

Prevalence of endemic Bancroftian filariasis in the high altitude region of south-eastern Nigeria

E.C. Uttah

Department of Biological Sciences, Faculty of Science, Cross River University of Technology, Calabar, Nigeria

ABSTRACT

Background & objectives: The study was aimed at determining the prevalence and intensity of *Wuchereria bancrofti* microfilaraemia in a high altitude region of south-eastern Nigeria, and ascertaining the prevalence of clinical signs and symptoms associated with the filarial infections.

Methods: Thick smear of 50 µl finger-prick blood collected at night between 2200 and 0200 hrs from consenting persons were stained with Giemsa and examined microscopically in a cross-sectional study. Consenting individuals were examined for various gradations of hydrocele, limb and scrotal elephantiasis by qualified medical personnel.

Results: The prevalence of *W. bancrofti* microfilaraemia was 4.3%, highest in the older people but comparable in both sexes. The overall microfilarial (mf) geometric mean intensity (GMI) among mf positive individuals was 123 mf/ml of blood (138 mf/ml for males and 110 mf/ml of blood for females); and rose significantly with increasing age (one-way analysis of variance; $p < 0.001$). Prevalence of clinical manifestations was: hydrocele (7.1%), scrotal elephantiasis (4%), and limb elephantiasis (6%). The mf GMI was significantly higher among those without hydrocele or limb elephantiasis than among those with the clinical manifestations (t-test; $p < 0.05$ for both tests); the opposite was the case for scrotal elephantiasis, (t-test; $p < 0.01$).

Conclusion: Filariasis is endemic in the high altitude region of south-eastern Nigeria. The chronic clinical manifestations observed there underscore the need for urgent combination therapy interventions.

Key words Elephantiasis; filariasis; hydrocele; Nigeria; *Wuchereria bancrofti*

INTRODUCTION

Filariasis is recognized as one of the world's most disabling diseases. Available statistics show that the disease affects some 120 million people worldwide, out of which over 40 million persons show severe chronic manifestations of the disease. It is estimated that 1.2 billion (20% of the world population) are at risk of acquiring the infection^{1,2}. Chronic clinical manifestations associated with it such as lymphoedema (elephantiasis) and hydrocele are debilitating, and are estimated by the World Health Organization to account for nearly five million disability-adjusted life years, only second to malaria among parasitic diseases³. It is against this background that the World Health Organization has earmarked the disease for elimination by the year 2020 through mass treatment with combination therapy.

Nigeria is one of the most endemic countries in the world^{4,5}. Five species of filarial parasites have been reported in Nigeria, namely *Wuchereria bancrofti*, *Onchocerca volvulus*, *Loa loa*, *Mansonella perstans*, and *Mansonella streptocerca*^{6–9}. Studies on these infections have been carried out in parts of Nigeria, and these have shown that filariasis is widespread, and varies in preva-

lence of microfilaraemia and of clinical manifestations from one locality to another.

This work represents the first comprehensive epidemiological study, including parasitological and clinical manifestations aspects, carried out in the Imo River Basin, Nigeria, which traverses three states. The study was aimed at determining the prevalence and intensity of *W. bancrofti* microfilaraemia, and to ascertaining the prevalence of clinical signs and symptoms associated with the filarial infections.

MATERIAL & METHODS

Study area and study population

The study was conducted in 2006 in two neighbouring communities of Umuowaibu 1 and Ndiorji, in Okigwe Local Government area of Imo State, Nigeria. The two communities with a combined population of 11 16 at the time of this study are socio-culturally similar, both inhabited by Ndiigbo, the majority tribe in southern Nigeria. A familial settlement pattern was evident in the area with houses arranged in family clusters. A total of 381 houses were recorded in the two communities, 216 in Umuowaibul and 165 in Ndiorji, giving an overall average of three persons per house.

The area is hilly with characteristic undulating plains. There are a total of seven streams and three rivers in addition to the Imo River. There are two distinct seasons, the dry season (November–May), and the rainy season (June–October). According to data from the Imo State Meteorological Services, the annual rainfall between 1994 and 1996 averaged 2840 mm per annum, with most of the rainfall occurring in the months of June through October. The mean relative humidity for the three years was 74.4, 72.5 and 68.7%, respectively. Farming is the main occupation, however, those who are engaged in other occupations engage in subsistence farming.

