Research Article

# The Influence of Wi-Fi Rays on Human Cell Cultures: The Difference Between Cancer and Non-cancer Cells

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**ABSTRACT:** Today, everyday use of WiFi devices has become a necessity. There are several studies claiming the harmful effects of its rays on prokaryotes, yeasts, human and animal cells such as spermatozoids. The effects include DNA damage, oxidative stress, cellular apoptosis. However, the differences in how these rays affect cancer and non-cancer cells are still unknown. This research was aimed to find out if WiFi rays have the same influence on cancer and non-cancer cells. For the research, two different human cell lines were exposed by WiFi rays. The oxidative stress and DNA damage of each cell culture was studied with and without the influence of WiFi rays. Both these cell lines were seriously damaged by the rays; however, the non-cancer line showed a higher level of oxidative stress (measured by fluorescence microscopy) compared to the cancer cell line. In addition to this, it had more noticeable damage of DNA.

**Keywords:** WiFi rays, HeLa cells, MRC-5 cells, fluorescence microscopy, comet assay (single cell gel electrophoresis), cellular oxidative stress, DNA damage.

## INTRODUCTION

Sharing information is a necessary part of human life today. A very popular way to do this is WiFi. WiFi routers provide low-frequency rays, these rays are dominant in the environment we live, they are an indivisible part of modern life. We are always surrounded by WiFi rays; knowing this leads to worries.

Several experiments gave certain evidence about the influence of WiFi rays [1]. Many experiments were set on rats and rat and human spermatogenesis [2][3][4][5][6][7], they confirm the negative influence of WiFi rays. Some experiments reject its harmful effect [8]. Some experiments were done on WiFi rays' ability to index attention and working memory operation of the brain [9]. In many cases though, a certain spectrum of rays was used [10][11] [12], which does not reflect the influence WiFi rays would have in normal conditions. Even experiments were set on breast cancer cells using the exact frequency spectrum of WiFi rays, 2.4 GHz, but this, too, may not show the real pattern [13].

There are some major differences between cancer cells and normal cells. Elevated rates of reactive oxygen species (ROS) have been detected in almost all cancers but they also have increased levels of antioxidant proteins to detoxify from reactive oxygen species [14]. There are some important metabolism differences in these two kinds of cells as well. Many DNA changes (mutations) occur in cancer cells that are not present in healthy cells [15].

However, differences in the ways normal and cancer cells respond to WiFi rays, remain unknown. So, we found it interesting to find out how these different cell lines respond to WiFi rays exposure. Hopefully, this research can someday help better understand cancer cells and maybe even help in cancer treatment researches.

WiFi router is a device that emits electromagnetic radiation of 2,4 GHz frequency, in some cases 5 GHz, that helps to connect and provide with internet connection other devices like mobile phones, computers, etc. This kind of EMRs are considered as super-high frequency (SHF) radio waves [16]. For the experiment TP-Link-TL-WR340G device was used which emits 2,4 GHz frequency radio waves [17][18].

HeLa cell line comes from a woman, Henrietta Lack, who was treated for cervical cancer in 1951. A sample of her tissue was sent to an expert who successfully cultured these cells and established the HeLa cell line. MRC-5 (fibroblasts) are cells of the tissues between structures like bones and muscles and skin. These cell cultures were radiated by WiFi rays and examined to find any differences in cell features. [19]

### Measuring Oxidative Stress

It is commonly known that one of the ways of radiation influence is by generating unstable and reactive factors such as radioactive oxygen species (ROS). These molecules contribute to many processes in a living cell that lead to oxidative stress which in turn results in cell malfunctioning. Regarding this, all measuring oxidative stress level in the cells influenced by WiFi rays was a necessity.

