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HEALTH EFFECTS ON HUMAN BODY TISSUES DUE TO ELECTROMAGNETIC WAVES OF RADIO BROADCASTING AT THE FREQUENCY 148.5 kHz, 190 kHz & 210 kHz

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ABSTRACT

In modern communication of radio broadcasting system, the EMWs of frequency 148.5 kHz to 283.5 kHz are used. These electromagnetic waves spread in the atmosphere and incident on the human beings. When the incident EMW, penetrates it's induced the electric field inside the tissues of the human beings. In this manuscript EMWs of 148.5,190 and 210 KHz resulted for the study. The incident and penetrated electric fields inside the tissues are calculated and compared with the international agencies as ICNIRP, WHO, NRPB etc., and found that EMWs of given frequencies are harmful for the tissues body fluid, cerebral spinal fluid, gall bladder bile and vitreous humor.

INTRODUCTION

In radio broadcasting services the non-ionizing electromagnetic waves are used for communication of signals. The People who are living around the radiators are affected by these waves .In this manuscript 148.5, 190 and 210 kHz frequency of electromagnetic radiation are used for this study because these frequencies are generally used for communication. The purpose of this manuscript is to aware the people about the radiation of the radiator/towers emitted non-ionizing electromagnetic field (NIEMF) about the harmful effects. When these EMW penetrate inside the human body, its produce electric field inside the tissues. The excess amount of electric field increases the amount of absorption of energy inside the tissues. The energy of cell becomes more to its required natural energy. In natural process the heat energy is produced inside the human body due to:

(i) The rate at which thermal energy is produced through metabolic processes (M)
(ii) The rate at which work is produced (W)
Total heat energy gain by body = M±W
This energy is spent in five parts as follows:
(i) The rate of exchange with the surroundings via evaporation (E)
(ii) The rate of heat exchange with the surroundings via radiation (R)
(iii) The rate of heat exchange with the environment via evaporation (C)
(iv) The rate of heat exchange with the surroundings via conduction (D)
(v) The rate of body heat storage (S).

Total heat energy spent by the body = E ± R ± C ± D ±S --- (I)

The whole gain energy becomes equal to the spent energy by the body and equation (I) becomes balanced. Thus there is no excess temperature in the body in this natural process. The balance of heat energy is expressed by the following equation

$$M \pm W = E \pm R \pm C \pm D \pm S \quad \text{---------- (II)}$$

But when electromagnetic radiation is penetrated inside the body, the energy is absorbed by the tissues of the biological material. It works as a source of production of extra energy inside the body. Therefore,

$$M \pm W + E_{\square} = E \pm R \pm C \pm D \pm S \quad \text{---------- (III)}$$

where $E_{\square}$ is the energy due to electromagnetic radiation of radiator. Above equation becomes unequilibrium because production of energy becomes greater to the energy inside the body. This excess energy may increase the temperature of the tissues and may be harmful in many other ways for tissues life. Change of body temperature is detected, especially externally at the skin and internally by the specialized region of the brain. The information is integrated in the central nervous system, and regulation is achieved by autonomic and behavioral thermoregulatory reactions.

Review of literature

EMWs affect to the most important factor of human beings i.e. DNA. Electromagnetic energy affects on DNA molecules and/or impairment of DNA-damage repair mechanisms in brain cells (Lal, H., 1996). RF-EMR affects on the male reproductive system. The oxidative stress may have a key role in the detrimental effects observed in the human spermatozoon and that this cell type may be a unique model to determine the

