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# Effect of Electromagnetic Radiation, Telecommunication Mast on *Clarias gariepinus*

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## Abstract

Telecommunication masts, also known as cell towers or base stations, are structures that emit electromagnetic radiation to facilitate wireless communication. These masts play a crucial role in modern telecommunications infrastructure, enabling the transmission and reception of signals for mobile phones, internet connectivity and other wireless devices. This study is to evaluate the effects of electromagnetic radiation on behavior, growth and heamatological indices of *Clarias gariepinus*. A total of 90 juvenile *Clarias gariepinus* of approximately equal body weight of (6.66 g-6.96 g) were purchased from a private hatchery in Birnin Kebbi and were transported in a gerry can to the research location, Gwadangwaji village of Birnin Kebbi. A plastic tank of 50 liters were used. The fishes were divided into two groups of 15 with three replicate fishes each, of which group one was made to be the control group and placed 800 meters away from the direct source of EMR (telecommunication mast). Group two was exposed to 18000 MHz EMR at about 50 m away from telecommunication mast. The reactions of the fishes were observed daily for 90 days, after which the fishes were sacrificed. The data for this study were analyzed using the Statistical Package for Social Sciences (SPSS) version 20 for windows. The student's t-test was used to compare the differences between the test and control groups in which $P<0.05$ was considered as significant difference. The activeness of the experimental fish was recorded to be very active on controlled group and active on exposed group. More so on growth parameters, the highest final weight (291.49 ± 0.50 g) while the least (279.44 ± 0.50 g) were observed in group A and B respectively. The highest mean weight (284.83+19.26 g), highest average daily growth (3.16 +0.211 g) and highest survival rate (86.10+2.92%) were obtained in control (group). On the other hand, the least growth parameters were obtained in exposed (group). The result on the highest PCV (27.10 ± 0.50%), haemoglobin (8.70 ± 0.50) and red blood cell (2.01 ± 0.29) was observed in control group while the least PCV (25.77 ± 0.29) haemoglobin (8.37 ± 0.29), red blood cell (1.77 ± 0.29) was in the exposed group. The high white blood cell (4.59 ± 0.29) was observed in exposed group while least (2.84 ± 0.29) was in the control group. The highest granulocyte count (2.7%) was observed exposed (group B) while the least granulocyte (0.9%) was in the control (group A). Conclusively, this study have shown that exposure to telecommunication mast (EMR) can induce toxicity in biological systems and it is therefore, recommended that the mass media, in their report of environmental and health matters, should also give adequate attention to issues of health and environmental risks associated with situating telecommunication masts close to people's residents.

**Keywords:** *Clarias gariepienus*; Birnin Kebbi; Telecommunication

## Introduction

Telecommunication masts, also known as cell towers or base stations, are structures that emit electromagnetic radiation to facilitate wireless communication. These masts play a crucial role in modern telecommunications infrastructure, enabling the transmission and reception of signals for mobile phones, internet connectivity and other wireless devices. While there is ongoing research on the potential effects of telecommunication masts on various organisms, including fish, the current scientific consensus suggests that these structures have minimal direct impacts on aquatic life [1].

The length of the wavelength is inversely proportional to the amount of energy. Thus, short-wavelength radiations have more energy than long-wavelengths. As such, gamma rays, x-rays and some ultraviolet waves with short wavelengths have a high amount of energy and frequency to knock out electrons from atoms and are termed ionizing EMR. EMR such as radio waves, microwaves and heat waves have a long wavelength which results in low frequency and energy and are termed non-ionizing EMR. This study is to evaluate the effects of electromagnetic radiation on heamatological indices of *Clarias gariepinus*.

## Materials and Methods

### Study area

The research was conducted, at Gwadangwaji village. Gwadangwaji is a locality in Birnin Kebbi, Kebbi state. With latitudes 12°27'51"N and longitude 4°15'36"S minimum and maximum temperature ranges were 18°C-29°C and 30°C-42°C, respectively. The relative humidity ranged between 20% to 50%

and speed ranged from 7 to 11. Kebbi state is bordered by Sokoto state in the north, Niger state in the south, Katsina and Zamfara state in the east as well as Niger and Benin Republic in the west. As of 2006, at least 3,256,541 people lived in the state, mostly artisans and farmers. The natural vegetation of the state comprises a mixture of Sudan and Guinea Savannah. However, long-term anthropogenic activities have changed the natural vegetation of the state to mainly Sudan Savannah vegetation. The climate of the state is characterized by a long dry season and short wet season with an annual rainfall of about 787 mm [2].

## Acquisition of the experimental fish

A total of 90 juvenile *Clarias gariepinus* of approximately equal body weight of (6.66 g-6.96 g) were purchased from a private hatchery in Birnin Kebbi local government area. The juvinile were transported in a jerry can to the research location, Gwadangwaji village Birnin Kebbi. The fishes were acclimatized for 1 week during which they were fed with the vital feed with 2 mm of 40% crude protein [3].