For the measuring of oxidative stress, two-photon microscopy procedure was used. This method measures levels of fluorescence of carboxy-DCFDA fluorescent dye which is sensitive to ROS. In normal conditions, it is colourless and non-fluorescent, but in the presence of ROS, it emits bright green fluorescence proportional to ROS intensities. The camera captures it and Fiji/ImageJ software analyses the images generating quantitative data given in CTCF (corrected total cell fluorescence).[20][21]

For the experiment 4 cell samples were used: HeLa cell culture control group, HeLa cell culture under WiFi influence, MRC-5 cell culture control group and MRC cell culture under WiFi influence. The samples were kept in thermostats (37℃) for 4 days and the experimental groups were exposed to radiation via WiFi router placed in a thermostat. Afterwards, the oxidative stress level of these cells was measured using two-photon microscopy procedure.

### Results and discussion

Collected data (graph 1) and obtained images (fig. 1) suggest that oxidative stress level is higher under WiFi influence both in HeLa and MRC-5 cell cultures compared to their control groups. As we can see CTCF value of WiFi affected cultures is more than 60000 in contrast with control groups which are around 20000. Here we can see that MRC cells have lower oxidative stress level compared to HeLa cells in control groups.

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ut a different picture is formed in WiFi affected cultures where MRC-5 oxidative stress level is higher. Because HeLa cells are cancer cells and MRC-5 cells are not, we can conclude that non-cancer cells are more sensitive to WiFi radiation in the context of oxidative stress.

As a general conclusion, we can say that WiFi rays contribute to high oxidative stress level both in cancer and non-cancer cells. This, in turn, may lead to cell malfunctioning and death by necrosis.

**Measuring DNA damage**

The comet assay is based upon the movement of nuclear DNA through an agarose gel when an electrical field is applied. The theory is that undamaged DNA retains a highly organised association with matrix proteins in the nucleus and when the DNA is damaged (by chemicals or UV radiation), this organisation is disrupted. During the application of an electric field, the individual strands of DNA lose their compact structure and drift out of the nucleus and into the low melting point agarose suspension. The DNA (which has an overall negative charge) is drawn towards the positively charged anode. The undamaged DNA does not move, maintaining the round shape of the nucleus, whereas the damaged DNA (smaller fragments) are free to migrate away from the nucleus. The resulting pattern with a tail and a head resembles a comet. Simply put, the amount of DNA which leaves the nucleus is a measure of the amount of DNA damage to the cell. The brighter and longer the DNA tail, the higher the level of damage. [22]

For the experiment 4 cell samples were used: HeLa cell culture control group, HeLa cell culture under WiFi influence, MRC-5 cell culture control group and MRC-5 cell culture under WiFi influence. The samples were kept in thermostats (37□) for 4 days and the experimental groups were exposed to radiation via WiFi router placed in a thermostat. Afterwards, the cells were isolated, single cell gel electrophoresis was conducted. For the results the samples were stained with ethidium bromide and examined under laser scanning microscope. Around 400 cells were examined. Comet Assay IV software program was used to evaluate the results. [23] Tail moment and olive tail moment values were obtained, which correspond to DNA single strand breaks (SSBs) and double strand breaks (DSBs).

## Result and discussion

Results show significant damage of DNA in case of MRC-5 cells ($p=0.03$) and no significant change in case of HeLa cells ($p=0.4$)(graphs 2, 3). Tails are clearly visible in Tail moment values were tested with student t test. 4 days of WiFi rays exposure, cells show the level of DNA damage as it was shown by HeLa cells (control group). DNA breaks is a mechanism by which cancer cells can be created so there is a chance WiFi rays can make MRC-5 cells cancerous. [24]

As a general conclusion, the DNA of non-cancer cells was damaged by WiFi rays and the results of cancer cells showed no significant difference in levels of DNA damage between control group and WiFi affected group. In addition to this, under the exposure of WiFi rays, non-cancer cells show a pattern of DNA damage very similar to cancer cells' DNA, from which we can conclude that normal cells can become cancerous under the influence of WiFi rays (in vitro condition).

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