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# Effect of Exposure of 900 MHz Radiofrequency Radiation on Rat Brain

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**ABSTRACT**

*This study investigated the effect of 900 MHz Radio frequency radiation (RF) from digital mobile telephone on the brain of Albino wistar rats. Twelve (12) male rats were used for the study divided into 3 groups of 4 rats each. Group A and Group B were exposed to 8 hours/day and 4 hours/day mobile phone radiation for 2 months respectively while Group C served as control. Genomic DNA (Deoxyribonucleic acid) fragmentation was accessed by agarose elecetrophoresis and histological study was conducted to check the structural changes in the brain tissue after exposure to the radiation for the period. The result showed that there was no observable DNA damage in the brain of rats. Alterations such as congestion of the cerebral blood vessels and presence of numerous spongiform vacuoles in the neuropil of the brain tissues of the exposed rats were observed. We concluded that exposure to mobile phone radiation can modify brain structure at tissue level but not at DNA level.*

**Keywords:** 900 MHz Radiofrequency Radiation, Mobile phone, Brain, DNA, Histology

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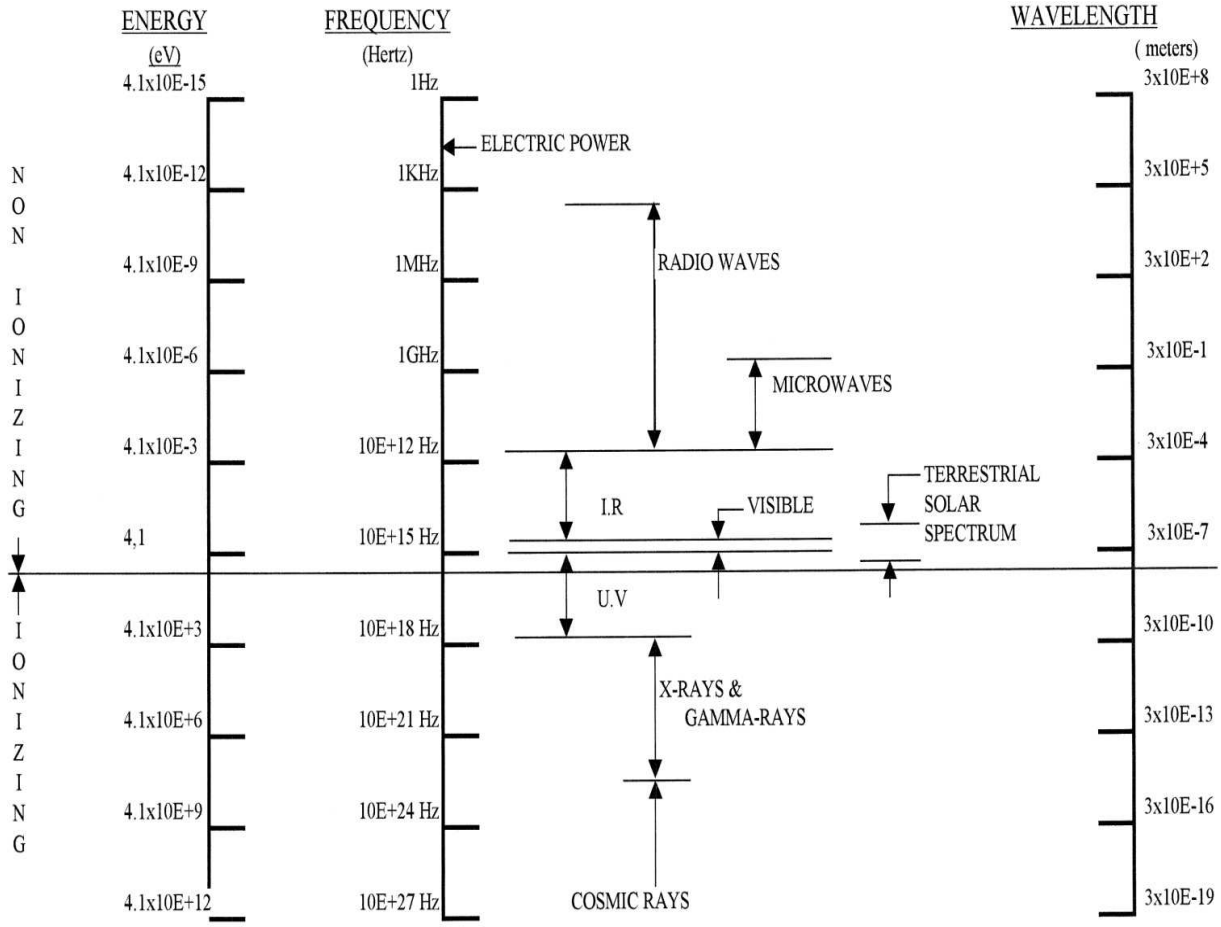
## INTRODUCTION

