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7TH INAUGURAL LECTURE

Topic

"UNDERSTANDING THE SECRETS OF SCIENCE AND MEDICINE: MY JOURNEY OF FAITH PLUS A £100"

By

PROFESSOR ODUOLA OLAKUNTE ABIOLA

PROFESSOR OF CHEMICAL PATHOLOGY AND MOLECULAR NEUROSCIENCE

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INAUGURAL LECTURE SERIES 7

UNDERSTANDING THE SECRETS OF SCIENCE AND MEDICINE:
My Journey of Faith *plus a* £100

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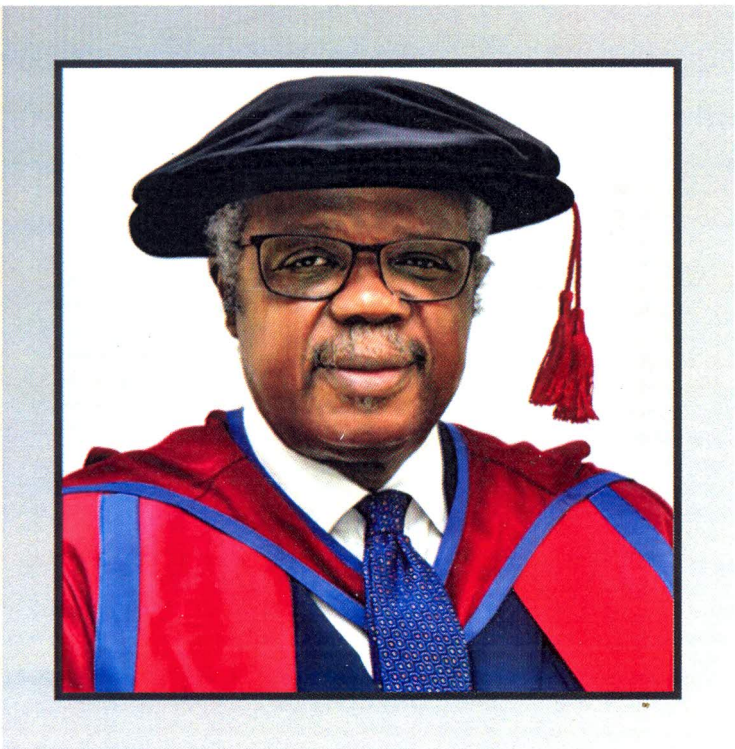
Professor of Chemical Pathology and Molecular Neuroscience

BOWEN UNIVERSITY, IWO
INAUGURAL LECTURE



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UNDERSTANDING THE SECRETS OF SCIENCE AND MEDICINE: My Journey of Faith plus a £100

An Inaugural Lecture Delivered at
Chris Alabi Lecture Theatre,
Bowen University, Iwo, Osun State, Nigeria
On Tuesday, 22nd June, 2021

by

PROFESSOR ODUOLA OLAKUNTE ABIOLA
Professor of Chemical Pathology and Molecular Neuroscience

Inaugural Lecture Series 7
June 2021

Bowen University,
Iwo, Nigeria

UNDERSTANDING THE SECRETS OF SCIENCE AND MEDICINE:
My Journey of Faith Plus One Hundred Pounds

The Vice-Chancellor, Sir, the Deputy Vice-Chancellor, Registrar, Bursar, University Librarian, University Chaplain, Chairman Committee of Provosts and Academic Directors, College Provosts, Directors, Deputy Provosts, Distinguished Professors and Members of Senate, Programme Coordinators, all Bowen University staff and students, my dear students: past and present, across professional disciplines at both undergraduate and postgraduate levels in all the continents of the world, Olivet 71 Set, all members of the Abiola Adulewu Clan worldwide, my lords spiritual and temporal, gentlemen of the press, distinguished guests, ladies and gentlemen.

It is indeed my immense pleasure to welcome you to the seventh in the inaugural lecture series of Bowen University where Excellence synergises with Godliness.

There are at least two unique things about my inaugural lecture of today: it comes by word of prophesy and has a forerunner. The forerunner came fourteen years ago, precisely on the 17th day of February, 2007 when about five months into my contract with the Pengiran Anak Puteri Hasnal Bolkiah Institute of Health Sciences, University of Brunei Darussalam, my Dean, after a casual discussion, told me that I was expected to give an "Inaugural Lecture". I said to him that 'but I was just a Senior Lecturer". He replied that it was the first time that the University had appointed an alumnus of King's College, London and someone with such a research exposure and profile that I had. For the first time, I realised that the divine privilege of birthing my academic career at the Institute of Psychiatry (IoP) (and now Institute of Psychiatry, Psychology and Neuroscience - IoPPN), King's College, London had conferred on me a presumed elitist stature as he gladly added that the Palace, meaning His Majesty, Sultan Hasnal Bolkiah was interested in my appointment. I had no excuse/choice but to consent: "He who pays the piper dictates the tune"! A few days later, I was given a date for the PAP Hasnal Bolkiah Institute of Health Sciences' First Inaugural Lecture that was February 17th 2007. Consequently, fourteen years and a few months ago, the forerunner to today's Inaugural Lecture titled "The mother, the child and their brain: Understanding the role of sex steroids in disorders of the brain" was delivered.

The main uniqueness of this Inaugural Lecture resides not only in its being Bowen University's 'Seventh' which, as 'philosophically spiritualised' by one of my colleagues on the B.MLS Programme symbolises perfection, but mainly in the fact that the push into my academic career, which has culminated in it, was given by a prophesy that was duly documented by my wife as it flowed at a Christian Fellowship Meeting in June 1982 at the UCH, Ibadan. While the prophesy was coming forth, I knew it was for me even though I did not write it down and was not seated with my young bride at the time. Once we got back to our 'Boys Quarters' one-room apartment in 'Angola' inside the UCH, my wife brought out her note and we discussed the prophecy extensively. This is summarised as "God's promise to show me the secrets of Science and Medicine with a demand for total dedication to the course". Seventeen years later on a visit home from the UK to bid my great father and mentor goodbye as he got ready to meet his Saviour and Lord, his last wish for me was to become a professor! It is this and the way the prophecy played out that gave rise to the title of this Inaugural Lecture.

Fast forward eight (8) years from 1982, I was on my way to London's Institute of Psychiatry to start my PhD in Neuroscience in what could be described only as a manifestation of God's unalloyed and unstinted faithfulness and goodness right at the beginning of what President George Bush, Snr christened the 'Decade of the Brain'. The intervening eight years were spent working in routine diagnostic Laboratories of the Oyo State Hospitals' Management Board notably Adeoyo State Hospital (now Adeoyo Maternity Hospital, Ibadan where my Medical Laboratory Science Career as a Laboratory Technician began in November, 1976); State Hospital, Oyo and Ring Road State Hospital, Ibadan as well as studying for a Master's degree in Chemical Pathology at the College of Medicine, University of Ibadan.

I arrived at De' Crespigny Park, Camberwell, London SE5 8AF, which houses the IoP then as an Institute of the British Postgraduate Medical Federation on Monday, 22nd January, 1990. It was to be my second home for the next sixteen and a half years as well as my primary academic career habitat where most of the work that I will be talking about today was carried out. It is the academic powerhouse for the Royal Bethlem Hospital, the world's first Neuropsychiatric Hospital as well as the Maudsley Hospital both of which are located in South East London.

Figure 1: Institute of Psychiatry, Psychology and Neuroscience, King's College London De' Crespigny Park, London SE5 8AF

Consonant with the traditions of Inaugural Lectures, I will be speaking on the highlights of my academic career thus far which essentially consist of my work on model systems relevant to psychosis: specifically postpartum psychiatric disorders; which was the work that I did to become a PhD. I will also be reporting on some of the work that I carried out on host factors that are involved in the pathogenesis of Transmissible Spongiform Encephalopathies (TSEs) otherwise called Prion Disorders in particular, Bovine Spongiform Encephalopathies (BSE, which is mad cow disease in layman's parlance) in cattle, and scrapie of sheep and goat. I will close by looking at what I call 'The Bowen Chapter' which essentially touches on my experience and work in Bowen University to date as well as research engagement in Bowen and the plan for the remainder of my academic career.

Postpartum Psychiatric Disorders

Childbirth is an eventful experience for a woman and her family and is anticipated to be a fulfilling one. However the immediate postpartum period is characterised by an increase in all psychiatric disorders (Wolk and Weissman 1995), except non-psychotic depression (Cooper et al., 1988). The rise is most

dramatic in the first month postpartum and may persist for up to two years (Kendal et al., 1987). For example, in the first three months following childbirth, a woman is 16-20 times more likely to have psychiatric admission to a hospital than in an equivalent period prior to conception (Kendell et. al., 1981). The psychiatric disorders of the postpartum period include postpartum blues, postpartum (postnatal) depression and postpartum (puerperal) psychosis (Zuckerman et. al., 1990). These disorders have distinct clinical features and affect women in all social classes and cultures (Robinson and Stewart, 1986).

Maternity blues

This is a mood instability that is characteristic of the puerperium (Iles et. al., 1989; Beck 2003). The affected new mothers have a lack of concentration, anxiety and an increased concern over their own welfare and the infant's health (Harding, 1989). The condition, which develops around the fourth postpartum day in up to 80% of newly delivered mothers is usually self-limiting and does not need hospital admission (O'Hara et. al., 1991). The symptoms, which generally abate by ten days after parturition (though a mother may occasionally have some mild residual symptoms for several months), are considered normal emotional changes related to the puerperium (Oates, 1986). Because up to 80% of new mothers may develop this condition, it can be argued that it is a normal phenomenon. However, when one considers that it may adversely affect the whole family, including the infant, it does seem to merit attention.

The "blues" are dysphoric reactions and may be intermingled with the normal feelings of happiness and achievement which follow childbirth; very occasionally, euphoria and elation may be excessive and could be associated with insomnia, and overactivity which may indicate impending manic psychosis (Kumar, 1990). Maternity blues have significant association with primiparity and tearfulness during pregnancy (Gard et. al., 1986), neuroticism, anxiety and depressed mood during pregnancy, a fear of labour, poor social adjustment and retrospectively, of severe premenstrual tension, but have no association with previous psychiatric disorders (Kennerly and Gath, 1989). Pessimism in late pregnancy, which is fulfilled by postpartum reality, an unplanned pregnancy and a consideration given to elective termination for have all been associated with associated with the blues (Condon and Watson, 1987). Thus, it is arguable that 'maternity blues' has a psychosomatic rather than obvious biological aetiology.