## Measurement of EMR

The EMR around the telecommunication mast was measured using a Trifield EMR meter.

## Experimental design

A plastic tank of 50 liters were used. The fishes were divided into two groups of 15 with three replicate fishes each, of which group one was made the control and placed 800 meters away from the direct source of EMR (telecommunication mast). Group two was exposed to 18000 MHz EMR at about 50 m away from telecommunication mast. The reactions of the fishes were observed daily for 90 days, after which the fishes were sacrificed [4].

## Experimental fish management

Experimental fish in each plastic tank were fed with the commercial fish feed. The daily ration was split into two and fed twice daily; in the morning and evening. The ration was adjusted on weekly bases. Water levels were maintained and changed after every 3 days in the plastic tank.

## Growth parameters

The body weight was recorded on weekly basis by weighing fishes in each experimental unit on a field weighing balance. The following growth performance indices were estimated using standard formulae as follows;

Mean Weight Gain (MWG) (g)=Final weight (g)-Initial weight (g)

Average Daily Growth (ADG)=MWG (g)/length of feeding trial (t) (days)

Specific Growth Rate (SGR, %/day)=100(lnW2-lnW1)/T2-T1

Where: W2=Weight at time T2; W1=Weight at time T1

Survival Rate (SR)=100 (Number at end of feeding trial/ Number at start of feeding trial)

## Procedure for blood collection

Two milliliters (2 ml) of blood was collected by direct cardiac puncture as described by Adebayo Tayo et al. The cardiac region was wiped with tissue paper to avoid contamination with mucus before puncture. The needle was inserted at right angle to the vertebral column of the fish, the needle was gently withdrawn and the blood was transferred in to EDTA containers.

## Data analysis

Data obtained was analyzed using the Statistical Package for Social Sciences (SPSS) version 20 for windows. The student's t-test was used to compare the differences between the test and control groups in which $P<0.05$ was considered as significant difference [5].

# Results

## Effects of EMR on behavior and growth of *C.gariepinus*

Table 1 shows the result of EMR exposure resulted in behavioral changes, swimming activities were reduced; moreover, a reduction in appetite was also observed in exposed fish compared to the controlled [6].

**Table 1:** Behavioral activities.

| Activities | Controlled group (A) | Exposed group (B) |
|---|---|---|
| Swimming | +++ | + |
| Feeding | +++ | + |

The increase and decrease in the level of behavioral activities shown by (+++) or (+) signs. The (+++) indicate very active while (+) indicate active. Table 2 shows the growth parameters.

The highest final weight gain (279.44 ± 0.50 g) was in observed in the control group, while the least (272.57 ± 0.50 g) was in the group exposed to EMR [7].

**Table 2:** Growth performance of experimental fish *Clarias gariepinus*.

| Parameters | Control group (A) | Exposed group (B) |
|---|---|---|
| IW (g) | 6.66 ± 0.10$^{b}$ | 6.96 ± 0.10$^{a}$ |
| FW (g) | 291.49 ± 0.50$^{a}$ | 279.44 ± 0.50$^{b}$ |
| MWG (g) | 284.83 ± 19.26$^{a}$ | 272.34 ± 35.49$^{b}$ |
| ADG (g) | 3.16 ± 0.211$^{a}$ | 3.02 ± 0.39$^{b}$ |
| SGR (g) | 4.21 ± 0.23$^{a}$ | 4.08 ± 0.22$^{b}$ |
| SR (%) | 86.10 ± 2.92$^{a}$ | 84.44 ± 0.50$^{b}$ |
| **Note:** n=3, Values are expressed as Mean ± Standard deviation, values on the same column with the different superscript are significantly different P<0.05; IW (g)=Initial weight; FW (g)=Final weight; MWG (g)=Mean weight gain; ADG (g)=Average daily growth; SGR (g)=Specific growth rate; SR (%)=Survival rate | | |

## Hematological analysis

The blood samples were immediately conveyed to Amma and Diagnosis Laboratory Birnin Kebbi, Kebbi state for analysis of haematological indices. Haemaglobin (Hb), Packed Cell Volume (PCV), Red Blood Cell count (RBC), White Blood Cell count (WBC), Mean Corpuscular Volume (MCV) and Mean Corpuscular Haemaglobin (MCH) were analyzed using Automated Mindry Haematological Machine Model: BC-2800.

## Hematological indices of experimental fish

Result from Table 3 revealed the mean values for hematological indices of *C. gariepinus* in control group and exposed group are presented in Table 3. Result showed significant difference (P<0.05) for all the parameters measured, when compared to the control. There was decreased in values of some haematological parameters of *C. gariepinus* in the control group when compared with exposed group; these includes MCH (41.37 ± 0.29), WBC (4.59 ± 0.29), MCV (123.90 ± 0.29) and MCHC (33.37 ± 0.29). However, some parameters were found to be higher in the control group these include; PCV (27.10 ± 0.50%), Hb (8.70 ± 0.50 g/dL) and RBC (2.01 ± 0.29). The result shows significant difference on haematological indices at P<0.05 when the control group was compared with other groups [8].