The mobile phone, also known as cellular phone, has become one of the most successful inventions in the 20th century. According to Cellular Online, an agency of the UN in 2011 estimated 4.1billion mobile subscriptions [1] which is about 54 percent of the current world population. Cell phones fall to the category of radiofrequency radiation which currently operate in the frequency range of about 900 to 2,200 Megahertz (MHz). In the electromagnetic spectrum it forms the group called non-ionizing radiation, as shown in Figure 1. As a result of the global concern of the potential health hazard induced by this type of radiation, a considerable amount of research has focused on the modulation of normal physiological function especially the brain [2-5].

A study showed that when people used a cell phone for 50 minutes, brain tissues on the same side of the head as the phone's antenna metabolized more glucose than did tissues on the opposite side of the brain. The researchers noted that the results are preliminary, and possible health outcomes from this increase in glucose metabolism are still unknown [6]. Laila *et al.*, [7] reported histological changes in the different visceral organs including heart, lung, liver and kidney of rats exposed to radio frequency radiation for 4weeks (1h/day). Fehmi *et al.*, [8] observed histopathological changes in the skin of rats exposed to 900MHz radiation for 10 days. Sarookhani *et al.*, [9] suggested that testosterone and FSH levels are disturbed as a result of mobile phone exposure and it possibly affects reproductive functions. Wistar rats (35 days old, male, six rats in each group) were exposed for 35 days. After the exposure period, single strand DNA breaks by microgel electrophoresis (comet assay) conducted. The study showed that the chronic exposure to these radiations cause statistically significant increase in DNA single strand breaks in brain cells of rats [10].

This work therefore investigated the genomic DNA and histological changes in brain tissue of rats exposed to cellular phones.