Postpartum depression

This form of depression develops in the first postpartum year in about 10-15% of new mothers and may be mild to severe, and either brief or prolonged (Brockington et al., 1992). In terms of severity, postpartum depression tends to represent the midway between maternity blues and postpartum psychosis (Weissman and Olfson, 1995). In comparison with non-postpartum depression, postpartum depressive episodes appear to be relatively milder (Whiffen and Gotlib, 1993) and in most cases, fail to reach the threshold of psychiatric referral (Brockington and Cox-Roper, 1988). About two thirds of major postpartum depressive episodes begin within two weeks after parturition (Brockington et al., 1992). However, there is a wide range of onset with some presentations occurring in the 24 months following delivery.

Postpartum psychosis

Postpartum psychosis was first described by Esquirol (1845). It is an acute psychotic syndrome and can be differentiated from maternity blues and postpartum depression as it is characterised by symptoms resembling an organic brain syndrome (Kumar, 1990). In postpartum psychosis, there is a marked impairment of reality testing as evidenced by hallucinations, delusions and gross disorganisation (Harding, 1989). It usually starts within two weeks of parturition, generally takes the form of an affective or schizo-affective disorder and has a frequency of 1-1.4 per 1000 pregnancies (Brockington et al., 1992). More than half of the affected women meet the diagnostic criteria for major depression (Brockington et al., 1992; Weissman and Olfson, 1995). Although the onset is usually within the first two weeks of the puerperium, the risk remains high for the first three months postpartum (Brockington et al., 1981; Weissman and Olfson, 1995). Because it seems to present as an organic brain syndrome without any evidence of associated psychosocial variables, the pathogenesis of postpartum psychosis appears to be predominantly biological.

Aetiology of postpartum psychosis

Postpartum psychosis provides a unique opportunity to investigate the aetiology and potential triggers of psychotic and mood disorders and, in no other psychiatric condition are we able to predict as precisely the onset of the disorder definable to within such a narrow timeframe in relation to a trigger (Perry et al., 2019). It is evident that the aetiology of postpartum psychosis like other psychiatric disorders is likely to be a complex interplay of several variables including biological and non-biological variables.

For over a century, the various studies on severe mental illnesses associated with the postpartum period have shown that the incidence of psychosis has remained constant at 1-2 women per thousand births (Kumar, 1990, for review). Thus, the much improved healthcare delivery and general improvements in the overall standard of living seem to have no effect on the incidence of this disorder. Investigations into the role of the other non-biological variables that have been studied have shown no consistent association with the disorder. For example, the observation of Agrawal et al. (1990), which significantly linked the birth of a female child to postpartum psychosis has not been replicated. So also the association of stressful life events (Brockington et al., 1990); and those of primiparity. Overall, it could be argued that the disorder to a great extent is independent of psychosocial factors.

On the contrary, the evidence of a biological aetiology seems highly convincing. For example, genetic factors (Schöpf and Rust 1994), sensitivity of hormonal changes that occur in relation to labour and parturition (Maguire et al., 2020), obstetric variables (Kendell et al. 1981), sleep and circadian rhythm disruption occurring within the peripartum period and immunological factors (Piccoli de Melo et al., 2017).

Female sex steroid hormones and postpartum psychosis

Of particular relevance to this study is the overwhelming involvement of female sex steroid hormones. They are an integral part of the endocrine system which acts to coordinate the complex events involved in the development, differentiation and physiological response to stimuli (McEwen, 1994 for review); are profoundly important and their aberrant production is associated with a broad spectrum of diseases (Evans, 1988). They readily cross the blood brain barrier (Backstrom et al., 1982) and with their receptors being widely distributed in the brain, they are therefore able to act on the central nervous system (CNS) and modulate the activities thereby influencing human and animal behaviour (Weeks and Levin, 1995). At the molecular level, gonadal hormones affect among others CNS neuronal enzyme activities, neurotransmitter syntheses, uptake and turnover (McEwen and Parsons, 1982), neuronal growth and differentiation (Ch'ang et al., 1997).

Variations in circulating levels of oestrogen and progesterone across the menstrual cycle have been observed in humans and are associated with mood changes. During pregnancy, oestradiol and progesterone concentrations increase several folds reaching more than 100 times the average menstrual

cycle levels at the end of gestation (Willcox et al., 1985). At parturition and following on from the expulsion of the placenta, there is a phenomenal fall in the circulating levels of both oestrogen and progesterone. Interestingly in rats, oestradiol and progesterone concentrations not only vary across the oestrous cycle but are significantly increased towards the of pregnancy (Escalada et al., 1996) and observe similar reduction at parturition. Given that oestrogen and progesterone concentrations vary across normal ovulation cycles, during pregnancy and in the immediate postpartum period in both mammalian species, the rat arguably therefore, is ethically a model for studying molecular events that may characterise reproductive activities and associated events in humans.

Candidate systems for the study of the biology of postpartum psychosis

Clinically, postpartum psychosis has been shown to share symptomatology with schizophrenia, bipolar affective disorders and schizo-affective disorders (Brockington et al., 1992). Furthermore, postpartum psychosis is therapeutically responsive to electroconvulsive therapy, neuroleptics and antidepressant drugs which are therapeutic regimes used for some forms of schizophrenia and major affective disorders (Kumar, 1990; Seeman, 1987). Since both symptomatology and treatment are assumed to be underlined by biological mechanisms, such data suggest that postpartum psychosis may share aetiological bases with schizophrenia and/or bipolar affective disorders. In investigating the aetiology of postpartum psychosis therefore, it is relevant to consider the biological bases of these disorders. For example, the dopaminergic system is associated with bipolar affective disorders and schizophrenia (Seeman, 1987) and the serotonergic system with both schizophrenia and depression (Kandel 1991; Perry et al., 2019; for review).

Considerable clinical and experimental evidence show that in the CNS, oestrogen and progesterone significantly influence both the nigro-striatal dopaminergic pathway, which controls movement and the mesolimbic dopaminergic system which has a role in affect. This is likely facilitated by the proximity of the steroid hormone receptors and the anatomical location of the dopaminergic systems. Experimental data for example show that oestrogen decreases the expression of Tyrosine hydroxylase the rate limiting enzyme in catecholamine synthesis (Levitt et al., 1965) and increases the striatal density of D1 and D2 receptors in male and ovariectomised rats (Di Paolo et al., 1979; Levesque and Di Paolo, 1989) possibly as a consequence.

Oestrogen and progesterone have also been shown to increase serotonergic function in both human and animals and seem to affect serotonin (5HT)

Postpartum psychosis is a distinct clinical entity that shares certain clinical features with schizophrenia and affective disorders. The similarity in the clinical presentation of postpartum psychosis and schizo-affective disorders suggests a relationship which possibly results from similar biological basis.

Although several aetiological factors may have been implicated in the development of postpartum disorders, it can be argued that the most likely factor appears to be the sharp reduction in female sex steroid hormone levels in the peripartum period. Female sex hormones themselves have widespread effects in the brain at various times which are consistent with both genomic and non-genomic actions and include CNS actions consistent with the brain's role in controlling female sex steroid hormone secretion during menstrual cycle and actions on both motor and cognitive functions.

In view of the possible link between female sex steroid hormone action and postpartum psychotic disorders, this study investigated the effects of oestradiol and progesterone on genes that have been implicated in the aetiology of schizophrenia and affective disorders as an appropriate starting point for studies of the biological basis of postpartum psychosis using both in-vitro and in-vivo systems.

In-vitro system

The in-vitro system used 2-dimensional polyacrylamide gel electrophoresis (2DPAGE) to identify changes in human lymphocyte protein synthesis modulated by oestrogen and progesterone that might be used to study trait differences between individuals. I will not be going into the details of this, however, suffice it to say that data from it were published *in Journal of Psychiatric Research (1997).*

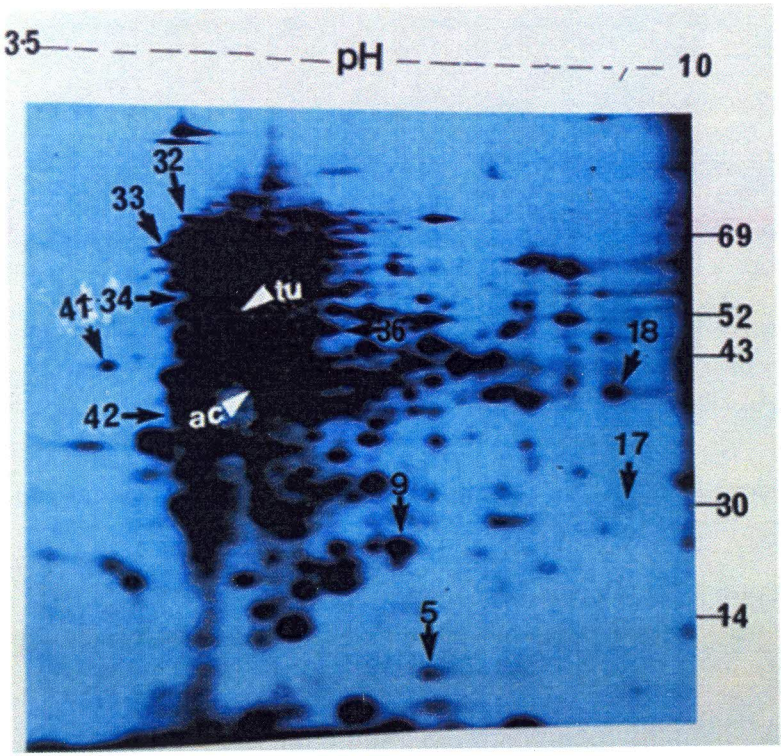

Figure 2. Fluorograph of 2-Dimensional Gel Electrophoresis of lymphocyte proteins.
The numbered proteins were significantly affected when treated with either oestradiol and progesterone. The right-hand numbers indicate relative markers and migration of standard markers.
Key: ac, actin; tu, tubulin.

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EFFECTS OF SEX STEROIDS ON PROTEIN SYNTHESIS IN CULTURED HUMAN LYMPHOCYTES

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Summary—In cultured human lymphocytes, oestrogen and progesterone at concentrations found in plasma during the normal menstrual cycle, significantly increase the incorporation of [^{35}S] methionine into protein and, in addition, both hormones significantly alter the relative synthesis of certain proteins. At concentrations found in plasma during pregnancy, some changes are augmented while others are reversed. These specific sex-steroid-induced changes in protein synthesis provide possible peripheral biological markers of hormone action which may be tested for their association with predisposition to, and/or onset of, conditions such as postpartum psychiatric illness. Copyright © 1996 Elsevier Science Ltd.