Preparation for the study

Local Government Area (LGA) health authorities were contacted and their consent was obtained before the actual work began. Furthermore, the local Ezes (traditional rulers of Ndiigbo), chiefs, and leaders of town development unions were briefed about the project, and their cooperation was sought in the mobilization of their people. During the parasitological and clinical surveys, health personnel from the LGA were always present to monitor safety standards.

Census and mapping

All individuals in the selected communities who were more than one year of age were included in the study population which comprised natives as well as non-natives who had resided there for at least one year. The target population was 1000 persons. During the census, the house registration numbers written on houses by the National Population Commission during the 1993 national census were used. Where such numbers were unavailable, one was provided. The appropriate positions of houses, markets, religious places, major roads and some track roads, as well as water bodies in the communities were noted.

Clinical surveys

Informed oral consent was obtained from all adults and from parents or guardians of children aged ≤ 15 yr, before any examination was carried out. Individuals were examined for various gradations of hydrocele, limb and scrotal elephantiasis by qualified medical doctors. The grading was carried out using the following criterion: Hydrocele 0 = normal, 1 = 6–7 cm, 2 = 8–11 cm, 3 = 12–15 cm, 4 = >15 cm; limb elephantiasis 0 = normal, 1 = loss of contour (lymphoedema), 2 = thickened skin, loss of elasticity, 3 = evident elephantiasis, deep skin folds, wart-like skin; scrotal elephantiasis 0 = normal, 1 = lymphoedema, 2 = thickened scrotal skin, loss of elasticity, 3 = evident elephantiasis. Those who were sick with ailments were given medicine.

Parasitological surveys

Night blood samples (50 μ l) for parasitological examination were taken from every consenting person of age one and above between 2200 and 0200 h. This was then stained with Giemsa and examined under microscope following established laboratory techniques. Identification of microfilariae was conducted according to keys in Learning Bench Aid No. 3 (Tropical Health Technology).

Data analysis

The Epi-Info version 6.0 was used in entering data from parasitological survey, and SPSS for windows (1995 version) was used for data analysis. The geometric mean intensity (GMI) of microfilaraemia was calculated as $\text{antilog}(\sum \log(x+1)/n)$, with 'x' being the number of mf per ml of blood in microfilaraemic individuals and 'n' the number of microfilaraemic individuals examined.

RESULTS

Microfilaraemia in relation to age and sex

Wuchereria bancrofti microfilaraemia was determined from blood collected at night (one blood sample per person). The prevalence and GMI according to age and sex are shown in Table 1. In addition, the mf prevalence in relation to age and sex is presented in Fig. 1, and the mf GMI in relation to age and sex is also presented in Fig. 2. The overall coverage was high (90.5% for the whole study population; 91.7% for males and 90.5% for females).

Of those examined, 4.3% were positive for *W. bancrofti* microfilariae. Microfilaraemia was rarely seen in children. The youngest mf positive boy was 7 yr old and the youngest mf positive girl was 12 yr old. The mf prevalence increased with age to reach 18.5% in the 60+ yr age group (23.1% for males and 14.3% for females). There was no significant difference in mf between males

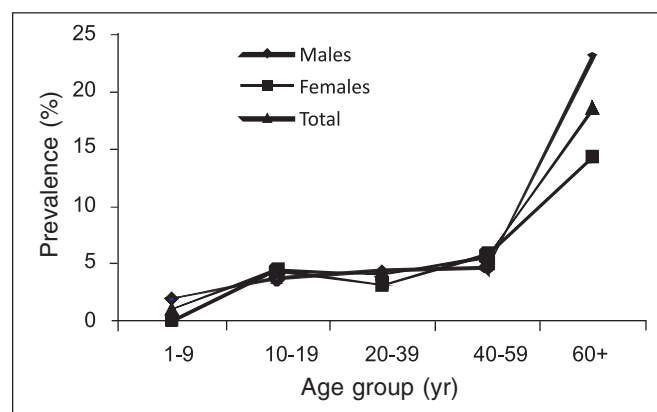


Fig. 1: Prevalence of *W. bancrofti* microfilaraemia in relation to age and sex.