**Figure 1: Electromagnetic Spectrum [11]**



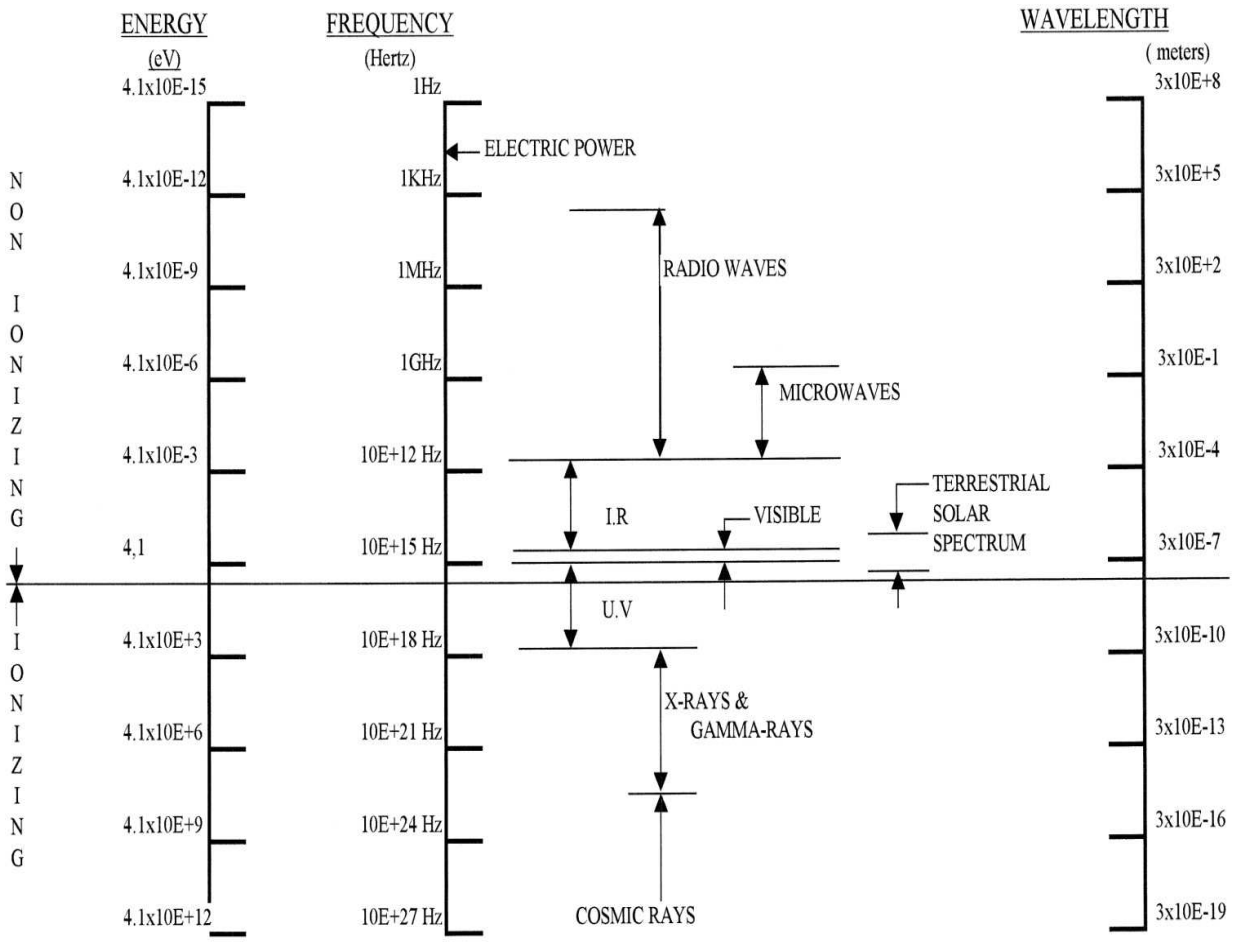

## MATERIALS AND METHODS

### 2.1 Animal Preparation and Exposure

Twelve weaning male Albino wistar rats, weighing 30–40 g, were used for the experiment. The rats were purchased from the animal house of University of Agriculture, Abeokuta. The animals were left for five days for acclimatization in the laboratory with food and water provided *ad libitum* throughout the experimental period. For the care and use of laboratory animals, this study used the guidelines of the biological sciences animal house of the Covenant University. The rats were divided into three groups (A, B and C) of four rats each. The two cell phones used in the study were Nokia 1202 (China), which have a personal communications service code division multiple access (PCS CDMA) frequency band of 2G network (900 MHz / 1800MHz digital), weight 78g and SAR 1.090W/kg (head). Group A received cell phone radiation exposure for 8 hours per day, group B received cell phone radiation exposure for 4 hours per day for eight weeks and group C acted as a control group under the same environmental conditions.

### 2.2 DNA fragmentation assay

DNA was isolated using DNAzol, a novel guanidine-detergent lysing solution that hydrolyzes RNA and allows for the selective precipitation of DNA from cell lysates [12]. Briefly, 50mg brain tissue was homogenized in 1 mL DNAzol on ice using a motorized Teflon Potter-Elvehjem homogenizer. The samples were stored for 10 min at room temperature and then centrifuged at 2400g for 10 min. DNA was precipitated from the supernatant using 0.5 mL of absolute ethanol per mL of supernatant. The DNA was centrifuged at 2400g and washed three times with 75% aqueous ethanol prior to dissolution in 8mM NaOH.