Table 1
Effects of Oestradiol on the Synthesis of Specific Peptides

Peptide number	Molecular weight (kDa)	Control	0.1 nM	10 nM	1000 nM
17	35.5	1.125 (100%) ±0.144	1.473* (131%) ±0.396	0.617' (55%) ±0.265	0.438** (39%) ±0.147
18	50	0.573* (100%) ±0.213	1.228' (214%) ±0.284	1.156' (202%) ±0.355	1.864** (325%) ±0.395
32	79.4	1.397* (100%) ±0.143	0.410** (29%) ±0.123	0.510' (37%) ±0.153	0.498' (36%) ±0.334
33	77.2	1.423 (100%) ±0.438	2.026** (142%) ±0.301	2.612' (185%) ±0.600	2.191' (154%) ±0.347
34	64	0.566 (100%) ±0.198	0.590 (104%) ±0.363	1.138* (201%) ±0.465	1.155** (204%) ±0.052
36	56.2	0.277* (100%) ±0.033	0.958' (345%) ±0.383	0.752' (271%) ±0.420	0.809 (292%) ±0.542

Normalized integrated grey values (IGVs) of proteins whose syntheses were significantly influenced by oestradiol (mean ± *SD* for four separate experiments except * where $n = 3$). $^{'}p < .05$; $^{''}p < .025$; $^{'}p < .01$; $^{*}p < .005$; $^{**}p < .0025$; $^{'}p < .0005$. (Student's *t*-test, two tailed.) Percentage of value relative to control is shown in brackets.

Table 2
Effects of Progesterone on the Synthesis of Specific Peptides

Peptide number	Molecular weight (kDa)	Control	0.1 nM	10 nM
5	16.8	0.652 (100%) ±0.172	0.280' (43%) ±0.153	0.225* (35%) ±0.163
9	29	0.539 (100%) ±0.033	0.883** (164%) ±0.276	1.043* (193%) ±0.487
41	46	1.050 (100%) ±0.389	1.840* (175%) ±1.312	1.567* (149%) ±0.238
42	44.7	0.942 (100%) ±0.491	0.331* (35%) 0.188	0.643 (68%) ±0.499

Normalized integrated grey values (IGVs) of proteins whose syntheses were significantly affected by progesterone (mean ± *SD* for four separate experiments except * where $n = 3$). $^{*}p < .05$; $^{''}p < .0125$; $^{'}p < .01$. (Student's *t*-test, two tailed.) Percentage of value relative to control is shown in brackets.

Figure 3: Plate of in-vitro publication summary of results

In-vivo system

The in-vivo study used a rat model of the postpartum period to investigate the regional expression of genes of the central dopaminergic systems, a serotonin receptor isoform and the mitochondrial enzymes of oxidative metabolism with the aid of in-situ hybridisation histochemistry. In addition, cytochrome oxidase activity was measure by a quantitative histochemical staining and oestrogen and progesterone concentrations were determined by ELISA. I will be presenting data on steroid concentrations and region specific expression of genes for D2 and D4 receptor isoforms and 5HT1A receptor.

Results

Plasma oestrogen and progesterone concentrations are different in the 4 groups of the rat model of the human postpartum period (See Table 1) and correlate the mRNA levels of the transmitter receptors to varying degrees.

Table 1: Plasma oestradiol and progesterone concentrations in control (C), pregnant (PREG), postpartum (PP), ovariectomised (OVX) rats

Group	Female sex steroid hormones	
	Oestradiol (pMol)	Progesterone (nMol)
C	103±15 (100)	218±35 (100)
PREG	333±49^{c} (323)	1029±142^{c} (472)
PP	97±14 (94)	447±51^{b} (205)
OVX	65±15^{a} (63)	76±13^{c} (34)

Table 1: Plasma oestradiol (pMol) and progesterone (nMol) concentrations (mean±SEM) for 6 sets of estimations in the 4 groups of rats used in this study (percentage of controls are in brackets). "p" values (Students' t-test, two tailed) for comparison between C and each of the other 3 groups are shown in superscript: ap<0.05; bp<0.005; cp<0.001.

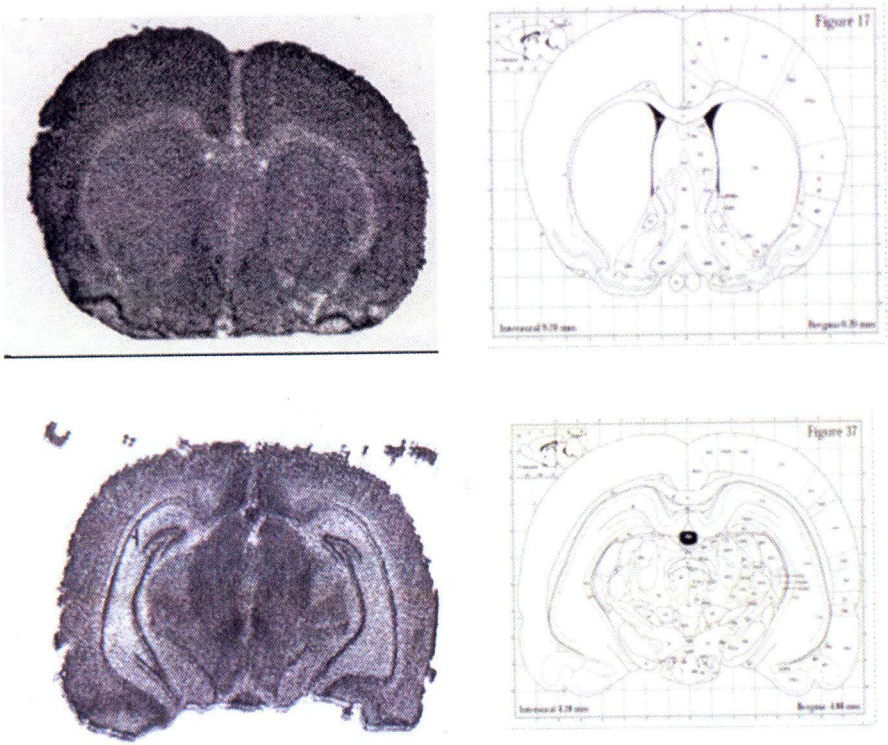


Figure 4: Autoradiograph of Representative coronal sections of anterior and posterior regions of the brain and corresponding plates from a Brain Atlas.

There is increased expression of $D_{2(A\&B)}$ and D4 receptors in pregnancy with further increases and in the postpartum.

D_{2A} receptor mRNA (normalised grey values: NGV) in rat groups

Brain Region	Groups			
	Control	PREG	PP	OVX
ACB	6.58±0.5 (100)	7.78±0.4[a] (118)	10.37±0.4[c] (158)	5.44±0.5 (83)
AMY	8.43±0.8 (100)	9.36±0.8 (111)	9.92±0.8 (118)	7.10±0.4 (84)
CA1	8.66±0.8 (100)	8.98±0.7 (104)	9.24±1.0 (107)	7.22±04 (83)
CA3	8.28±0.5 (100)	10.24±0.4[a] (124)	9.96±0.8[a] (120)	7.63±0.5 (92)
CG	8.31±0.8 (100)	9.73±0.5[a] (117)	11.27±0.3[b] (136)	6.57±0.8 (79)
DG	10.46±0.4 (100)	11.85±0.7[a] (113)	13.16±0.7[b] (126)	8.58±0.2[a] (82)
ENT	8.68±0.6 (100)	8.15±0.7 (94)	8.49±0.5 (98)	7.34±0.5 (85)
LS	6.44±0.4 (100)	8.11±0.6 (126)	9.02±0.9[a] (140)	6.22±0.6 (97)
PC	9.46±0.6 (100)	9.74±0.4 (103)	7.82±1.3 (83)	7.68±0.6 (81)
SN	9.83±0.6 (100)	10.54±0.5 (107)	10.02±0.7 (102)	8.94±0.4 (91)
STR	7.38±0.6 (100)	10.78±1.2[a] (146)	13.34±1.5[c] (181)	6.59±0.8 (89)
TS	6.94±0.6 (100)	9.62±1.3[a] (139)	11.99±1.4[c] (173)	6.41±0.6 (92)
VTA	10.65±1.0 (100)	10.50±0.9 (99)	9.87±0.5 (93)	9.29±0.2 (87)
MOE	8.47±0.2 (100)	9.64±0.3[b] (114)	10.34±0.3[c] (122)	7.31±0.2 (86)

Table 3: NGV for 6 sets of estimations in the 4 groups of rats used in this study (control percentages are in brackets). "p" values (Students' t-test, two tailed) for comparison between C and each of the other 3 groups are shown in superscript: ap<0.05; bp<0.005; cp<0.001.

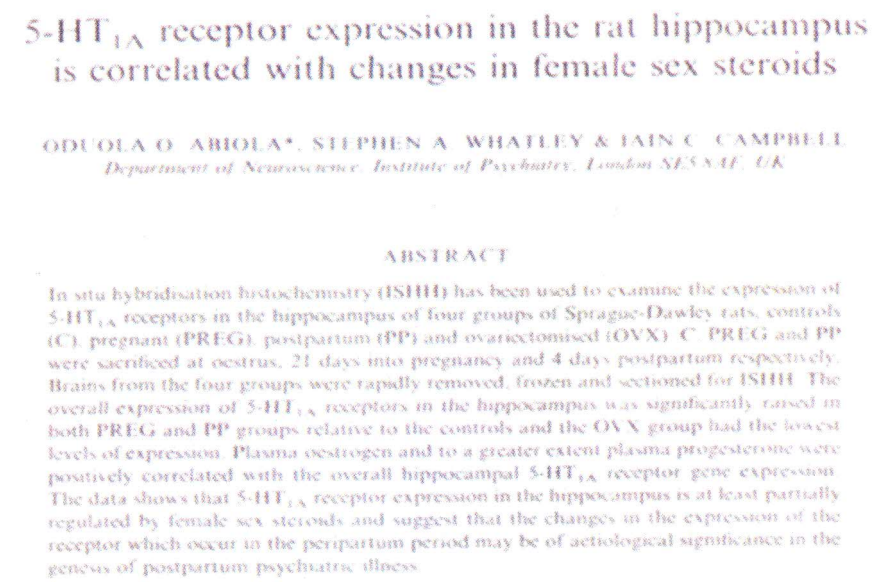
D2B receptor mRNA (normalised grey values: NGV) in rat groups

