, John Jacob Abel of Johns Hopkins University, together with A.C Crawford, isolated and purified the active principle from the adrenal gland which Abel named Epinephrine (Adrenaline).

This edition of chronicles of Medical history examines Neuropharmacology publications indexed in the database of the National Library of Medicine, PUBMED (the world's most famous biomedical database), with the aim of developing a broad chronological picture of basic Neuropharmacology research in Nigeria. Publications not indexed on PUBMED and not captured by the search terms were not captured, a major limitation of this review. Many publications that qualify as basic Neuropharmacology research were not reviewed because of this limitation. It is recommended that authors should pay greater attention to use of Research Units when stating affiliations and appropriate key words to enhance visibility during online searches.

Basic Neuropharmacology research in Nigeria, as shown by publications on PUBMED reviewed suggests that the subspecialty is young but vibrant and rapidly expanding, with more publications registered on the database in 2018 – 2019. The Neuropharmacology Unit of the University of Ibadan, Nigeria, ably headed by Dr. Solomon Umukoro (with a remarkable record of Postgraduate Student supervision) had 50% of the publications examined in this review. A significant majority of publications (76.2%) from the Neuropharmacology unit, University of Ibadan were during the period spanning 2018 to date of search (June 2019). This clearly shows the rise in Basic Neuropharmacology research at the Unit. However, the need for translation of basic research findings to bedside and community will be a major goal for the years to come. This need has partially been met with the completion of the Nathaniel Idowu Multidisciplinary Translational Research Complex at the Department. At this new Research Complex Basic and Clinical Researchers will work side-by side to extend the frontiers of Biomedical Research in Nigeria.

**Keywords:** Neuropharmacology, Research, Nigeria, History, Chronicles

**Neuropharmacology:** since antiquity, the nervous system, unarguably the most complex system in living organisms has remained an area on intense research. Often regarded as the final frontier of science, discoveries relating to the nervous system are among the most spectacular discoveries in the history scientific research. Nerve cells form complex networks that link the central nervous system to peripheral areas of the body. From observations on whole animals in behavioural studies to present day molecular studies, neuroscientists in various sub-specialties have gained insights into the workings of neurons and their multi-complex inter-connections.

In 1901, John Newport Langley (1852 – 1925) showed that an extract from the adrenal glands produced responses similar to those elicited when sympathetic nerves are stimulated. At about the same period, John Jacob Abel of Johns Hopkins University, together with A.C Crawford, isolated and purified the active principle from the adrenal gland which Abel named Epinephrine (Adrenaline). Studies conducted over the years following the identification of Epinephrine showed how neurotransmitters mediate the transfer of information from one nerve cell to another and to effector cells. This electrochemical transfer of signals

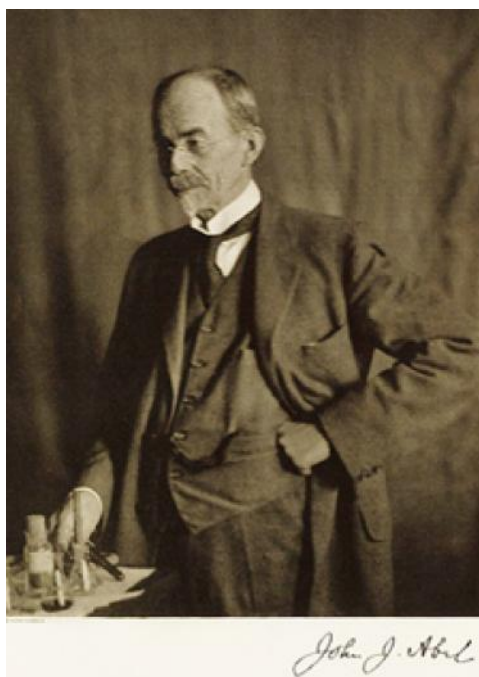


Photo of John Jacob Abel. Photo credit [https://en.wikipedia.org/wiki/John\\_Jacob\\_Abel](https://en.wikipedia.org/wiki/John_Jacob_Abel)

in the nervous system ignited a fury of research in the neurosciences.