To visualize the DNA ladder, extracted DNA in sample buffer (0.25% bromophenol blue, 30% glyceric acid) electrophoretically separated on 1.0% agarose gel containing 1.0 µg/ml ethidium bromide for 2.5h at 100V. Pictures were taken by UV transillumination.

**2.3 Histological Study**

Slices of the tissues of animals of each group were fixed in 10% formalin for and then, embedded in paraffin. Sections of 5–6mm were routinely stained with haematoxylin and eosin (H & E) and examined under a light microscope (Olympus CH02). Any alterations compared to the normal structure were registered.

## RESULTS AND DISCUSSION

**3.1 Body Weight Study**

Figure 2 presents the variation in the body weight of the exposed and control rats. There was progressive increase in the body weight of all the groups. However, from week 5 through week 8, rats exposed to the RF radiation experienced a slight decrease in body weight gain. This observation is consistent with previous studies that showed that whole body exposure to radiation could result in decrease in weight gain of rats [13,14]. Decrease in weight compared to the control could be due to stress the rats were subjected to during exposure to 900 MHz RF radiation from the cell phone.

**3.2 Electrophoresis Assay**

Figure 3 shows the result of the rats brain DNA as observed on the agarose gel. The DNA samples travelled a very short distance due to the fact that the DNA being fully packed and void of breakage. This implies that there was no significant different between the rat brain DNA in the exposed and control group. Although DNA damage is known to be induced by radiation; this damage, is through the radiolysis of water, which triggers formation of several reactive intermediates. Therefore, to overcome this oxidant stress, cells are equipped with comprehensive and integrated endogenous enzymatic and non-enzymatic antioxidant systems that are designed to mitigate DNA damage [14].