Brain Region	Groups			
	Control	PREG	PP	OVX
ACB	7.16±0.6 (100)	10.74±1.2[c] (150)	10.46±0.9[d] (146)	6.82±0.6 (95)
AMY	11.41±0.3 (100)	12.89±0.5[a] (113)	13.43±1.1 (118)	8.74±0.6[c] (84)
CA1	13.43±0.8 (100)	14.78±1.1 (110)	16.00±1.4[a] (119)	9.29±08[a] (69)
CA3	12.22±0.2 (100)	13.87±0.6 (114)	15.33±0.8[a] (125)	9.30±0.7[a] (76)
CG	7.10±0.2 (100)	7.70±1.0 (108)	10.19±1.0[a] (144)	7.09±0.6 (100)
DG	14.68±0.8 (100)	16.58±1.1 (113)	15.31±1.4 (105)	11.82±0.7[a] (81)
ENT	11.05±0.5 (100)	13.27±0.5[a] (120)	13.11±0.5[b] (119)	9.98±0.6 (90)
LS	7.05±0.6 (100)	8.04±0.7[c] (114)	9.87±0.8[c] (140)	7.82±0.7[a] (111)
PC	12.14±0.5 (100)	14.41±0.7[a] (110)	13.86±1.0 (112)	10.36±0.5[a] (85)
SN	13.31±0.6 (100)	14.82±0.6c (111)	14.84±1.1 (111)	11.91±0.6 (89)
STR	7.30±0.4 (100)	9.44±1.3 (129)	12.28±1.4[b] (175)	8.62±0.8 (118)
TS	7.57±0.9 (100)	10.73±0.8[d] (142)	13.19±1.6[c] (174)	7.98±0.8 (105)
VTA	13.42±0.9 (100)	12.72±0.7 (95)	12.25±0.5 (91)	11.57±0.4 (86)
MOE	10.60±0.2 (100)	12.30±0.3[b] (115)	13.09±0.4[c] (123)	9.33±0.3 (88)

Table 4: NGV for 6 sets of estimations in the 4 groups of rats used in this study (control percentages are in brackets). "p" values (Students' t-test, two tailed) for comparison between C and each of the other 3 groups are shown in superscript: ap<0.05; bp<0.005; cp<0.001.

$5HT_{1A}$ Receptor expression in the *in-vivo* model

Increase in the expression of $5HT_{1A}$ receptor is densely located in the hippocampus and its expression is significant only the postpartum group: Abiola et al., (1997) *J Serotonin Res.*, **4**, 1-9.



5-HT_{1A} receptor expression in the rat hippocampus is correlated with changes in female sex steroids

ODUOLA O. ABIOLA*, STEPHEN A. WHATLEY & IAIN C. CAMPBELL

Department of Neuroscience, Institute of Psychiatry, London SE5 8AF, UK

ABSTRACT

In situ hybridisation histochemistry (ISHH) has been used to examine the expression of 5-HT_{1A} receptors in the hippocampus of four groups of Sprague-Dawley rats, controls (C), pregnant (PREG), postpartum (PP) and ovariectomised (OVX). C, PREG and PP were sacrificed at oestrus, 21 days into pregnancy and 4 days postpartum respectively. Brains from the four groups were rapidly removed, frozen and sectioned for ISHH. The overall expression of 5-HT_{1A} receptors in the hippocampus was significantly raised in both PREG and PP groups relative to the controls and the OVX group had the lowest levels of expression. Plasma oestrogen and to a greater extent plasma progesterone were positively correlated with the overall hippocampal 5-HT_{1A} receptor gene expression. The data shows that 5-HT_{1A} receptor expression in the hippocampus is at least partially regulated by female sex steroids and suggest that the changes in the expression of the receptor which occur in the peripartum period may be of aetiological significance in the genesis of postpartum psychiatric illness.

Figure 5: Plate of Pg.1 of paper on 5HT1A receptor expression showing the Abstract

D_4 receptor mRNA (normalised grey values: NGV) in rat groups

Brain Region	Groups			
	Control	PREG	PP	OVX
ACB	6.48±0.2 (100)	7.60±0.2^c (117)	7.75±0.1^c (120)	5.80±0.1 (90)
AMY	6.35±0.2 (100)	7.56±0.1^b (111)	7.60±0.1^c (120)	5.88±0.2 (93)
CA1	7.47±0.5 (100)	7.25±0.6 (97)	9.33±1.1^a (125)	7.06±0.5 (95)
CA3	9.08±0.5 (100)	10.29±1.2 (113)	12.20±1.3^a (134)	7.91±0.8 (87)
CG	6.90±0.3 (100)	7.80±0.1^a (113)	7.90±0.1^b (115)	6.05±0.2 (88)
DG	8.60±0.4 (100)	8.90±0.1 (103)	9.31±1.0 (108)	9.22±0.8 (108)
ENT	6.83±0.4 (100)	6.85±0.7 (100)	7.86±0.6 (115)	7.42±1.0 (109)
LS	6.48±0.3 (100)	7.59±0.2^a (117)	7.47±0.2^b (115)	5.97±0.1 (92)
PC	7.63±0.7 (100)	7.97±0.1 (103)	9.85±1.1^a (129)	7.21±1.0 (94)
STR	6.14±0.1 (100)	6.99±0.1^b (114)	7.29±0.1^c (119)	5.30±0.2^a (86)
TS	6.40±0.2 (100)	7.21±0.1^c (113)	7.45±0.2^c (116)	5.72±0.2 (89)
VTA	6.41±1.0 (100)	7.49±0.1^c (117)	7.41±0.2^c (116)	5.55±0.2 (87)
MOE	7.06±0.3 (100)	7.79±0.3 (114)	8.45±0.4^c (120)	6.60±0.3 (93)

Table 5: NGV for 6 sets of estimations in the 4 groups of rats used in this study (control percentages are in brackets). "p" values (Students' t-test, two tailed) for comparison between C and each of the other 3 groups are shown in superscript: $a p<0.05$; $b p<0.005$; $c p<0.001$.

Conclusion

Parturition in the rat is a relevant and accepted model for studying human parturition with respect to the profiles of plasma oestradiol and oestrogen receptors in oestrogen responsive cells in late pregnancy and early postpartum period (Fang et al., 1996). There is an increased expression of dopamine and serotonin receptors in the brain in late pregnancy with further increases in the postpartum: the mechanisms that if produced in humans, may lead to the development of mood changes in the postpartum are therefore already in place in late pregnancy.

Figure 6: A PhD Student in one of the top five (5) institutions globally in Neuroscience for more than a hundred years but also a certified Security Man in the UK: being in God's school is not limited to the classroom and laboratory. He trains and prepares the total man for His Service!

My Early Postdoctoral Years

My early postdoctoral years were spent in my "regular academic home", the IoP at a time of a national emergency involving UK's livestock industry. The causal disease, which first came to attention in mid to late eighties seemed unabating. It indeed was escalating with evidence that the disease might be transmitting to humans. Research into Transmissible Spongiform Encephalopathies (TSEs) therefore provided a justified engagement for me during my early postdoctoral years. The work investigated host factors that are involved in the pathogenesis and transmission of spongiform encephalopathies. It has undeniably turned out to be the most professionally fulfilling part of my entire research career.

Transmissible Spongiform Encephalopathies (Prion Disorders)

TSEs are a group of progressive, fatal, neurodegenerative disorders of humans and animals, triggered by abnormal folding of the endogenous prion protein molecule (Prusiner, 1982). They share symptomatology, neuropathology and transmissibility: they are transmissible between and within strains (Scott et al., 1999). They are therefore of both public health and economic importance. Examples of prion diseases are bovine spongiform encephalopathy (BSE) in cattle, scrapie in sheep and goat, Kuru, Creutzfeldt-Jakob disease (CJD) and its new variant, vCJD. Once considered highly controversial, the prion hypothesis is now generally accepted and offers a unifying paradigm within which to classify and investigate these diseases that are characterised by prion protein pathology.

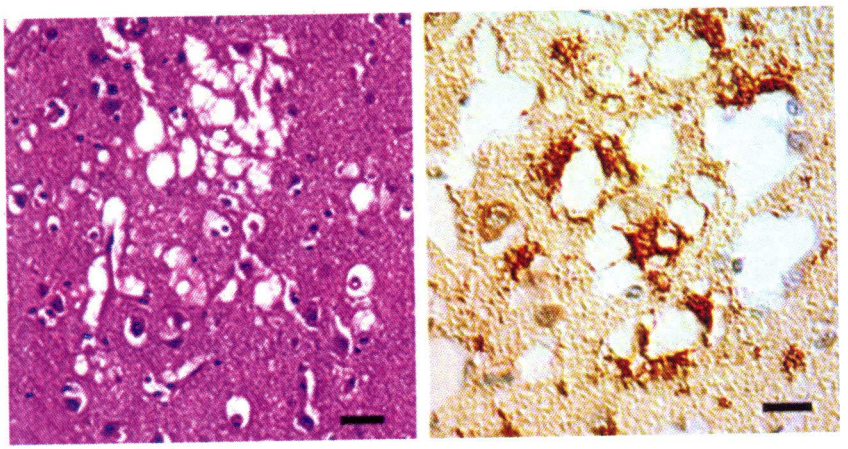
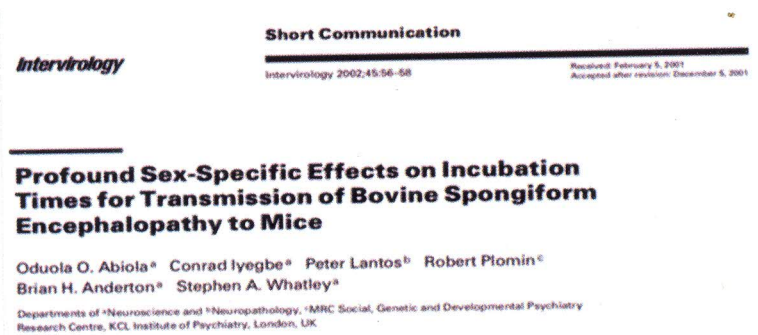


Figure 7, H&E Stain (Spongiform Changes) Immunohistochemistry of Prion protein Taken from: Safar et al., (2005). PNAS USA, 102(9): 3501-3506



Short Communication

Intervirology

Intervirology 2002;45:56–58

Received: February 5, 2001
Accepted after revision: December 5, 2001

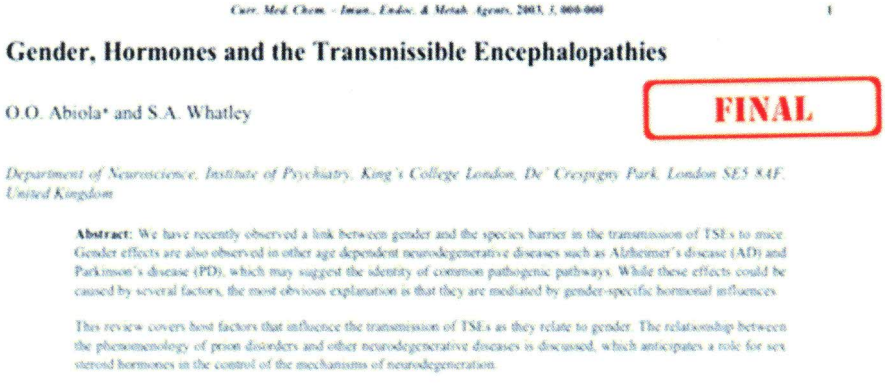
Profound Sex-Specific Effects on Incubation Times for Transmission of Bovine Spongiform Encephalopathy to Mice

Oduola O. Abiola[a] Conrad Iyegbe[a] Peter Lantos[b] Robert Plomin[c]
Brian H. Anderton[a] Stephen A. Whatley[a]

Departments of [a]Neuroscience and [b]Neuropathology, [c]MRC Social, Genetic and Developmental Psychiatry Research Centre, KCL Institute of Psychiatry, London, UK

Figure 8, Plate of page one of a paper published on the prion work

This publication led to an invitation for me to give a Seminar on Gender and Transmissible Encephalopathies: 2003 Seminar Series: New York State Institute for Basic Research in Developmental Disabilities, 1050 Forest Hill Road, Staten Island, New York, USA. 8 April, 2003 and a request for a review on the subject as shown below.