Soon after the discovery of the principal neurotransmitters of the nervous system, drugs with demonstrable activities on the nervous system were found and methods of evaluating their effects were described. Neuropharmacology (the study of drugs and their effects on the nervous system) did not appear in the scientific field until the 1930s. In 1891, Paul Ehrlich observed the antimalarial effects of methylene blue, a phenothiazine derivative. Later, the phenothiazines were developed for their antihistaminergic properties and were subsequently used in the treatment of psychiatric patients which serendipitously uncovered its antipsychotic activity.<sup>1</sup> Though this drug showed very little hope in the use against malaria-infected individuals, it was found to have sedative effects along with what appeared to be beneficial effects toward patients with Parkinson's disease. From these simple beginnings, neuropharmacology has become a very broad region of science that encompasses many aspects of the nervous system from single neuron manipulation to entire areas of the brain, spinal cord, peripheral nerves, basic, clinical, and epidemiological specialties. Basic neuropharmacology encompasses an area of neuropharmacology that precedes studies in humans. From traditional *in vitro* and animal studies, basic neuropharmacology now involves numerous *in silico* models. This edition of chronicles of Medical history examines neuropharmacology publications indexed in the database of the National Library of Medicine, PUBMED (the world's most famous biomedical

database), with the aim of developing a broad chronological picture of basic neuropharmacology research in Nigeria.

**Methods:** PUBMED search was conducted in the month of June 2019. Using the search terms neuropharmacology and Nigeria (delimited, conducted in the month of June 2019), a chronological review of the publications are summarized. Articles were selected for inclusion in this review if the leading (first) author is affiliated with a tertiary institution in Nigeria. Though this approach may be limited, as many publications not index on PUBMED and/or not captured by the search terms were not examined and the search terms may be absent from articles satisfying the definition of neuropharmacology research, the general trend of basic neuropharmacology research in Nigeria is apparent. It is recommended that authors should pay greater attention to use of Research Units when stating affiliations and appropriate key words to enhance visibility during online searches.

#### **Basic Neuropharmacology Research in Nigeria:**

the earliest report on PUBMED, from the search method described above, was a publication from workers at the Department of Pharmacology, Obafemi Awolowo University, Ife. Akanmu and colleagues in 2011<sup>2</sup> found that some honey samples evaluated had central inhibitory property, anxiolytic, antinociceptive, anticonvulsant and antidepressant effects, thus may be used as nutraceuticals. It was also inferred that some of these effects were probably mediated through dopaminergic and opioidergic systems. From the same university, in the same year, and in the same journal, Bamitale, Akanmu, and Ukponmwan reported the Neuropharmacological profile of aqueous extract of *Anaphe venata* larva (Notonodotidae) in rats<sup>3</sup>. The investigators found that the extract inhibited the amphetamine-induced stereotype behaviour and locomotion. They concluded that the results showed that the anaphe-induced behavioural effects were mediated via cholinergic, GABAergic, opioidergic and dopaminergic receptor systems with strong muscarinic-cholinergic receptors involvement in ataxia-induced behaviour. From these results the authors suggested that muscarinic-cholinergic like drugs may be of benefit in the management of patients that present with the clinical condition of seasonal ataxia. In 2016, Dr Solomon Umukoro (Neuropharmacology Research Unit, Department of Pharmacology and Therapeutics, University of Ibadan, Nigeria) and collaborators conducted a study that evaluated the adaptogenic-like activity of methyl jasmonate (MJ) in mice exposed to unpredictable chronic mild stress<sup>4</sup>. Results of their study suggested that MJ demonstrated adaptogenic-like activity in mice;

**Table:** Abstracts of publications indexed on PUBMED database on basic neuropharmacology research in Nigeria (by the search term described in methods)