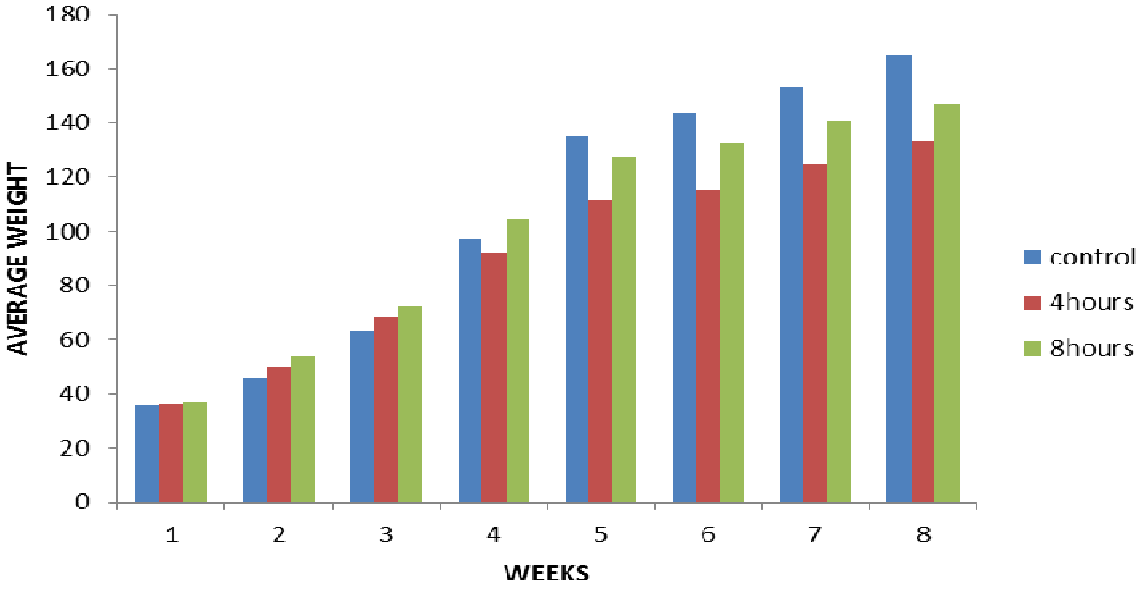



**Fig 2: Variation in the Body Weight**

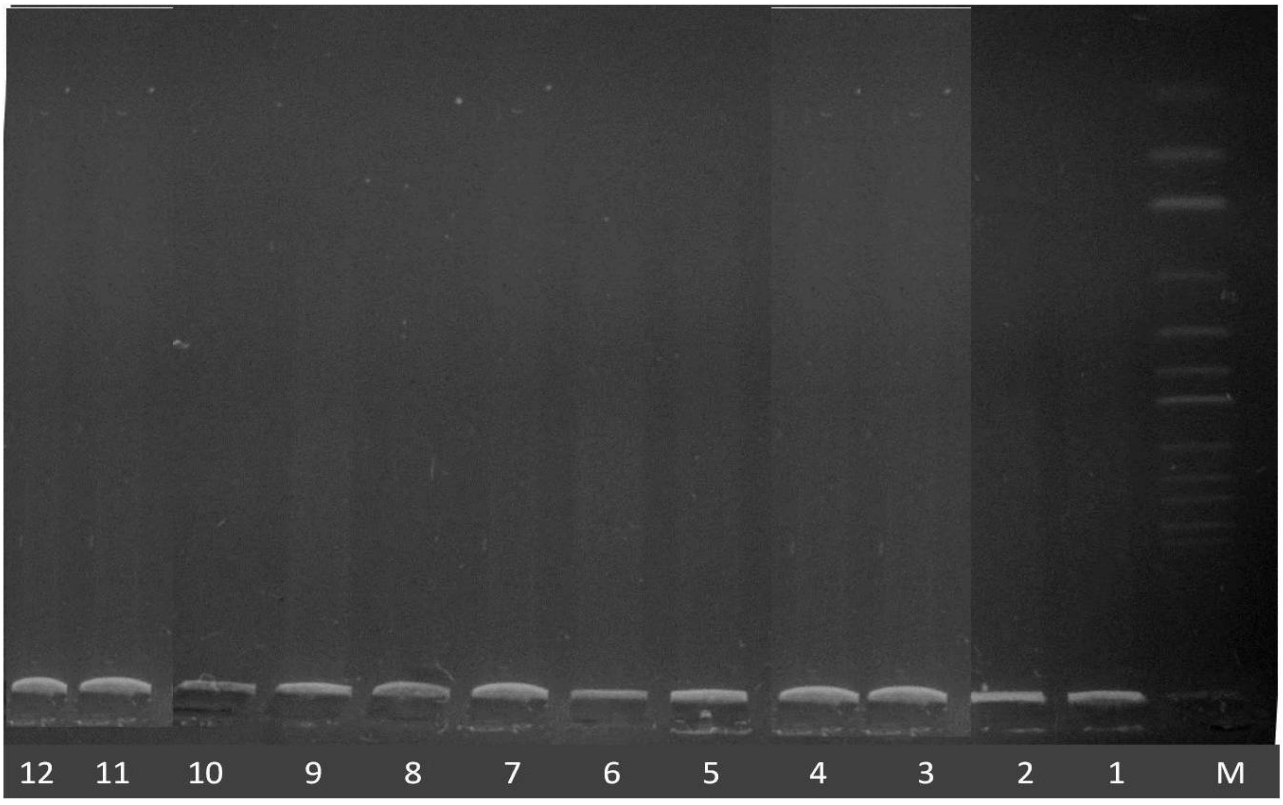



**Fig 3: Agarose gel showing the genomic DNA band of each rat. Lanes from right (M) DNA marker; group A (1-4); group B (5-8) and group C (9-12)**