Curr. Med. Chem. - Imun., Endoc. & Metab. Agents, 2003, 3, 000-000 1

Gender, Hormones and the Transmissible Encephalopathies

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FINAL

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Abstract: We have recently observed a link between gender and the species barrier in the transmission of TSEs to mice. Gender effects are also observed in other age dependent neurodegenerative diseases such as Alzheimer's disease (AD) and Parkinson's disease (PD), which may suggest the identity of common pathogenic pathways. While these effects could be caused by several factors, the most obvious explanation is that they are mediated by gender-specific hormonal influences.

This review covers host factors that influence the transmission of TSEs as they relate to gender. The relationship between the phenomenology of prion disorders and other neurodegenerative diseases is discussed, which anticipates a role for sex steroid hormones in the control of the mechanisms of neurodegeneration.

Figure 9, Plate of page one of a paper published on the prion work

Genetic Factor

The encoding gene is a major biological factor influencing the length of the asymptomatic period after infection. It remains unclear the extent to which the variation between quantitative trait loci (QTLs) reported in mouse models is due to methodological differences between approaches or genuine differences between traits. With this in mind, our approach to identifying genetic factors sought to extend the linkage mapping approach traditionally applied, to a series of additional traits, while minimising methodological variability between them. Thus, the approach allows estimations of heritability to be derived, as well as predictions to be made about possible existence of genetic overlap between the various traits.

OPEN ACCESS Freely available online PLoS one

Evidence for Varied Aetiologies Regulating the Transmission of Prion Disease: Implications for Understanding the Heritable Basis of Prion Incubation Times

Conrad O. Iyegbe[1,2]*, Oduola O. Abiola[3], Chris Towlson[2], John F. Powell[2]*, Steven A. Whatley[2]*

1 Psychosis Centre, Institute of Psychiatry, King's College London, London, United Kingdom, 2 Department of Neuroscience, Institute of Psychiatry, King's College London, London, United Kingdom, 3 Experimental Neurochemical Pathology Laboratory, Institute of Medicine, Universiti Brunei Darussalam, Negara Brunei Darussalam

Abstract

Background: Transmissible Spongiform Encephalopathies (TSEs) are a group of progressive fatal neurodegenerative disorders, triggered by abnormal folding of the endogenous prion protein molecule. The encoding gene is a major biological factor influencing the length of the asymptomatic period after infection. It remains unclear the extent to which the variation between quantitative trait loci (QTLs) reported in mouse models is due to methodological differences between approaches or genuine differences between traits. With this in mind, our approach to identifying genetic factors has sought to extend the linkage mapping approach traditionally applied, to a series of additional traits, while minimising methodological variability between them. Our approach allows estimations of heritability to be derived, as well as predictions to be made about possible existence of genetic overlap between the various traits.

Methodology/Principal Findings: Our data indicate a surprising degree of heritability (up to 60%). Correlations between traits are also identified. A series of QTLs on chromosomes 1, 2, 3, 4, 6, 11 and 18 accompany our heritability estimates. However, only a locus on chromosome 11 has a general effect across all 4 models explored.

Conclusions/Significance: We have achieved some success in detecting novel and pre-existing QTLs associated with incubation time. However, aside from the general effects described, the model-specific nature of the broader host genetic architecture has also been brought into clearer focus. This suggests that genetic overlap can only partially account for the general heritability of incubation time when factors, such as the nature of the TSE agent and the route of administration are considered. This point is highly relevant to vCJD (a potential threat to public health) where the route of primary importance is oral, while the QTLs being sought derive exclusively from studies of the ic route. Our results highlight the limitations of a single-model approach to QTL-mapping of TSEs.

Figure 10, Plate of page one of a paper published on the genetics of prions

The nature of the Prion protein

Prions are small proteinaceous infectious particles that resist inactivation by nucleic acid-modifying procedures (Prusiner, 1982). These pathogens may also cause Kuru and Gerstmann-Straussler syndrome in humans, transmissible mink encephalopathy, as well as chronic wasting disease of mule deer and elk (Gajdusek, 1977; , Masters et al., 1981; William and Young, 1982). The molecular properties of prions distinguish them from both viruses and viroids (Prusiner 1982; Diener et al., 1982). In addition, they are resistant to digestion by proteinase K and appear to polymerise into rod-shaped particles. The destruction of prion infected materials are therefore only effectively carried out by incineration. An epidemic of any of these infections would consequently be accompanied by massive environmental pollution. We therefore sought to devise environmentally friendly methods of denaturing prion materials especially during a possible outbreak. The inspiration for this work came during a conversation with my younger brother, His Excellency Dr Abimbola Taye Abiola at the time that we were celebrating my father's life shortly after he went to be with his The Lord and Maker. Taye I'm deeply grateful for this and the various other supports from you and Jumoke to smoothen the course of this journey.

International Biodeterioration & Biodegradation 74 (2012) 54–60

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journal homepage: www.elsevier.com/locate/ibiod

Identification and characterisation of a *Bacillus licheniformis* strain with profound keratinase activity for degradation of melanised feather

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ABSTRACT

Significant amount of keratins in the form of feather, hair, hoof and horn are generated annually by the livestock industry. Keratinases are increasingly important in the reprocessing and environmental pollution control of keratin wastes. The aim of this study is to isolate a microbial strain of high keratinase activity and to evaluate its feather degrading potential. Thirty-two keratin degrading microbial strains from farmyard wastes and primary effluent were isolated using a selective medium containing feather meal at 30, 37 and 50 °C. One of the isolates, which demonstrated the highest keratinolytic activity (11.00 ± 0.71 U ml^{-1}) was identified as a species of *Bacillus licheniformis* based on the 16S rDNA analysis, designated as strain N22 and deposited in a culture collection. Optimum keratinase production by this bacterium was achieved in 32 h using a minimum growth medium containing 1.1% (w/v) feather meal at 50 °C and pH 8.5. The molecular weight of the keratinase was ≈ 28 kDa as determined using sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) analysis and confirmed by matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS). The keratinase reported here significantly degraded melanised feather in 48 h in the absence of reducing agents. There are few reports on the evaluation of feather degrading ability of keratinases using highly resistant melanised feather. The efficient degradation of melanised feathers by this keratinase may offer an environmentally friendly solution to the degradation of feather waste and other organic matter of similar molecular composition.

Figure 11. Plate of page one of a paper published on "prion-like" material

OPEN ACCESS Freely available online

PLOS ONE

Enzymatic Formulation Capable of Degrading Scrapie Prion under Mild Digestion Conditions

Emeka A. Okoroma[1], Diane Purchase[1]*, Hemda Garelick[1], Roger Morris[2], Michael H. Neale[3¤], Otto Windl[3], Oduola O. Abiola[4]

1 Department of Natural Sciences, School of Science and Technology, Middlesex University, London, United Kingdom, 2 School of Biomedical Sciences, King's College London, London, United Kingdom, 3 Animal Health and Veterinary Laboratories Agency (AHVLA), Surrey, United Kingdom, 4 PAP Rashidah Sa'adatul Bolkiah Institute of Health Sciences, Universiti Brunei Darussalam, Gadong, Brunei Darussalam

Abstract

The prion agent is notoriously resistant to common proteases and conventional sterilisation procedures. The current methods known to destroy prion infectivity such as incineration, alkaline and thermal hydrolysis are harsh, destructive, environmentally polluting and potentially hazardous, thus limit their applications for decontamination of delicate medical and laboratory devices, remediation of prion contaminated environment and for processing animal by-products including specified risk materials and carcases. Therefore, an environmentally friendly, non-destructive enzymatic degradation approach is highly desirable. A feather-degrading *Bacillus licheniformis* N22 keratinase has been isolated which degraded scrapie prion to undetectable level of PrP^{Sc} signals as determined by Western Blot analysis. Prion infectivity was verified by *ex vivo* cell-based assay. An enzymatic formulation combining N22 keratinase and biosurfactant derived from *Pseudomonas aeruginosa* degraded PrP^{Sc} at 65 °C in 10 min to undetectable level -. A time-course degradation analysis carried out at 50 °C over 2 h revealed the progressive attenuation of PrP^{Sc} intensity. Test of residual infectivity by standard cell culture assay confirmed that the enzymatic formulation reduced PrP^{Sc} infectivity to undetectable levels as compared to cells challenged with untreated standard scrapie sheep prion (SSBP/1) (p-value = 0.008 at 95% confidence interval). This novel enzymatic formulation has significant potential application for prion decontamination in various environmentally friendly systems under mild treatment conditions.

Figure 12, Plate of page one of a paper published on prion denaturation

THE BOWEN CHAPTER

The Chapter kicked off on a 'roller coaster'. I was walking back to a land that I first bumped into with my head several decades back: the land of my birth! But this time unlike the first coming, there were rightly no 'cheerleaders' nor any vacuum to fill. On the contrary, it was a frosty ground to tread, a completely different world from the one that I just left behind and the Nigeria that propelled me to go in search of the proverbial golden fleece a little over a quarter of a century before. The atmosphere around me was filled with an immiscible combination of the Christian love that a Christian University like Bowen offers and the elements that accompany the morbid unbridled quest for self-propagation and survival instincts of the unregenerate. This threw me into my first challenge in Bowen University. I was offered appointment in Biochemistry rather than my preferred specialty of Chemical Pathology. Of course, I readily accepted the appointment, knowing that like all things that relate to me, it was for the name of the Lord to be glorified. I am proud of my three years and four months' headship of Biochemistry in Bowen University and grateful to God for the services that I was privileged to render to students and their parents, as well as the cultivated friendships and relationships with staff and students. The intercalated Biochemistry degree along with its heavy burdens on my person are what I will not hesitate to go for any day should I find myself in a similar situation. The gains therefrom in overcoming a most rallying challenge, but much more, having the destinies of several more young people tied to yours, will always dwarf such pains. It is no gainsaying that a resulting cataclysm of my 'demeanours' in Biochemistry, intriguingly led to the premature, though belated birth of the B.MLS programme of which I am privileged to be described as the founding Chair and currently Programme Coordinator: a most satisfying though challenging position. I have also had the privilege of serving the present administration as Director of Research and Strategic Partnerships and currently as Director of Academic Planning and Monitoring. Certainly, it is greatly honourable to be born to serve.