| Authors                                                                                                                   | Year of publication | Affiliation                                                                                                                                                                                                                                                                      | Title                                                                                                                                                                    | Major conclusion and Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Akanmu MA,</b><br>Olowookere TA,<br>Atunwa SA,<br>Ibrahim BO,<br>Lamidi OF,<br>Adams PA,<br>Ajimuda BO,<br>Adeyemo LE. | 2011                | Department of Pharmacology, Obafemi Awolowo University, Ile - Ife, Nigeria                                                                                                                                                                                                       | Neuropharmacological effects of Nigerian honey in mice.                                                                                                                  | The study showed that some of the honey samples evaluated had central inhibitory property, anxiolytic, antinociceptive, anticonvulsant and antidepressant effects, thus may be used as nutraceutical. It was also inferred that some of the effects were probably mediated through dopaminergic and opioidergic systems. <sup>2</sup>                                                                                                                                                                                   |
| <b>Bamitale KD,</b><br>Akanmu MA,<br>Ukponmwan OE.                                                                        | 2011                | Department of Physiological Sciences, College of Health Sciences Obafemi Awolowo University, Ile-Ife, Nigeria                                                                                                                                                                    | Neuropharmacological profile of aqueous extract of <i>Anaphe venata</i> larva (Notodontidae) in rats.                                                                    | The extract inhibited the amphetamine-induced stereotypic behaviour and locomotion. The results showed that anaphe-induced behavioural effects are mediated via cholinergic, GABAergic, opioidergic and dopaminergic receptor systems with strong muscarinic-cholinergic receptors involvement in ataxia-induced behaviour. The authors went on to suggest that muscarinic-cholinergic like drugs may be of benefit in the management of patients that present with clinical condition of seasonal ataxia. <sup>3</sup> |
| <b>Umukoro S,</b><br>Aluko OM,<br>Eduviere AT,<br>Owoeye O.                                                               | 2015                | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, University of Ibadan, Nigeria.                                                                                                                                                                              | Evaluation of adaptogenic-like property of methyl jasmonate (MJ) in mice exposed to unpredictable chronic mild stress.                                                   | The findings suggested that MJ demonstrated adaptogenic-like activity in mice; which might be related to modulation of serum corticosterone levels, inhibition of oxidative stress, and neuroprotection. <sup>4</sup>                                                                                                                                                                                                                                                                                                   |
| <b>Onaolapo OJ,</b><br>Onaolapo AY,<br>Akanmu MA,<br>Gbola O.                                                             | 2016                | Department of Pharmacology, Faculty of Basic Medical Sciences, College of Health Sciences, Ladoke Akintola University of Technology, Osogbo, Osun State, Nigeria; and Department of Pharmacology, Faculty of Pharmacy, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria. | Evidence of alterations in brain structure and antioxidant status following 'low-dose' monosodium glutamate ingestion.                                                   | The study showed morphological alterations consistent with neuronal injury, biochemical changes of oxidative stress and a rise in plasma glutamate and glutamine. The data was interpreted as supporting the need for cautious consideration in the use of MSG as a dietary flavour enhancer. <sup>5</sup>                                                                                                                                                                                                              |
| <b>Bamigboye JT,</b><br>Josephine Y O,<br>Olujide O O, A<br>OI, Shakir A M<br>A, Mark R J E,<br>Raymond C F J.            | 2016                | Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Obafemi Awolowo University, Ile Ife. Nigeria.                                                                                                                                                                       | Isolation of novel para-pentyl phenyl benzoate from <i>mondia whitei</i> (hook.f.) skeels (periplocaceae), its structure, synthesis and Neuropharmacological evaluation. | The data provided evidence for the role of para pentyl phenyl benzoate in the habitual consumption of the fruit as well as its central nervous system activities. <sup>6</sup>                                                                                                                                                                                                                                                                                                                                          |