This result corroborate the reports by various researchers that exposure to mobile phone may not lead to DNA damage. Aitken *et al*., [15] who exposed mice to 900 MHz RF radiation for 7 days at 12 h per day and assessed DNA damage in caudal spermatozoa by Gel electrophoresis reported no significant change in single- or double-DNA strand breakage in spermatozoa. Lagroye *et al*., [16] reported no significant change in DNA strand breaks in brain cells of rats exposed for 2 hours to 2450 MHz field. Vershaeve *et al*., [17] long-term exposure (2 hours/day, 5 days/week for 2 years) of rats to 900 MHz GSM signal at 0.3 and 0.9 W/kg did not significantly affect levels of DNA strand breaks in cells. A study by Zeni *et al*., [18] human peripheral blood leukocytes was exposed for 2 hours to 900 MHz radiofrequency radiation SAR of 0.3 and 1 W/kg observed no DNA damage in blood leucocytes.

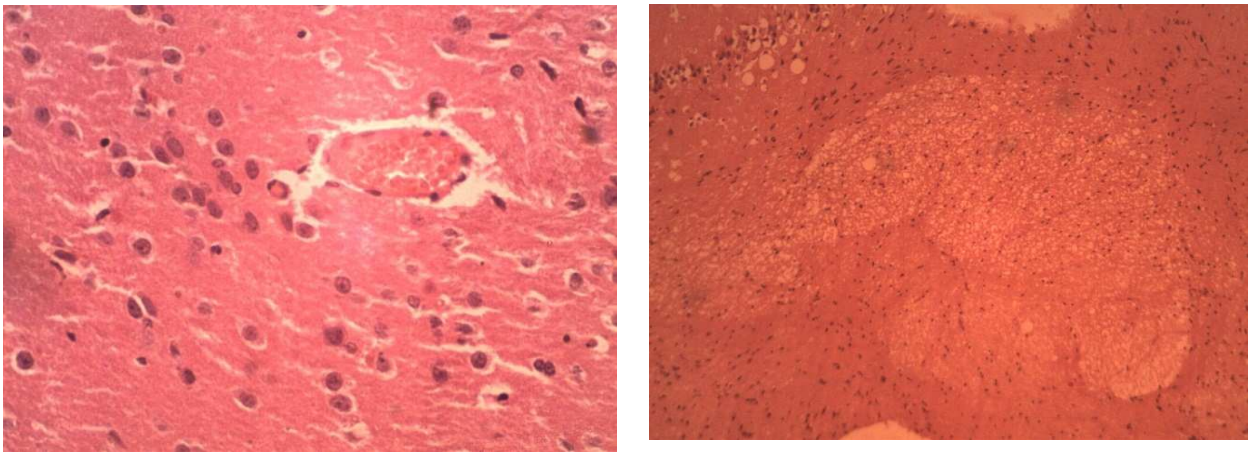


**Fig 4 Photomicrograph of histological study of Group A exposed to 8 hours.**

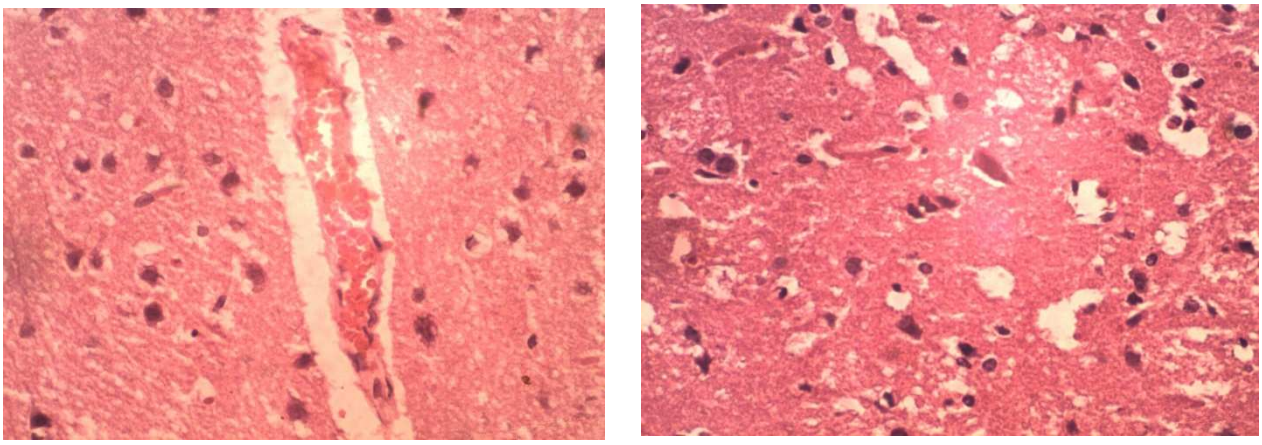


**Fig 5 Photomicrograph of histological study of Group B exposed to 4 hours**

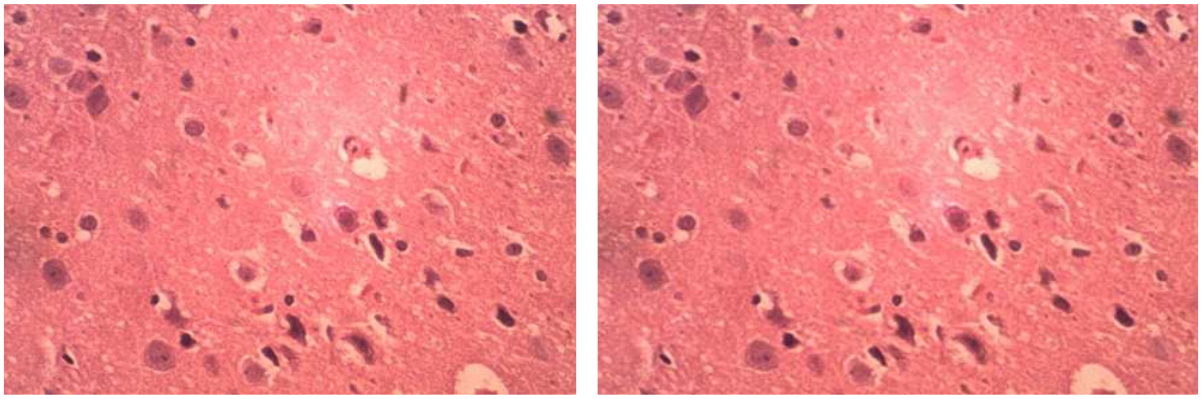


**Fig 6 Photomicrograph of the histological study of Group C exposed to no radiation -: Photomicrographs are at magnification of 100X**

### 3.3 Histological Study

Figure 4 to 6 are the micrographs of the exposed and control rat brain tissue. There were observable histological changes in the rats exposed to radiation when compared to the control.. The photomicrograph of rats brain exposed to 8 hours (Fig 4) showed a marked congestion of the cerebral blood