Table 1. Relationship between *W. bancrofti* microfilaraemia and hydrocele (A), limb elephantiasis (B), scrotal elephantiasis (C)

Age group (yr)	No. examined	No. positive	GMI (mf/ml)	No. examined	No. mf positive	GMI (mf/ml)
A						
Males with hydrocele			Males without hydrocele			
1-19	3	0 (0)	–	233	7 (3.0)	43
20+	33	4 (12.1)	388	229	11 (4.8)	195
Total	36	4 (11.1)	388	388	18 (3.9)	108
B						
Males with limb elephantiasis			Males without limb elephantiasis			
1-39	24	1 (4.2)	–	708	23 (3.2)	43 [†]
40+	37	3 (8.1)	128 [†]	241	16 (6.6)	598 [†]
Total	61	4 (6.6)	97 [†]	949	39 (4.1)	126 [†]
C						
Males with scrotal elephantiasis			Males without scrotal elephantiasis			
1-19	2	1 (50.0)	–	236	6 (2.5)	58 [†]
20+	18	5 (27.8)	301 [†]	242	10 (4.1)	397 [†]
Total	20	6 (30.0)	193 [†]	478	16 (3.3)	120 [†]

[†]Only indicated if there are ≥ 3 mf positive cases; Figures in parentheses indicate percent prevalence.

and females, either overall or in any of the age groups (χ^2 -test: $p > 0.05$ for all tests).

The overall mf GMI among mf positive individuals was 123 mf/ml of blood (138 mf/ml for males and 10 mf/ml blood for females). Males had higher mf GMI in all but in the 40–59 yr age group, the difference in mf GMI between males and females was not statistically significant either overall or in any of the age groups (t -test; $p > 0.05$ for all the tests). The overall mf GMI for both sexes combined rose significantly with increasing age (one-way analysis of variance; $p < 0.001$) and reached 1375 mf/ml in the oldest age group. The highest individual mf intensity observed was 4960 mf/ml blood in a 68 yr old male.

Clinical manifestations

Three chronic manifestations of Bancroftian filariasis, hydrocele, limb elephantiasis and scrotal elephantiasis were observed. Examinations were not done for signs of acute lymphatic filariasis (lymphangitis, funiculitis, and orchitis)

because of differential diagnostic problems since the area is also endemic for malaria and other tropical diseases which could cause similar clinical signs.

The prevalence of different stages of hydrocele in relation to age is shown in Fig. 3A. The overall prevalence of all stages of hydrocele was 7.1% [4.3% for stage I, which is swelling of the spermatic cord and 2.8% for stages II-IV combined (true hydrocele)]. The youngest person with stage I hydrocele was 15 yr old. Swelling of the spermatic cord was observed mostly in 20–39 yr age group, and was not found in very old men. True hydrocele appeared later in life. The youngest person found with true hydrocele was 21 yr old (21 yr for stage II; 51 yr for stage III; 60 yr for stage IV). In adult males (≥ 20 yr), the prevalence of swelling of the spermatic cord was significantly higher than the prevalence of true hydrocele (7.1 and 5.2%, respectively; χ^2 test; $p < 0.001$). Expectedly, the prevalence of true hydrocele rose with increasing age, and its final stages were found only in older men.

The occurrence of limb elephantiasis in relation to age and stage is shown in Fig. 3B. The overall prevalence was moderately high. Of those examined, 6% had signs of limb elephantiasis. The overall prevalence in females (6.4%) was higher than in males (5.5%), but this difference was not statistically significant (χ^2 test; $p > 0.05$). The youngest male with limb elephantiasis was 20 yr old, while the youngest female was 18 yr old. The majority of cases of limb elephantiasis were of stage I (80.3% of all cases; 67% of all cases in males and 97.0% of all cases in females). Males had a higher prevalence of advanced stages

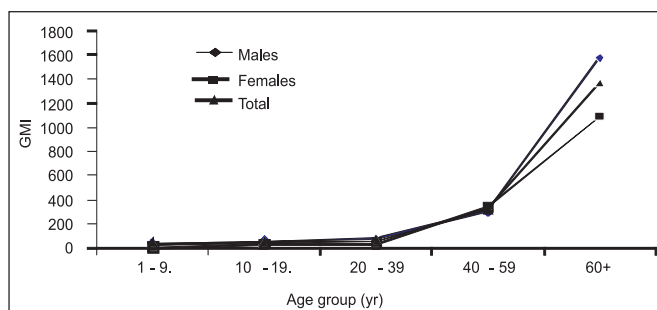


Fig. 2: *Wuchereria bancrofti* mf GMI in relation to age and sex.