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| <b>Eduviere AT</b> , Umukoro S, Adeoluwa OA, Omogbiya IA, Aluko OM.                                   | 2016 | Neuropharmacology unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Nigeria.                      | Possible Mechanisms Involved in Attenuation of Lipopolysaccharide-Induced Memory Deficits by Methyl Jasmonate in Mice.                                         | The findings showed that MJ offers protection against LPS-induced memory deficits via mechanisms related to inhibition of acetylcholinesterase, myeloperoxidase, oxidative stress and neuronal degeneration. <sup>7</sup>                                                                                                                                                                                                                                                                                                       |
| <b>Umukoro S</b> , Ogboh SI, Omorogbe O, Adekeye AA, Olatunde MO.                                     | 2017 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, University of Ibadan, Ibadan, Nigeria.                                           | Evidence for the Involvement of Monoaminergic Pathways in the Antidepressant-Like Activity of <i>Cymbopogon citratus</i> in Mice.                              | The results of the study showed that <i>C. citratus</i> might be interacting with serotonergic and noradrenergic pathways to mediate its anti-depressant-like effects in mice. <sup>8</sup>                                                                                                                                                                                                                                                                                                                                     |
| <b>Adebesin A</b> , Adeoluwa OA, Eduviere AT, Umukoro S.                                              | 2017 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria.           | <i>Methyl jasmonate</i> (MJ) attenuated lipopolysaccharide (LPS)-induced depressive-like behaviour in mice.                                                    | The findings suggested that attenuation of LPS-induced depressive-like behaviour by MJ may be related to suppression of oxidative stress and release of TNF alpha. <sup>9</sup>                                                                                                                                                                                                                                                                                                                                                 |
| <b>Adebesin A</b> , Ajayi AM, Olonode EO, Omorogbe O, Umukoro S.                                      | 2017 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Nigeria.                      | <i>Methyl Jasmonate</i> (MJ) Ameliorates Unpredictable Chronic Mild Stress-Induced Behavioural and Biochemical Alterations in Mouse Brain.                     | The findings suggested that MJ attenuated UCMS-induced depressive-like behaviours through decreased levels of corticosterone and decreasing oxidative stress and neuro-inflammation in mouse brain. <sup>10</sup>                                                                                                                                                                                                                                                                                                               |
| <b>Onaolapo OJ</b> , Onaolapo AY.                                                                     | 2017 | Behavioural Neuroscience/Neuropharmacology Unit, Department of Pharmacology, Ladoko Akintola University of Technology, Osogbo, Osun State, Nigeria.   | Melatonin, adolescence, and the brain: An insight into the period-specific influences of a multifunctional signalling molecule.                                | In the review, the influences of endogenous and exogenous melatonin on the adolescent brain, with specific reference to its involvement in the evolution of brain functions, brain structure, sleep regulation, and modulation of behaviours in health or disease were examined. <sup>11</sup>                                                                                                                                                                                                                                  |
| <b>Omorogbe O</b> , Ajayi AM, Ben-Azu B, Oghwese EE, Adebesin A, Aderibigbe AO, Okubena O, Umukoro S. | 2018 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Nigeria.                              | Jobelyn® (JB) attenuates inflammatory responses and neuro-behavioural deficits associated with complete Freund-adjuvant (CFA)-induced arthritis in mice.       | The study showed the ability of JB to attenuate CFA-induced nociception, sensorimotor deficits and depressive-like symptom which was interpreted as suggesting that it might improve the quality of life of patients with arthritic conditions. <sup>12</sup>                                                                                                                                                                                                                                                                   |
| <b>Ben-Azu B</b> , Aderibigbe AO, Omogbiya IA, Ajayi AM, Iwalewa EO.                                  | 2018 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria.           | Morin Pre-treatment Ameliorates Schizophrenia-Like Behaviours in Experimental Animal Models                                                                    | The results of the study revealed that morin demonstrated antipsychotic-like property devoid of extrapyramidal side effects in experimental animal models and that this may be beneficial in the treatment of schizophrenia-like behaviours; particularly in patients with behavioural hyperactivity and negative symptoms. <sup>13</sup>                                                                                                                                                                                       |
| <b>Umukoro S</b> , Adebesin A, Agu G, Omorogbe O, Asehinde SB.                                        | 2018 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Nigeria.                      | Antidepressant-like activity of methyl jasmonate (MJ) involves modulation of monoaminergic pathways in mice.                                                   | The results of the study suggested that serotonergic, noradrenergic and dopaminergic systems may play a role in the antidepressant-like activity of MJ. <sup>14</sup>                                                                                                                                                                                                                                                                                                                                                           |
| <b>Ben-Azu B</b> , Omogbiya IA, Aderibigbe AO, Umukoro S, Ajayi AM, Iwalewa EO.                       | 2018 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, PMB 5017, Oyo State, Nigeria. | Doxycycline prevents and reverses schizophrenic-like behaviours induced by ketamine in mice via modulation of oxidative, nitrenergic and cholinergic pathways. | The findings showed that doxycycline ameliorated schizophrenic-like behaviours induced by ketamine in both preventive and reversal treatment protocols in mice via inhibition of oxidative and nitrenergic alterations, and acetylcholinesterase activity. The data was further interpreted as suggesting that adjunctive oral administration of doxycycline may augment the therapeutic efficacy of risperidone particularly for the treatment of negative and cognitive symptoms associated with schizophrenia. <sup>15</sup> |