vessels and presence of numerous spongiform vacuoles in the neutropil. The photomicrograph of rats' brain exposed to 4 hours (Fig 5) showed moderate congestion of the blood vessels along side with moderate locally extensive gliosis and multiple foci of spongiform vacuolation. The photomicrograph of rat brain of the control (Fig 6) showed normal appearance and arrangement of cells and tissue in the brain. This result showed structural changes in the brain cells of the rats exposed to mobile phone radiation compared to the control. These changes in the histology is in consonance with the report given by other scientists such as Laila *et al*., [7] after exposing fifteen rats to mobile phone radiation daily for 4 weeks (1h/day) observed histological changes in the different visceral organs studied. In the same vein, Khayyat and Eurasia [19] exposed two groups of rats to same frequency of radio frequency radiation for 8 h per day for 3 days

and other group for 8 Hours per day for 12 days and reported significant histological alterations in the kidney and testis of the exposed animals for 3 days and were more obvious for those exposed for 12 days. Fehmi *et al*., [8] study the effect of 900 MHz radiation on the skin of thirty male rats exposed for 10 days he observed histological changes in the thoracic- abdominal area of the rats.

## CONCLUSION

We therefore conclude that mobile phone radiation could modify body weight produce observable histological changes in the brain tissue of exposed rats. However, these changes may not be associated with a concomitant DNA damage.

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