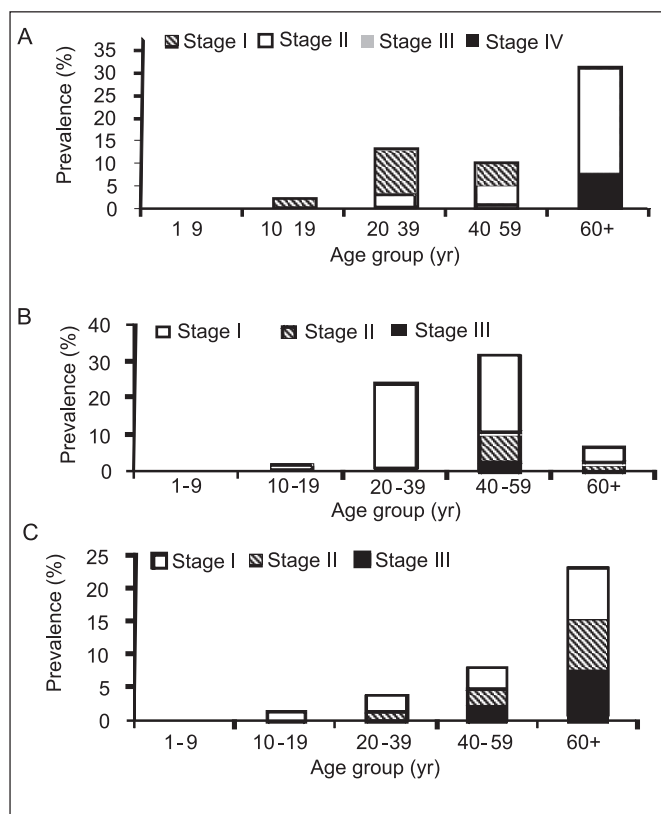


Fig. 3: Prevalence of different stages of hydrocele in males (A); limb elephantiasis in relation to age and stage (B); and scrotal elephantiasis in males in relation to age and stage (C).

of limb elephantiasis (stage II+III) than females. Only three individuals had stage III elephantiasis, and these were all males. The total prevalence of elephantiasis for both sexes combined rose with increasing age to reach 22.2% in the oldest age group. Of all cases of limb elephantiasis, 57 were unilateral and 4 were bilateral.

The occurrence of scrotal elephantiasis in relation to age and stage in males is presented in Fig. 3C. The overall prevalence for the three stages combined was 4%. The prevalence was generally low for all the three stages and it decreased with advancement in stage (2% for stage I; 1.2% for stage II; 0.7% for stage III). No scrotal elephantiasis was seen in the first decade of life. The youngest person who was observed with stage I was 18 yr old, while for stages II and III, the youngest persons were 55 and 68 yr old, respectively. The prevalence for the three stages combined rose with advancing age to reach 23.1% in the oldest age group. The sample size in the oldest age group was, however, quite small.

Relationship between microfilaraemia and clinical manifestations

The relationship between *W. bancrofti* microfilaraemia and hydrocele, limb elephantiasis and scrotal elephantia-

sis was analyzed. Of the 36 males with hydrocele, 4 (11.1%) had microfilaraemia. In all, 18 (3.9%) of the 462 males who were hydrocele negative were positive for *W. bancrofti* microfilaraemia (Table 1A). There was no significant difference between the *W. bancrofti* mf prevalence in those with hydrocele and those without (χ^2 -test; $p > 0.05$). Most cases of hydrocele were seen in males aged 20 yr and above. In this age group, the mf prevalence of those with hydrocele (12.1%) was higher than that of those without hydrocele (4.8%), but the difference was not statistically significant (χ^2 -test; $p > 0.05$).

Of the four persons who were positive for both *W. bancrofti* and hydrocele, three had stage II and one had stage I hydrocele and their mf intensity ranged from 80 to 2260 mf/ml of blood. The overall mf GMI, as well as the mf GMI of those ≥ 20 yr old, among those with hydrocele was significantly higher than the mf GMI of those without hydrocele (χ^2 test; $p < 0.01$ for both tests). However, the number of mf positive hydrocele cases was low.