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| <b>Ben-Azu B,</b><br>Aderibigbe AO,<br>Ajayi AM,<br>Eneni AO,<br>Umukoro S,<br>Iwalewa E.                   | 2018 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria.                                 | Involvement of GABAergic, BDNF and Nox-2 mechanisms in the prevention and reversal of ketamine-induced schizophrenia-like behaviour by morin in mice.                                               | The findings were interpreted as suggesting that the antipsychotic-like activity of morin found during the study may be mediated through mechanisms related to enhancement of GABAergic neurotransmission and neurotrophic factor, and suppression of NADPH-oxidase induced oxidative damage in mice. <sup>16</sup>                                                                                                                                                      |
| <b>Onaolapo OJ,</b><br>Onaolapo AY.                                                                         | 2018 | Behavioural Neuroscience/Neuropharmacology Unit, Department of Pharmacology and Therapeutics, Ladoke Akintola University of Technology, Osogbo 230263, Osun State, Nigeria. | Melatonin in drug addiction and addiction management: Exploring an evolving multidimensional relationship.                                                                                          | The review examined the possible indications(s) for melatonergic agents in addiction management, and how manipulations of the endogenous melatonin system may be of benefit. <sup>17</sup>                                                                                                                                                                                                                                                                               |
| <b>Onaolapo AY,</b><br>Onaolapo OJ.                                                                         | 2018 | Behavioural Neuroscience/Neurobiology Unit, Department of Anatomy, Ladoke Akintola University of Technology, Ogbomosho 210211, Oyo State, Nigeria.                          | Circadian dysrhythmia-linked diabetes mellitus: Examining melatonin's roles in prophylaxis and management.                                                                                          | In the review, the authors discussed the roles of circadian rhythms in the regulation of the metabolism of carbohydrates and other macronutrients; with emphasis on the importance of melatonin and the impacts of its deficiency on carbohydrate homeostasis. <sup>18</sup>                                                                                                                                                                                             |
| <b>Ben-Azu B,</b><br>Nwoke EE,<br>Umukoro S,<br>Aderibigbe AO,<br>Ajayi AM,<br>Iwalewa EO.                  | 2018 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria.                                 | Evaluation of the Neurobehavioral Properties of Naringin in Swiss Mice.                                                                                                                             | The findings were interpreted as suggesting that naringin possesses anti-depressant- and anxiolytic-like activities as well as memory enhancing effect in mice. <sup>19</sup>                                                                                                                                                                                                                                                                                            |
| <b>Ben-Azu B,</b><br>Aderibigbe AO,<br>Eneni AO,<br>Ajayi AM,<br>Umukoro S,<br>Iwalewa EO.                  | 2018 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Oyo state, Nigeria.                                 | Morin (MOR) Attenuates Neurochemical Changes and Increased Oxidative/Nitrergic Stress in Brains of Mice Exposed to Ketamine: Prevention and Reversal of Schizophrenia-Like Symptoms.                | The findings were interpreted as suggesting that the anti-schizophrenic-like activity of MOR may be mediated via mechanisms related to attenuation of neurochemical changes and oxidative/nitrergic alterations in mice. <sup>20</sup>                                                                                                                                                                                                                                   |
| <b>Umukoro S,</b><br>Kalejaye HA,<br>Ben-Azu B,<br>Ajayi AM.                                                | 2018 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Nigeria.<br>Electronic address: umusolo@yahoo.com.          | Naringenin attenuates behavioural derangements induced by social defeat stress in mice via inhibition of acetylcholinesterase activity, oxidative stress and release of pro-inflammatory cytokines. | The findings suggested that naringenin attenuates SDS-induced neurobehavioral deficits through inhibition of acetylcholinesterase activity, oxidative stress and release of pro-inflammatory cytokines. <sup>21</sup>                                                                                                                                                                                                                                                    |
| <b>Ben-Azu B,</b><br>Aderibigbe AO,<br>Omogbiya IA,<br>Ajayi AM,<br>Owoeye O,<br>Olonode ET,<br>Iwalewa EO. | 2018 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria                                  | Probable mechanisms involved in the antipsychotic-like activity of morin in mice.                                                                                                                   | The findings suggested that morin may demonstrate antipsychotic-like therapeutic effect via modulation of oxidative/nitrergic, cholinergic actions and neuroprotection. <sup>22</sup>                                                                                                                                                                                                                                                                                    |
| <b>Onaolapo AY,</b><br>Onaolapo OJ.                                                                         | 2018 | Behavioural Neuroscience/Neurobiology Unit, Department of Anatomy, Ladoke Akintola University of Technology, Ogbomosho, Oyo State, Nigeria.                                 | Food additives, food and the concept of 'food addiction': Is stimulation of the brain reward circuit by food sufficient to trigger addiction?                                                       | In the review, the relevant literatures dealing with the concept of food addiction were examined, and the factors which may predispose to food addiction were discussed. The possible influences that flavour-enhancers, sugars, sugar substitutes and non-nutritive sweeteners may exert on central neurotransmission, neurotransmitter/receptor interactions, appetite, satiety, conditioned-preferences and the brain reward system were also examined. <sup>23</sup> |