My Research in Bowen University

I came to Bowen University essentially with the determination to work with as many as would be willing in setting up a centre of excellence in Biomedical and Drug Research. Although, the turbulence that characterised my early years in the University seems to stifle progress in this direction, nonetheless, because "all things work together for good to them that love The Lord and are called according to His purposes", I am confident that this purpose will be

achieved to His glory. Indeed, the silver lining for accomplishing this came on the horizon with the advent of the Professor Joshua Ogunwole's administration in what to me is a divine arrangement and for which I am eternally grateful.

My research in Bowen therefore aims at understanding the molecular mechanisms underlying the efficacy of widely used herbal remedies in the treatment of various chronic diseases. In addition to making some sense to me personally, essentially because of the huge potential it has to deflate the ever bloating cost of healthcare to our people, the World Health Organisation (WHO) has also argued in support of this and encouraged researchers to engage in this area. Intriguingly, this synergises with the philosophy currently driving research at Bowen, which is "Putting science on indigenous knowledge". Thus, I am currently working with a group of highly intelligent, hardworking, Godly and much younger colleagues in the areas of Clotting disorders, Diabetes Mellitus, Colorectal cancer and Multidrug resistant microorganisms.

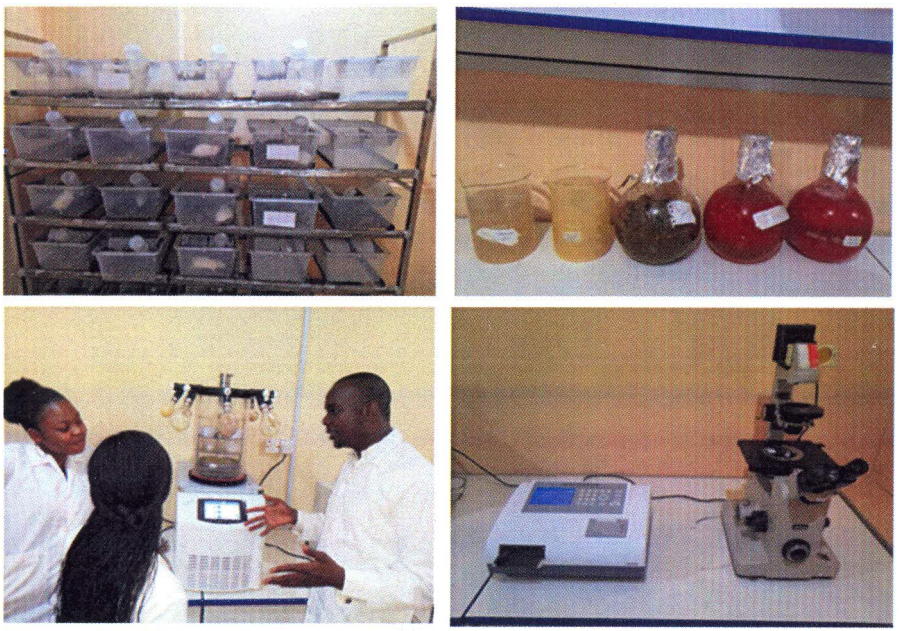

Figure 13: Three of my colleagues inside the BMLS Research Facility and some of the pieces of equipment for our research in Bowen University

My Contribution to Knowledge

My research has focused on the application of basic biochemical concepts to understanding the pathological bases of various disorders especially with the intent to finding appropriate therapy.

My PhD, which investigated the regulation of gene expression by female sex steroid hormones in model systems relevant to psychotic illness, contributed to understanding the biological basis of postpartum psychiatric disorders *(Abiola et al,1996, J. Psych. Res. 30(3),229-238; Abiola et al, 1997, J Ser. Res. 4, 1-9; Abiola et al, 1997, J Endocrinol 155, Suppl 2 p38; Abiola et al, 1998, J Endocrinol 156, Suppl, p169; Abiola et al, 1998, J Endocrinol 159, Suppl p3; Abiola et al, 1999, J Endocrinol 160, Suppl p127).*

The study developed: a) an in vitro system with the potential for identifying women at risk of developing postpartum psychotic disorders using a number of lymphocyte protein markers whose syntheses are altered by female sex steroids; and b) a physiological, endocrine model which has been used to identify female sex steroid hormone-induced changes in neurotransmitter systems' gene expression in several brain regions. These female sex steroid hormone-regulated genes provide candidates for future studies on the biological basis of postpartum psychiatric illnesses.

My postdoctoral research included studying host factors involved in the spread of TSEs or Prion Disorders. Our research used BXD recombinant in-bred (RI) strains of mice; a model system which reveals the following:

i) Varied aetiologies regulating the transmission of prion disease with implications for understanding the heritable basis of prion incubation times *(Iyegbe, Abiola et al, 2010, PLOS ONE 5(12):e14186)*
ii) A profound gender-specific differences with the initial transmission of bovine spongiform encephalopathies (BSE) *(Abiola et al 2002, Intervirology 45(1), 56-58);* [this has been replicated by others *(Akhtar et al 2011, PLOS ONE 6(12): e28741)];*
iii) A reversal of the profound gender specific differences in the absence of the alpha synuclein gene *(unpublished);*
iv) An association between gender and the process of host adaptation (also referred to as the 'species barrier') in the transmission of BSE *(Abiola et al, 2000, J Endocrinol 167, Suppl p85; Abiola & Whatley 2003, Curr. Med. Chem-Immun., Endoc. & Metab. Agents 3(2), 161-169; Abiola et al 2004, Endocrine Abstracts 8, 62).*

Interestingly, a gender difference also exists in other major neurodegenerative diseases such as Alzheimer's disease *(Musicco 2009, Funct Neurol 24(2),* 89-92) and Parkinson's disease (PD) *(Haaxma et al 2007, J Neurol Neurosurg Psychiatry 78; 819-824)* where a mutation in the alpha synuclein gene has been implicated in the pathogenesis *(Jowaed et al 2010, J. Neurosci 30(18), 6355-6359).* This suggests common mechanistic pathways involving gender associated biological substrates: the most obvious candidates being gender-specific hormonal and/or chromosomal parameters. In my opinion, the BSE mouse model has provided an experimentally powerful paradigm that is appropriate to investigate this phenomenon. This potentially has huge implications for further understanding and the development of much more effective treatment and possible prevention of these neurodegenerative diseases with gender delineated epidemiology.

In addition, in collaboration with colleagues in the United Kingdom and Canada, I studied keratinase-producing bacteria from different sources with a view to identifying consortia of bacteria that may be capable of prion protein inactivation under composting conditions. It is our opinion that this will provide an environmentally friendly mechanism for the destruction of prions in case of an epidemic of BSE, scrapie or chronic wasting disease of deer and elk: we published two papers in this area *(Okoroma et al 2012, Inter Biodeter. & Biodeg.; Okoroma et al 2013, PLoS ONE).*

In collaboration with Professor Dhinsa of the Faculty of Education, University of Brunei Darussalam, I have also contributed to using our knowledge of neuroplasticity to improve classroom practices *(Abiola & Dhinsa 2012, Inter. J Environ. & Sci. Edu).*

RESEARCH GRANTS

I)	Funder:	Bowen University (2020-2022)
	Amount:	N-,621,004:00
	Project:	Vegetable and Fruit Modulation of Blood Coagulation *(Principal Investigator; ongoing)*
ii)	Funder:	Bowen University (2020-2020)
	Amount:	N5,707,500:00
	Project:	An investigation of molecular mechanisms of antidiabetic action of *Psidium guajava* and Metformin with muscle relaxants using a rat model of Type 2 Diabetes Mellitus *(Principal Investigator; ongoing)*

iii) Funder: University of Brunei Darussalam (2007-2009)
Amount: BND$ 34,700.00
Project: A toxicological investigation of 'Obat asam urat flu tulang and cikunguya' *(Principal Investigator (PI); completed)*

iv) Funder: University of Brunei Darussalam (March-April 2007)
Amount: BND$ 3,900.00
Project: A study of mouse genetics and spongiform encephalopathies in experimental BSE *(PI Research Leave at King's College London; completed)*

v) Funder: Middlesex University, London, UK (2009-2012) (Matching grant riding on 'vi')
Amount: £16,161.82
Project: Enzymatic degradation of prion protein *(Co-PI with Dr Diane Purchase of Middlesex University, London, UK; completed)*

vi) Funder: Alberta Research Institute (2006-2011)
Amount: CA$ 205,000.00
Project: Neuropathological analysis of TSE (PI; completed)

vii) Funder: Medical Research Council UK (June 2002-May 2005)
Amount: £728,000.00
Project: Characterization of host genetics factors in oral transmission of BSE *(Recognized Researcher & Scientist carrying out the project; completed)*

viii) Funder: Medical Research Council UK (November 2002-October 2006)
Amount: £548,000.00
Project: Early disease progression and identification of molecular markers of BSE pathogenesis *(Recognized researcher; completed)*

ix) Funder: Medical Research Council UK (March 1998-May 2002)
Amount: £560,000.00
Project: Characterization of host genetic factors in transmission and pathology of transmissible encephalopathies *(Postdoctoral Fellow, completed)*

x) Funder: Deanery, Institute of Psychiatry, King's College London (1990-91)

Amount: £6,600.00
Project: Effects of female sex hormones on gene expression in peripheral human lymphocytes *(MPhil/PhD Studentship; completed)*

PRIZES, HONOURS, NATIONAL AND INTERNATIONAL AWARDS

i. Faculty of Public Health, University of Ibadan: Splendid Presentation Award at the Distinguished Lecture Series – 2019.
ii. NABS: Award for Service to Biochemistry and Humanity – 2017
iii. AMLSN: Award for Excellence – 2016
iv. Best Scientific Poster Award: Prion 2009, Thessaloniki – Chalkidiki Greece Okoroma E.A, D. Purchase, H. Garelick, A. Jen, R. Morris & O. Abiola: 2009
v. Medical Research Council (MRC, UK) Postdoctoral Research Fellowships: 1998-2006
vi. Dean, Institute of Psychiatry, KCL, London MPhil. Studentship: 1990-1991
vii. Oyo State Government Sponsorship to study Medical Laboratory Sciences: 1976-1982
viii. 2nd Place Winner, Oyo Educational Zone Nigeria Children's day Essay Competition: 1975
ix. Oyo State Government Sponsorship to train as a schoolteacher: 1974-1975