The relationship between *W. bancrofti* microfilaraemia and limb elephantiasis is presented in Table 1B. Among individuals who had limb elephantiasis, 4 (6.6%) were positive for *W. bancrofti* microfilaraemia with a mf GMI of 97 mf/ml. Among 949 individuals who had no limb elephantiasis, 39 (4.1%) were positive for *W. bancrofti* microfilaraemia with mf GMI of 126 mf/ml. There was no statistically significant difference between the mf prevalence in those with limb elephantiasis and those without (χ^2 test; $p > 0.05$). However, the mf GMI was significantly higher in the latter than in the former, but the number of mf positive individuals with limb elephantiasis was low (t -test; $p < 0.05$). Three of the four mf positive individuals with limb elephantiasis were females and all had stage I limb elephantiasis. The only male in that group had stage II limb elephantiasis.

Most cases of limb elephantiasis were seen in individuals aged 40 yr and above. Among these, the mf of those with limb elephantiasis (8.1%) was comparable with that of those without limb elephantiasis (6.6%) and the difference was not statistically significant (χ^2 test; $p > 0.05$). For the same age group the mf GMI of those with limb elephantiasis (598 mf/ml) was higher than the mf GMI of those with limb elephantiasis (128 mf/ml), but the difference was not statistically significant (t -test; $p > 0.05$).

The relationship between *W. bancrofti* microfilaraemia and scrotal elephantiasis is presented in Table 1C. Among 20 males who had scrotal elephantiasis, 6 (30%) were positive for *W. bancrofti* microfilaraemia with a mf GMI of 193 mf/ml. Among 478 males who had no scrotal elephantiasis, 16 (3.3%) were positive for *W. bancrofti* microfilaraemia with a mf GMI of 120 mf/ml. The mf prevalence

was significantly higher among those with scrotal elephantiasis than among those without scrotal elephantiasis (χ^2 test; $p < 0.001$). Similarly, the mf GMI of the former group was significantly higher than the mf GMI of the latter group (t -test; $p < 0.01$). Three of the six cases of mf positive scrotal elephantiasis were of stage I, two were of stage II and one was of stage III.

Most cases of scrotal elephantiasis were seen in individuals aged 20 yr and above. Among these, the mf prevalence of those with scrotal elephantiasis was significantly higher than the mf prevalence of those without scrotal elephantiasis (χ^2 test; $p < 0.01$). For the same age group, the mf GMI of those without scrotal elephantiasis was significantly higher than the mf GMI of those with scrotal elephantiasis (t -test; $p < 0.01$).

DISCUSSION

The prevalence of *W. bancrofti* here was lower than reported in the Igun River Basin¹⁰ and in the Niger Delta areas¹¹. This may be partly due to the lower volume of blood (50 μ l) used in our study than in those studies (100 μ l). The importance of the volume of blood examined in filariasis studies have been demonstrated^{12,13}. It was observed that 20 and 60 μ l blood films do not reliably detect microfilaraemic individuals with low parasitaemia levels¹⁴.

Another reason for the disparity in prevalence of microfilaraemia is the changing climate. There has been lower rainfalls in West Africa over the years¹⁵, which could shorten transmission seasons; lower mosquito densities; while the accompanying higher temperatures could reduce mosquito longevity and possibly also the survival of mosquito larvae¹⁶.

The prevalence of *W. bancrofti* increased gradually with age, which agrees with findings from other parts of Nigeria^{11,17} and Ghana¹⁸. The difference in mf prevalence between age groups may not be strictly attributed to differences in level of exposure, given the night-biting habit of the vector and the sleeping arrangements of the people¹⁹. Probably adults present a greater surface area to biting female mosquitoes. Although people including children, are continually exposed to infection, the rate of gain of infection exhibits a convex age profile peaking in the 16–20 yr old age class²⁰. The decline in older age group is considered to be due to resistance to new infection¹⁹. Lymphatic filariasis is acquired very early in life even though the clinical manifestations are seen in adults²¹.

The comparable prevalence in both sexes may reflect that both males and females engage equally in activities involving an exposure risk, such as nocturnal outdoor meetings and story-telling by most families. This is the

main man-vector contact activity with the main vectors in the area, particularly *Anopheles gambiae* s.l. and *An. funestus*. Exposure during sleep is also comparable in males and females with peak vector biting between 2200 and 0200 h. Similar results were reported in Nile Delta²². A review of 53 epidemiologic studies from different parts of the world in which gender susceptibility was examined, showed that difference is only apparent in the women's reproductive years, suggesting a pregnancy-associated mechanism²³.