**Table 3:** Blood parameters of the *Clarias grapienus* exposed to telecommunication mast EMR.

| Parameters | Control group (A) | Exposed group (B) |
|---|---|---|
| PCV (%) | 27.10 ± 0.50$^{a}$ | 25.77 ± 0.29$^{b}$ |
| Hb (g/dL) | 8.70 ± 0.50$^{a}$ | 8.37 ± 0.29$^{b}$ |
| PLT (L) | 8.00 ± 0.50$^{a}$ | 8.00 ± 0.50$^{a}$ |
| MCH | 39.10 ± 0.50$^{b}$ | 41.37 ± 0.29$^{a}$ |
| WBC | 2.84 ± 0.29$^{b}$ | 4.59 ± 0.29$^{a}$ |
| RBC | 2.01 ± 0.29$^{a}$ | 1.77 ± 0.29$^{b}$ |
| MCV | 117.40 ± 0.50$^{b}$ | 123.90 ± 0.29$^{a}$ |
| MCHC | 32.97 ± 0.29$^{b}$ | 33.37 ± 0.29$^{a}$ |
| **Note:** n=3, Values are expressed as Mean ± Standard deviation, values on the same column with the different superscript are significantly different P<0.05; PVC=Packed Cell Volume; Hb=Hemoglobin; WBC=White Blood Cells, RBC=Red Blood Cell | | |

# Discussion

The behavioral activies of the fishes exposed to EMR were less active. This finding agrees with the works of Ricardo and Susana, who reported that a change in behavioral, physiological and the metabolic changes in juvenile/adult fish under short- and long-term radiation exposure. Swimming activity was reduced; most of the fish tried to avoid exposure and showed a stationary behavior with slow caudal and dorsal fins movements or a slow displacement behavior. Moreover, a reduction in appetite, reflected by a remarkable increase in the time required to consume the food was

reported in exposed fish compared to the control [9].

The loss of body weight observed in fish exposed to EMR; could be due to interactions between the EMR and the cell leading to toxicity. This is also in line with Ricardo and Susana, who observed growth reduction and loss in body condition of juvenile and adult fishes exposed to radiation.

Earlier studies by Srivastava et al. also reported growth retardation among some rats exposed to 900 MHz EMR from mobile phones and Tajudeen et al. recorded no weight gain in rats exposed to EMR, which could have resulted in the loss of appetite and fewer feed intakes, culminating in iron deficiency [10].

An increase in the level of WBC was observed in exposed fish which was significantly higher ($P<0.05$) than the control which suggested that the body is recruiting more immune cells to fight the EMR from the mast. Adebayo et al. also observed elevated WBC levels in some rats exposed. The authors suggested that the increased WBC levels could be an indicator of a self-defense mechanism against exposure to foreign bodies. The level of PCV RBC and Hb lymphocytes of exposed fish decreased. A lower count of PCV means a loss in RBC count due to several reasons, such as cell destruction, low bone marrow production and blood loss. The decreased blood is an indication that the fishes were anaemic.

According to Tajudeen et al., EMR exposure may induce oxidative stress in animal systems, resulting in the reduction of blood parameters. Previous studies by Singh et al. and Aberumandet al. also found significant decreases in the levels of Hb, RBC and blood platelets of some mice exposed to mobile phone EMR. However, Sani et al. reported an increase in the Hb and RBC levels of some rats exposed to EMR from mobile phones. The levels of the MCH and MCV of the fish there was a significant increase in the level of exposure ($P<0.05$).

## Conclusion

The results of this study have shown that exposure to telecommunication mast (EMR) can induce toxicity in biological systems. In particular, the EMR interfered with the functions of the selected health indices of the exposed fishes, resulting in reduced behavioral activities. The exposed fishes also weighed less than the control, indicating mitotic cell death or a loss of appetite consequent of the reduced activities with subsequent decreased in survival rates. Similarly, the blood parameters were altered, which add to the body of evidence that EMR from the telecommunication mast was strong enough to cause harmful effects. Collectively, the findings of the study showed that exposure to telecommunication mast EMR can induce toxicity to cells and hence affect their functions.

## Recommendations

- The mass media, in their report of environmental and health matters, should also give adequate attention to issues of health and environmental risks associated with situating telecommunication masts close to animal farms. Such reportage would serve as a form of advocacy for an appropriate response from the authorities as well as an enlightenment for the populace.
- It is advisable to site telecommunication masts away from dwelling places.
- Concerned administrative bodies, for example, the NCC and NESREA ought to guarantee the adequate and strict implementation of pertinent ecological guidelines with respect to the erection of media transmission poles. This is one way of addressing the health risks attendant on the spread of telecommunication installations around the country.

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