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| <b>Onaolapo AY</b> , Odetunde I, Akintola AS, Ogundeji MO, Ajao A, Obelawo AY, Onaolapo OJ.           | 2018 | Behavioural Neuroscience/Neurobiology Unit, Department of Anatomy, Ladoke Akintola University of Technology, Ogbomosho, Oyo State, Nigeria.                                                                                                                                           | Dietary composition modulates impact of food-added monosodium glutamate (MSG) on behaviour, metabolic status and cerebral cortical morphology in mice.                                 | Animals were assigned to 8 groups [Standard diet SD control, High Fat Diet (HFD) control, and six groups fed MSG plus SD or HFD at 0.1, 0.2 and 0.4 g/kg of feed]. Compared to HFD, MSG/HFD groups had reduction in weight gain, food-intake, grooming and anxiety-response, an increase in locomotion, and improved memory. Protection against biochemical derangements and HFD-induced organ injuries were also observed. <sup>24</sup>                                                              |
| <b>Ben-Azu B</b> , Nwoke EE, Aderibigbe AO, Omogbiya IA, Ajayi AM, Olonode ET, Umukoro S, Iwalewa EO. | 2019 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria.                                                                                                                                           | Possible neuroprotective mechanisms of action involved in the neurobehavioral property of naringin in mice.                                                                            | The findings suggested that treatment with naringin might be useful to produce functional behavioral effects via mechanisms related to enhancement of cholinergic transmission, antioxidant defense systems, inhibition of lipid peroxidation and nitrosative processes. <sup>25</sup>                                                                                                                                                                                                                 |
| <b>Ofoegbu PU</b> , Lourenço J, Mendo S, Soares AMVM, Pestana JLT                                     | 2019 | Department of Biology and CESAM, University of Aveiro, Portugal; Department of Biology, Federal University of Technology, Owerri, Nigeria.                                                                                                                                            | Effects of low concentrations of psychiatric drugs (carbamazepine and fluoxetine) on the freshwater planarian, <i>Schmidtea mediterranea</i> .                                         | The study showed that freshwater planarians such as <i>Schmidtea mediterranea</i> , animal models in neuropharmacology, are sensitive to low concentrations of psychiatric drugs, displaying an array of sensitive sub-lethal endpoints that can be used for the ecological risk assessment of psychiatric substances. Future studies to determine effects of these psychiatric drugs on the levels of neurotransmitters and other biochemical biomarkers in planarians are recommended. <sup>26</sup> |
| <b>Onaolapo AY</b> , Onaolapo OJ, Nathaniel TI                                                        | 2019 | Behavioural Neuroscience/Neurobiology Unit, Department of Anatomy, Ladoke Akintola University of Technology, Ogbomosho, Nigeria.                                                                                                                                                      | Cerebrovascular Disease in the Young Adult: Examining Melatonin's Possible Multiple Roles.                                                                                             | In the review, the authors examined studies of stroke in the young adult and provided insights on the relationship between melatonin and stroke. <sup>27</sup>                                                                                                                                                                                                                                                                                                                                         |
| <b>Umukoro S</b> , Oghwere EE, Ben-Azu B, Owuoye O, Ajayi AM, Omorogbe O, Okubena O.                  | 2019 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Nigeria.                                                                                                                                                      | Jobelyn® (JB) ameliorates neurological deficits in rats with ischemic stroke through inhibition of release of pro-inflammatory cytokines and NF- $\kappa$ B signaling pathway.         | The findings showed the positive effects of JB on neurological function in rats with ischemic stroke that may be related to inhibition of oxidative stress, release of pro-inflammatory cytokines and expressions of immunopositive cells of NF- $\kappa$ B. <sup>28</sup>                                                                                                                                                                                                                             |
| <b>Onaolapo AY</b> , Ayeni OJ, Ogundeji MO, Ajao A, Onaolapo OJ, Owolabi AR.                          | 2019 | Behavioural Neuroscience and Neurobiology Unit, Department of Anatomy, Ladoke Akintola University of Technology, Ogbomosho, Oyo State, Nigeria.                                                                                                                                       | Subchronic ketamine alters behaviour, metabolic indices and brain morphology in adolescent rats: Involvement of oxidative stress, glutamate toxicity and caspase-3-mediated apoptosis. | It was shown that subchronic administration of ketamine to adolescent rats was associated with dose-related memory loss, oxidative stress and possibly caspase-3 mediated neurodegenerative changes. <sup>29</sup>                                                                                                                                                                                                                                                                                     |
| <b>Yetunde OA</b> , Yemisi OA, James OO                                                               | 2019 | Behavioural Neuroscience/Neurobiology Unit, Department of Anatomy, Ladoke Akintola University of Technology, Ogbomosho, Oyo State, Nigeria.                                                                                                                                           | Brain ageing, cognition and diet: a review of the emerging roles of food-based nootropics in mitigating age-related memory decline.                                                    | The review examined the role of food-based nootropics in the mitigation of age-related memory decline. <sup>30</sup>                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Ben-Azu B</b> , Aderibigbe AO, Ajayi AM, Eneni AO, Omogbiya IA, OwuoyeO, Umukoro S, Iwalewa EO.    | 2019 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, College of Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria; Department of Pharmacology, Faculty of Basic Medical Sciences, PAMO University of Medical Sciences, Port Harcourt, Rivers State, Nigeria. | Morin decreases cortical pyramidal neuron degeneration via inhibition of neuroinflammation in mouse model of schizophrenia.                                                            | Lipopolysaccharide in combination with ketamine significantly induced schizophrenia-like behaviours, which was attenuated by morin. Morin significantly decreased tumour necrosis factor- $\alpha$ , interleukine-6 levels and myeloperoxidase activity. <sup>31</sup>                                                                                                                                                                                                                                 |