The microfilarial densities varied between sexes and between age groups, which is consistent with results from studies elsewhere²⁴. Our study and studies from other endemic areas in southern Nigeria^{10,11} did not show any reduction in microfilaraemia level among women of reproductive age as has been reported in other parts of Nigeria and elsewhere^{17,23}.

Pathology of bancroftian filariasis is associated with a diverse range of inflammatory conditions, such as acute inflammation characterized by recurrent attacks of adenolymphangitis associated with death of adult worms²⁵; or chronic inflammation associated with hydrocele, lymphoedema, and elephantiasis²⁶. Hydrocele was the most common clinical manifestation seen among men, especially among individuals ≥ 40 yr. A similar pattern was observed in Ghana¹⁸, East Africa^{24,27}. The prevalence of hydrocele was lower than reported from studies in East Africa²⁴, and did not correlate well with the community prevalence in this study unlike in Ghana²⁸.

Limb elephantiasis was more common among females than males, and agrees with findings in Ghana¹⁸. Low prevalence of true, and stage I scrotal elephantiasis in this study is consistent with findings in some areas of West and East Africa^{18,24}. Chronic clinical manifestations were seen among people in their third or fourth decades of their lives, and not among those in their first decade of life. This could be due to the natural history of the disease, the early stage of which is remarkably silent and progression to latter stages is phenomenally slow²¹. On the whole, the number of individuals with clinical manifestation was higher than the number of individuals with microfilaraemia. This is expected because although point prevalence could be low, the total proportion of the population who eventually experience infection (cumulative prevalence) is substantial. Furthermore, development of disease is an evitable sequel to infection. Some of those once infected may become amicrofilaraemic but may retain their steady drift to chronic pathology²⁹. The type and frequency of clinical manifestations vary from one region to another. There has not been any reported case of podoconiosis (endemic non-filarial elephantiasis)³⁰ in the Imo River Basin, and there-

fore it is our informed inference that elephantiasis in the Imo River Basin is of filariasis origin.

The association between hydrocele and microfilaraemia is not fully understood, but microfilaraemia was common among males who had hydrocele, which is in line with findings from studies elsewhere^{24,31}. Similarly, microfilaraemia was common among individuals who had limb elephantiasis, and also among those with scrotal elephantiasis. The earlier cited report from Tanzania had a contrary observation. The presence of endemic onchocerciasis, mansonellosis, and loaiasis in our study area could explain this disparity. *Onchocerca volvulus* might play causative role in the pathogenesis of elephantiasis^{32,33}. There are strong indications that scrotal elephantiasis, hanging groin and hernias are important complications of onchocerciasis³⁴ and perhaps also of mansonellosis³⁵. The causal relationship between *W. bancrofti* infection and disease has been explained to result from death of microfilariae³⁶, from microbial involvement³⁷, or due to maternal infection status³⁸. Perhaps, the diversity of clinical responses to filarial infection is due to the intensity and type of immune response to the parasite or parasite products³⁹; the ongoing intense exposure to infective parasite stages which modifies the immunologic profile and its associated pathology⁴⁰. This suggests that decreasing transmission intensity will disproportionately decrease pathology⁴¹. Since the parasite does not replicate within the human host, the cumulative and/or temporal pattern of exposure to infective larvae determines the infection load and may therefore increase the likelihood of developing disease. Furthermore, secondary infection by bacteria of already damaged lymphatics may accelerate or exacerbate development of chronic lymphatic disease⁴². Indeed, the situation may be complex with many interacting factors and the picture may therefore be different in different endemic areas.

Overall, our study corroborates the observations on some school children⁴³ and showed that prevalence and risk of being affected with hydrocele is significantly higher than that of lymphoedema of limbs in the male population²⁴.

Filariasis is endemic in the high altitude region of south-eastern Nigeria. The chronic clinical manifestations observed there underscore the need for urgent combination therapy interventions.

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Correspondence to: Dr Emmanuel C. Uttah, Department of Biological Sciences, Faculty of Science, Cross River University of Technology, Calabar, Nigeria.
E-mail: drecuttah@yahoo.com

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