Acknowledgements

No doubt, "my journey of faith plus a hundred pounds" has been made possible by the King of kings, The Lord of lords, my Saviour and my Lord in a way that only Him can accomplish. To Him therefore be all the glory, honour, power and adoration for ever and ever. In this exciting journey, He has used several people innumerable for me to count in bringing about His purposes whether known or unknown to me like those who regularly pray for me without my knowing: I am immensely grateful to you all from the bottom of my heart even if I do not mention your name specifically. The Lord Himself whose we are will reward your labour of love. For very obvious reasons, I am greatly thankful to the Vice Chancellor, Professor Joshua Olalekan Ogunwole, for who he is, his strong but humane and just leadership, friendship and the trust and confidence that he has in my person and ability; I am indeed, grateful. I want to also thank the immediate past Vice Chancellor of this University, Professor Matthews Akintunde Ojo who strongly withstood the tremendous opposition to my appointment in Bowen even though he did not know me and we had not met. Sir, I thank you for every bit of encouragement that you kindly gave for me to stay and serve The Lord in Bowen. I am grateful to Professor

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Institution of Award For Academic Excellence

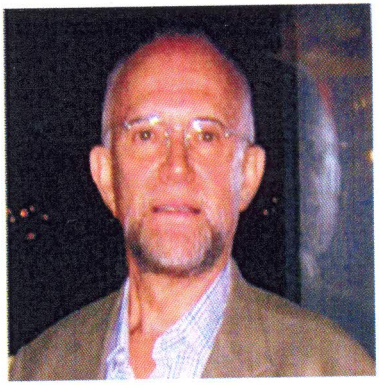
The Vice Chancellor, Sir, in appreciation of The Lord's faithfulness in seeing us thus far on this journey, my wife and I have decided to set up a Trust with the University for N250,000 each to institute Annual Academic Prizes in honour of my uncle Mr Jonathan Folaranmi Akanni Akinola, Retired Deputy Director of Public Health (Disease Control) Oyo State, Nigeria; my parents Samuel Adeleke Alabi Edu Abiola (MON) & Rebecca Faramade Ajoke Iko Abiola; my supervisor, teacher, mentor Professor Iain Cameron Campbell. I will also be instituting a prize in honour of my wife, Mrs Titilayo Olajumoke Abiola in the same vein as the others. The prizes will be as follows:

1. Jonathan Folaranmi Akanni Akinola Prize for the best graduating student in the Public Health Programme with a cGPA of not less than 4.0 instituted by Professor Oduola and Mrs Titilayo Abiola.
2. Samuel Adeleke Alabi Edu Abiola Prize for the best graduating student in the Agriculture Programme with a cGPA of not less than 4.25 instituted by Professor Oduola and Mrs Titilayo Abiola.
3. Rebecca Faramade Ajoke Iko Abiola Prize for the overall best graduating female student on the B.MLS Programme instituted by Professor Oduola and Mrs Titilayo Abiola.
4. Professor Iain Cameron Campbell Prize for the best graduating student in Pharmacology on the B.MLS Programme instituted by Professor Oduola and Mrs Titilayo Abiola.
5. Mrs Titilayo Olajumoke Abiola Prize for the best graduating student in Medical Microbiology on the B.MLS Programme instituted by Professor Oduola Abiola
6. In addition, we will be increasing the endowment for the existing Samuel Adeleke Alabi Edu Abiola (MON) Prize for the best graduating student in Agricultural Extension to be at par with the newly the newly established ones.

My uncle and mentor, a man of impeccable character, integrity and transparent honesty

Mr Jonathan Folaranmi Akanni Akinola
Retired Deputy Director of Public Health
(Disease Control) Oyo, State. Nigeria

My PhD Supervisor, A Great Teacher, Mentor and Friend

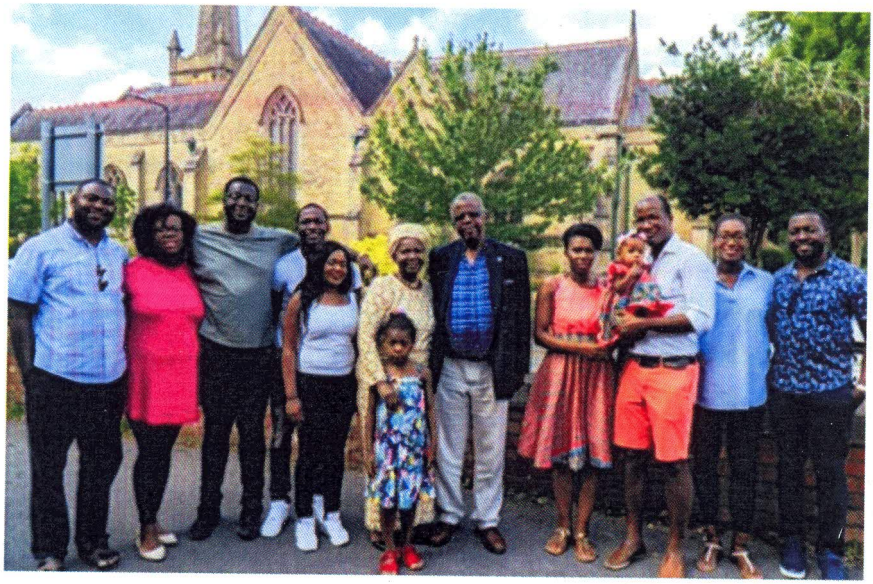


Professor Iain Cameron Campbell
BSc. Ph.D. DSc.
IoPPN, King's College London

My loving parents, great inspirers, excellent mentors: Abiyamo Tooto!

Samuel Adeleke Alabi-Edu Abiola (MON) & Rebecca Faramade Ajoke-Iko Abiola

The Abiola Clan in the UK: My beloved Family!



My wife Titilayo Olajumoke and awesome children and grandchildren who have supported and keep supporting me here

REFERENCES

Abiola Oduola O, Checkley Stuart A, Campbell Iain C and Whatley Stephen A (1996). Effects of female sex steroids on protein synthesis in cultured human lymphocytes. *Journal of Psychiatry Research,* **30**(3), 229-238.

Agrawal, P., Bhatia, M.S. and Malik, S.C. (1990). Postpartum psychosis: a study of indoor cases in a general hospital psychiatric clinic. *Acta Psychiatr. Scand.,* **81**, 571-575.

Akhtar S, Wenborn A, Brandner S, Collinge J, Lloyd SE (2011). Effects of sex in mouse prion disease incubation times. *PLoS ONE* **6**(12): e28741. http://doi.org/10.1371/journal.pone.0028741

Backström, T., Carstenson, H. and Sodergad, R.J. (1982). Concentrations of estradiol, testosteroneaa and progesterone in cerebrospinal fluid compared to plasma unbound and total concentrations. *J Steroid Biochem.*, **7**, 469-472.

Beck, C.T. (2003). Postpartum depression predictors inventory-revised. *Adv Neonatal Care*, **3**, 47-48.

Brockington, I.F. and Cox-Roper, A. (1982). The nosology of puerperal mental illness. In: *Motherhood and Mental Illness 2. Causes and Consequences*. Edited by Kumar, R. and Brockington IF, London Buttersworth. pp 1-16.

Brockington I.F., Cernik, K.F., Schofield, E.M., Downing, A.R., Francis, A.F. and Keelan, C. (1981). Puerperal psychosis: phenomena and diagnosis. *Arch. Gen. Psychiatry*, **38**, 829-833.

Brockington, I.F., Roper, A., Edmunds, E., Kaufman, C. and Meltzes, H. Y. (1992). Longitudinal, psychological schedule. *Psychological Med.,* **10**, 73-83.

Bruce, M.E., McConnell, I., Fraser, H. and Dickinson, A.G. (1991). The disease characteristics of different strains of scrapie in Sinc congenic mouse lines: Implications for the nature of the agent and host control of pathogenesis. *J Gen Virol.*, **72**:595–603.

Bruce, M., Will, R.G., Chree, A., McConnell, I., Forster, J., Pearson, G. and Fraser, H. (1994). Transmission of bovine spongiform encephalopathy and scrapie to mice: Strain variation and the species barrier. *Philos Trans R Soc Lond B Biol Sci.*, **343**, 405–411.

Ch'ang, H.J., Su, J.J., Chen, C.L., Chiang, I.P., Wang, C.H. and Cheng, A.L. (1997). Angioimmunoblastic lymphadenopathy with dysprotenemia- lack of prognostic value of clear cell morphology. *Oncology,* **54**, 193-198.

Condon, J.T. and Watson T.L. (1987). The maternity blues: exploration of a psychological hypothesis. *Acta Psychiatr. Scand.*, **76**, 164-171.

Conrad O. Iyegbe, **Oduola O. Abiola**, Chris Towlson, John F. Powell, Steven A. Whatley (2010).

Evidence for varied aetiologies regulating the transmission of prion disease: Implications for understanding the heritable basis of prion incubation times *PLoS ONE*, 5(12): e14186. doi:10.1371/journal.pone.0014186.

Cooper, P.J., Campbell, E.A., Day, A., Kennerley, H. and Bond, A. (1988). Non psychotic psychiatric disorder after childbirth: a prospective study of prevalence, incidence, course and nature. *Br. J. Psychiatry*, **152**, 799-806.

Diener, T.O., McKinley, M.P. and Prusiner, S.B. (1982). Viroids and prions. *Proc. Natl. Acad. Sci. USA*, **79**, 5220-5224.

Di Paolo, T., Camichel, R. and Labrie, F. (1979). Effects of estrogen on the characteristics of [3H] spiroperidol and [3H]RU24213 binding in rat anterior pituitary gland and brain. *Mol. Cell Endocrinol.*, **16**, 99-112.

Emekà A. Okoroma, Diane Purchase, Hemda Garelick, Roger Morris, Michael H. Neale, Otto Windl and **Oduola O. Abiola** (2013). Enzymatic formulation capable of degrading scrapie prion under mild digestive conditions. *PLOS One* 8(7): e68099. doi:10.1371/journal.pone.0068099.

Emeka A. Okoroma, Hemda Garelick, Oduola O. Abiola **and Diane Purchase (2012). Identification and characterisation of a *Bacillus licheniformis* strain with profound keratinase activity for degradation of melanised feather.** *International Biodeterioration & Biodegradation* **74**, 54-60.

Endersby, C.A. and Wilson, C.A. (1974). The effect of ovarian steroids on the accumulation of 3H-labelled monoamines by hypothalamic tissue in vitro. *Brain Res.*, **73**, 321-331.