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| <b>Omorogbe O</b>                                                                | 2019 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, University of Ibadan, Ibadan, Nigeria.                                                                                                                                                                                          | Jobelyn Attenuates Oxidative Stress and Improves Memory Performance in Mice Exposed to Anoxic Stress.                                                                                                                                                                 | The results suggested that the antioxidant activity of Jobelyn® might be contributing to its ability to attenuate sub-chronic anoxic stress-induced memory deficits in mice. <sup>32</sup>                                                                                                              |
| <b>Ekwutosi Patricia C,</b><br>Adewale Ganiyu B, Benneth BA, Ezekiel Olugbenga I | 2019 | Neuropharmacology Unit, Department of Pharmacology and Therapeutics, Faculty of Basic Medical Sciences, College of Medicine, University of Ibadan, Ibadan, Nigeria.                                                                                                                                  | Evaluation of the Memory Enhancing Activity of Dichloromethane (DCM) Fraction of the Methanolic Extract of <i>Pycnanthus angolensis</i> Stem Bark on Experimental Models of Memory Impairment.                                                                        | DCM increased glutathione, and superoxide dismutase, but decreased malondialdehyde and AChE activity in the brain. The findings suggested that DCM possesses significant memory enhancing activity, which may be due to enhancement of antioxidant activity and cholinergic transmission. <sup>33</sup> |
| <b>Ajayi AM1,</b><br>Ayodele EO(1), Ben-Azu B, Aderibigbe AO, Umukoro S.         | 2019 | Neuropharmacology unit, Department of Pharmacology & Therapeutics, University of Ibadan, Oyo-State, Nigeria.                                                                                                                                                                                         | Evaluation of neurotoxicity and hepatotoxicity effects of acute and sub-acute oral administration of unripe ackee ( <i>Blighia sapida</i> ) fruit extract.                                                                                                            | <i>Blighia sapida</i> unripe fruit extract increased susceptibility to seizure and impaired locomotor and memory function. The biochemical and histopathological findings revealed potential toxicity mechanisms related to neurotoxicity and hepatotoxicity. <sup>34</sup>                             |
| <b>Alabi AO,</b> Ajayi AM, Ben-Azu B, Bakre AG, Umukoro S                        | 2019 | Department of Pharmacology and Therapeutics, Faculty of Basic Medical Sciences, Olabisi Onabanjo University, Ago-Iwoye, Nigeria; Neuropharmacology Unit, Department of Pharmacology and Therapeutics, Faculty of Basic Medical Sciences, College of Medicine, University of Ibadan, Ibadan, Nigeria. | Methyl jasmonate (MJ) abrogates rotenone-induced parkinsonian-like symptoms through inhibition of oxidative stress, release of pro-inflammatory cytokines, and down-regulation of immunopositive cells of NF- $\kappa$ B and $\alpha$ -synuclein expressions in mice. | The findings suggested that MJ has anti-parkinsonian-like activity, which may be related to the inhibition of oxidative stress, release of pro-inflammatory cytokines, and down regulation of NF- $\kappa$ B and $\alpha$ -synuclein expressions. <sup>35</sup>                                         |