Escalada, J., Cacicedo, L., Ortego, J., Melian, E. and Sanchez-Franco, F. (1996). Prolactin gene expression and secretion during pregnancy and lactation in the rat: role of dopamine and vasoactive intestinal peptide. *Endocrinology*, **137**, 631-637.

Esquirol, E. (1845). Mental Maladies: a Treatise on insanity (trans. E.K. Hunt). Lea and Blanchard: Philadelphia.

Evans, R. (1988). The steroid and thyroid hormone receptor super family. *Science*, **240**, 889-895.

Fink, G. and Sumner, B.E.H. (1996). Oestrogen and mental state. *Nature*, **383**, 306.

Fraser H, Bruce ME, Chree A, McConnell I, Wells GA (1992). Transmission of bovine spongiform encephalopathy and scrapie to mice. *J Gen Virol*, **73**:1891–1897.

Gard, P.R., Handley, S.L., Parsons, A.D. and Waldron, G. (1986). A multivariate investigation of postpartum mood disturbance. *Br. J. Psychiatry*, **146**, 567-575.

Gajdusek, D.C. (1977). Unconventional viruses and the origin and disappearance of kuru. *Science*, **197**(4307), 943-960.

Harding, J.J. (1989). Postpartum psychiatric disorders: a review. *Comp. Psychiatry*, **30**, 109-112.

Kandel, R.E. (1991). Disorders of thought – Schizophrenia. In: *Principles of Neural Science*. Edited by Kandel, E.R., Schwartz, J.H. and Jessell, T.M. Appleton and Lange, Norwalk, CT. pp. 653-686.

Kandel, R.E., Chalmers, J.C. and Platz, C. (1987). Epidemiology of puerperal psychosis. *Br. J. Psychiatry*, **150**, 662-673.

Kennerley, H. and Gath, D. (1989). Detection and measurement by questionnaire. *Br. J. Psychiatry*, **155**, 356-362.

Kumar, R. (1990). Childbirth and mental illness. *Triangle*, **29**, 73-81.

Lévesque, D. and Di Paolo, T. (1989). Chronic estradiol treatment increases ovariectomized rat striatal D_1 dopamine receptors. *Life Sci.*, **45**, 1813-1820.

Levitt, M., Spector, S., Sjoerdsma, A. and Udenfriend, S. (1965). Elucidation of the rate limiting step on norepinephrine biosynthesis in the perfused guinea-pig heart. *J. Pharmacol. Exp. Ther.*, **148**, 1-7.

Maguire, J., McCormack, C., Mitchell, A. and Monk, C. (2020). Neurobiology of maternal mental illness. *Handb. Clin. Neurol.*, **171**, 97-116.

Masters, C. L., Gajdusek, D. C. & Gibbs, C. J., Jr. (1981). Creutzfeldt-Jakob disease virus isolations from the Gerstmann-Sträussler syndrome. *Brain*, **104**, 559-588.

McEwen, B.S. (1994). Endocrine effects on the brain and their relationship to behaviour. In: *Basic Neurochemistry*. Edited by Siegel, G.J., Agranoff, B.W., Albers, R.W and Molinoff, P.B., Raven Press. pp. 1003-1023.

McEwen, B.S. and Parsons, B. (1982). Gonadal steroid action on the brain: neurochemistry and neuropharmacology. *Ann. Rev. Pharmacol. Toxicol.*, **22**, 555-598.

O'Hara, M.W., Schlecthte, J.A., Lewis, D.A. and Varner, M.W. (1991). Controlled prospective study of postpartum mood disorders: psychological, environmental and hormonal variables. *J. Abnormal Psychol.*, **100**, 63-73.

Oates, M.R. (1986). The treatment of psychiatric disorders in pregnancy and the puerperium. *Clinics in Obstet. Gynaecol.*, **13**, 385-395.

Oduola O. Abiola **& Hakirat S Dhindsa (2012). Improving classroom practices using our knowledge of how the brain works.** ***International Journal of Environmental and Science Education*** **7(1), 71-81.**

Oduola Abiola, Mohamed Mabruk, Mohammad Moshaddeqque Hossain & Zorah Hj Sulaiman (2011). Research Clusters in Brunei Darussalam. ***Brunei International Medical Journal*** *7(2), 64-71.*

Oduola O. Abiola, Joe M. Angel et al (2003). The nature and identification of quantitative trait loci: a community's view; The Complex Trait Consortium (CTC). *Nature Reviews Genetics* **4**, 911-916.

Oduola O. Abiola and S.A. Whatley (2003) Gender, Hormones and Transmissible Encephalopathies.

Current Medicinal Chemical Immunology Endocrinology & Metabolism Agents **3, 161-169.**

Oduola O. Abiola, Iyegbe Conrad, Lantos Peter, Plomin Robert, Anderton Brian H and Whatley Stephen A. (2002). Profound sex-specific effects on incubation times for transmission of BSE to mice. *Intervirology,* **45**(1), 56-58.

Oduola O. Abiola, Whatley Stephen A and Campbell Iain C (1997) $5HT_{1A}$ receptor expression in the rat hippocampus is correlated with changes in female sex steroids. *Journal of Serotonin Research* **4**, 1-9.

Oduola O. Abiola, Olubodun JO, Agbedana EO and Taylor GO (1996) Serum lipids in black Africans on chronic ambulatory dialysis. *Peritoneal Dialysis International* **16**(3), 333-334.

Oduola O. Abiola, Conrad Iyegbe, Robert Plomin, Brian H. Anderton & Stephen A. Whatley (2004) Gender effects on incubation period are associated with host adaptation of Bovine Spongiform Encephalopathy. *Endocrine Abstracts* **8**, 62.

Oduola O. Abiola, Conrad Iyegbe, Robert Plomin, Brian H. Anderton & Stephen A. Whatley (2003). Gender and species barrier are linked in BSE transmission to mice. ***Keystone Symposia, Molecular Aspects of Transmissible Spongiform Encephalopathies***, Abstract Book; Abstract 101, p43.

Oduola O. Abiola, Anderton BH, Plomin R and Whatley SA (2000) Do female sex steroids affect transmission of TSEs? *Journal of Endocrinology* **167**, Suppl. p85.

Oduola O. Abiola, Whatley SA and Campbell IC (1999) Female sex steroids have a threshold effect on the activity and the expression of cytochrome oxidase (COX) in maternal rat brain *Journal of Endocrinology* **160**, Suppl. p127.

Oduola O. Abiola, Whatley SA and Campbell IC (1998) Changes in tyrosine hydroxylase (TH) and brain dopamine (DA) receptors are not correlated in the peripartum period. *Journal of Endocrinology* **159**, Suppl. p31.

Oduola O. Abiola, Whatley SA and Campbell IC (1998) Dopamine D_4 receptor mRNA in maternal rat brain in the peripartum period. *Journal of Endocrinology* **156**, Suppl. p169.

Oduola O. Abiola, Whatley SA and Campbell IC (1997) Rat brain dopamine D_2 receptor isoforms are modulated by changes in female sex steroid hormones in the peripartum period. *Journal of Endocrinology* **155**, Suppl. 2 p38.

Olubodun JO, Akingbade OA and **Oduola O. Abiola** (1997) Salt intake and blood pressure in Nigerian hypertensive patients. *International Journal of Cardiology* **59**(2), 185-188.

Perry, A., Gordon-Smith, K., Webb, I., Fone, E., Di Florio, A., Craddock, N., Jones, I. and Jones, L. (2019). Postpartum psychosis in bipolar disorder: No evidence of association with personality traits, cognitive style or affective temperaments. *BMC Psychiatry*, **19**, 395-404.

Picoli de Melo, L.G., Vargas Nunes, S.O., Anderson, G., Vargas, H.O., Barbosa, D.S., Galecki,

P., Cavalho, A.F. and Maes, M. (2017). Shared metabolic and immune-inflammatory, oxidative, and nitrosative stress pathways in the metabolic syndrome and mood disorders. *Prog. Neuro. Psychopharmacol. Biol. Psychiatry*, **78**, 34-50.

Prusiner, S. B. (1982). Novel proteinaceous infectious particles cause scrapie *Science*, **216**, 136-144.
Prusiner, S.B. and Scott, M.R. (1997). Genetics of prions. *Annu Rev Genet*, **31**, 139–175.
Robinson, G.E. and Stewart, D.E. (1986). Postpartum psychiatric disorders. *Can. Med. Assoc.J.*, **134**, 31-37.

Schöpf, J. and Rust, B. (1994). Follow-up and family study and postpartum psychoses. Part1: Overview. *Eur. Arch. Psychiatry Clin. Neurosci.*, **244**, 101-111.

Scott, M.R., Will, R., Ironside, J., Nguyen, H.O., Tremblay, P., DeArmond, S.J. and Prusiner, S.B (1999). Compelling transgenetic evidence for transmission of bovine spongiform encephalopathy prions to humans. *Proc Natl Acad Sci USA*, **96**, 15137–15142.

Seeman, P. (1987). Dopamine receptors and dopamine hypothesis of schizophrenia. *Synapse*, 1, 133-152.

Stephenson, D.A., Chiotti, K., Ebeling, C., Groth, D., DeArmond, S.J., Prusiner, S.B. and Carlson, G.A. (2000). Quantitative trait loci affecting prion incubation time in mice. *Genomics*, **69**,47–53.

Weeks, J.C. and Levine, R.B. (1995). Steroid hormone effects on neurons subserving behaviour. *Curr. Opin. Neurobiol.*, **5**, 809-815.

Weissman, M.M. and Olfson, M. (1995). Depression in women: implications for health care research. *Science*, **269**, 799-801.

Whiffen, V.E. and Gotlib, I.H. (1993). Comparison of postpartum and non-postpartum depression: clinical presentation, psychiatric history and psychosocial functioning. *J. Consult. Clin. Psycol.*, **61**, 485-494.

Willcox, D.L., Yovich, J.L., McColm, S.C. and Phillips, J.M. (1985). Progesterone, cortisol and oestradiol-17ß in the initiation of human parturition: partitioning between free and bound hormone in plasma. *Br. J. Obstet and Gynae.*, **92**, 65-71.

Williams, E.S. and Young, S. (1982) Spongiform encephalopathy of Rocky Mountain elk. *J. Wildl. Dis.*, **18**, 465-471.

Wolk, S.I. and Weissman, M.M. (1995). Women and depression: an update. *In Review of Psychiatry*, Edited by Oldham, J. and Riba, M. American Psychiatric Press, Washington D.C. pp 227-259.

Zuckerman, B., Bauchner, H., Parker, S. and Cabral, H. (1990). Maternal depressive symptoms. *Dev. Behav. Pediatr.*, **11**, 190-194.