which might be related to modulation of serum corticosterone levels, inhibition of oxidative stress and neuroprotection. Table one summarizes the results of the PUBMED search in chronological order.

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Thirty-four publications fulfilled the set criteria for this review. The retrieved publications were from four Universities, Obafemi Awolowo University Ife (3 publications), University of Ibadan (21 publications), Ladoke Akintola University of Technology (LAUTECH, 9 publications), and the Federal University of Technology Owerri (1 publication). While the search very likely did not capture publications that did not mention Neuropharmacology even though they would have qualified for this review, there is a need for investigators to select journals carefully so they can be more visible on the world's most reputable

biomedical databases. The National Library of Medicine, NLM, owners of perhaps the most reputable database, has contributed immensely to the growth of every specialty of biomedical science. This database guarantees international visibility, a significant factor in the art and science of publishing science and medicine.

The Neuropharmacology unit of the college of medicine university of Ibadan, Nigeria, has established itself as a most vibrant hub of Neuropharmacology in Nigeria.

The Unit, ably headed by Dr Solomon Umukoro, has produced ground breaking research in basic Neuropharmacology. Together with his Postgraduate students, Dr Umukoro had 17 publications (50%) of the generated results on PUBMED. Interestingly, the recent years (2018 – 2019) have seen more publications indexed on PUBMED than the period spanning 2011 – 2017. With a remarkable record of supervision of



Department of Pharmacology and Therapeutics, Faculty of Basic Medical Sciences, College of Medicine, university of Ibadan, Nigeria. With the recently completed Nathaniel Idowu multidisciplinary Translational Research Complex forming the top floor of the Department.



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postgraduate students, the unit has graduated over 10 PhD students and countless M.Sc students within the period reviewed. The burden of neurological and neuropsychiatric illness in Nigeria is high.<sup>36,37</sup> However, the need for translation of basic research findings to bedside and community will be a major goal for the

years to come. This need has partially been met with the completion of the Nathaniel Idowu Multidisciplinary Translational Research Complex at the Department in February 2018. At this new Research Complex Basic and Clinical Researchers will work side-by side to extend the frontiers of Biomedical Research in Nigeria.



Dr. Solomon Umukoro, PhD, Neuropharmacology Unit, University of Ibadan, Nigeria



New Nathaniel Idowu Multidisciplinary Translational Research Complex, Department of Pharmacology, University of Ibadan, Nigeria

## CONCLUSION

Basic Neuropharmacology research as shown by publications on PUBMED suggests that the subspecialty is young but vibrant and rapidly expanding, with more publications registered on the database in 2018 – 2019. A significant majority of publications (76.2%) from the Neuropharmacology unit, University of Ibadan were during the period spanning 2018 to date of search (June 2019). This clearly shows the rise in Neuropharmacology research at the unit. However, the need for translation of basic research findings to bedside and community will be a major goal for the years to come.

**Conflict of Interest:** None

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