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potential mechanism of action given its sensitivities to such stress (Geoffry *et al.,* 2012). The effects of non-thermal levels of ELF electromagnetic fields on the biochemistry and activity of immune cells and then closely examines new results that suggest a role for Ca2+ in the induction of these cellular field effects. Membrane- mediated Ca2+ signaling processes are involved in the mediation of field effects on the immune system (J .Walleczek, 1992). The effects of pulsed, extremely low-frequency electromagnetic fields (ELF–EMF) on in-vitro mouse pre-antral follicle development. The follicles with failed antrum formation showed lower oestradiol release and granulosa cell DNA synthesis, but these effects were not related to granulosa cell apoptosis. Furthermore, a high percentage of the in-vitro grown oocytes obtained from exposed follicles had a reduced ability to resume meiotic maturation when compared with controls. ELF–EMF exposure might impair mammalian female reproductive potentiality by reducing the capacity of the follicles to reach a developmental stage that is an essential pre-requisite for reproductive success (Sandra Cecconi1 et al. 2000). According to Vijayalaxmi & Thomas J. Prihoda (2009) The difference between ELF-EMF-exposed and control cells as well as the 'effect size' due to ELF-EMF exposure were biologically small (although statistically significant) with very few exceptions. At certain ELF-EMF exposure conditions there was a statistically significant increase in genetic damage assessed from some end-points. The mean indices for chromosomal aberrations and micronuclei end-points in ELF-EMF-exposed and control cells were within the spontaneous levels reported in historical database. Considerable evidence for publication bias was found in the meta-analysis. Electromagnetic fields (EMF) of frequencies up to about 100 kHz, emitted by electric/electronic devices, have been suggested to enhance free radical production through an iron dependent pathway. Possible relationship between iron status, exposure to EMF and brain oxidative stress in young adult rats is given. These data suggest that EMF exposure may be harmful in young adults by impairing the antioxidant defenses directed at preventing iron-induced oxidative stress (K. Maaroufi *et al.,* 2011). Short-term exposure to RF generated by mobile BTS has a deleterious effect on the quality of epididymal sperm (viability and motility) and that this effect is more severe in the head section and increases with increased exposure time (Gholamali Jelodar *et al.,* 2011). The interaction of human beings with electromagnetic fields (EMF) artificially created can interfere in our psychobiological equilibrium. This EMF is correlated with the dissemination of radiations produced in our modern technology. For living creatures suffer under influences of these fields, once every external stimulus generates internal ones (L. C. Almeida, 2011). The electromagnetic field also affect on the childhood (I. Calvente *et al.,* 2010). The exposure to non-ionizing electromagnetic radiation (NIEMR) poses a risk or is a risk factor for the development of cancer in humans. Exposure to EM fields and the thundering results related various cancers, most notably leukemia, lymphoma, and brain cancer caused of EM fields (Vahdettin Bayazit., 2009, David Andrew McNamee *et al.,* 2009). According to (Goknur Guler *et al.,* 2008), the protective effects of N-Acetyl-L-cysteine (NAC) and epigallocatechin-gallate (EGCG) in the liver tissues of guinea pigs against the possible detriments of electromagnetic field exposures. Extremely low frequency (ELF) electric field has potential harmful effects on the living organisms by enhancing the free radical production. NAC and EGCG might have hepatoprotective effects in ELF-E field induced oxidative and nitrosative stress. The effects of short-term exposure to RF waves generated by BTS antenna on the viability and motility of stored sperm in different parts of the epididymis are studied. The short-term exposure to RF generated by mobile BTS has a deleterious effect on the quality of epididymal sperm (viability and motility) and that this effect is more severe in the head section and increases with increased exposure time (Gholamali Jelodar *et al.,* 2011). Possible effects of Electromagnetic Radiation (EMR) use on oxidant and antioxidant status in erythrocytes and kidney, heart, liver, and ovary tissues from rats, and possible protective role of vitamin C. EMR at the frequency generated by a cell phone causes oxidative stress and per-oxidation in the erythrocytes and kidney tissues from rats. In the erythrocytes, vitamin C seems to make partial protection against the oxidant stress (Erdinç Devrim, *et al*.2008).

MATERIAL AND METHODS

The proposed approach is useful to predict the induced electric field around the tower, penetrated electric field inside the body and specific absorption rate (SAR) of the tissues of the human body. In this manuscript the power of transmission towers which radiate 148.5 kHz, 190 kHz and 210 kHz is 10 kW. The EMW of navigation is incident on the human body. The waves produced by the dipole antenna have a spherical wave front .The incident electric field (E_0) around the radio transmitter radiator of power P is given by

$$E_0 == \frac{7.746\sqrt{P}}{(r+x)} \quad \text{..... ..... (1)}$$

Where (x) be the distance from the tower and r be the radius of cross section of the dipole antenna which emit spherical wave front (Kumar V. et al. 2008). The induced electric field around the transmitter of 10 kW is,

$$E_0 = 774.6/(r+x) \quad \text{---------- (2)}$$

Actually, these radiations are used for navigation .It means, the radiation should more effective for the people living very near from the radiator. Thus 100 m distance from the radiator is taken for this study. The radius of cross section of transmitting antenna which we are using for our study is 10 cm .Now for the tissue of biological material well inside the boundary, field strength will further reduce due to dissipation during propagation inside the body. Electric field decreases exponentially with distance from the boundary and are given by (Kumar V. et al. 2010).

$$E_z = E_o e^{(-z/\delta)} \quad \text{----------(3)}$$

Where E_z is the field inside the depth z and E_0 is the magnitude of field just inside the boundary. The skin depth δ is the distance over which the field reduces to $\frac{1}{e}$ (= 0.368) of its value just inside the boundary.

Specific absorption Rate

The specific absorption rate is defined as the time derivative of the incremental energy (*dW*) absorbed by or dissipated in an

Table 1- Penetrated electric field inside different human tissues at frequency 148.5 kHz

Tissue of human body	Penetrated electric field (E_z) in (V/m) at frequency (f) = 148.5 KHz at depth (0.1mm-0.5mm)				
	0.1mm	**0.2mm**	**0.3mm**	**0.4mm**	**0.5mm**
Bladder	7.7317	7.7313	7.7309	7.7306	7.7302
Blood	7.7316	7.7309	7.7303	7.7297	7.7292
Blood vessel	7.7317	7.7312	7.7307	7.7303	7.7297
Body fluid	7.7314	7.7304	7.7296	7.7288	7.7279
Brain white matter	7.7319	7.7315	7.7313	7.7310	7.7308
Cerebella spinal fluid	7.7312	7.7301	7.7293	7.7283	7.7274
Eye sclera	7.7317	7.7310	7.7305	7.7300	7.7295
Fat	7.7320	7.7317	7.7314	7.7313	7.7311
Gall bladder	7.7315	7.7307	7.7300	7.7294	7.7288
Gall bladder Bile	7.7314	7.7305	7.7297	7.7289	7.7281
Gland	7.7317	7.7310	7.7305	7.7299	7.7295
Heart	□.7318	7.7314	7.7310	7.7306	7.7303
Lung outer	7.7317	7.7312	7.7309	7.7305`	7.7301
Lung inner	7.7319	7.7315	7.7312	7.7310	7.7306
Lymph	7.7317	7.7310	7.7305	7.7299	7.7295
Mucous membrane	7.7320	7.7316	7.7314	7.7312	7.7310
Muscle	7.7317	7.7312	7.7307	7.7302	7.7298
Pancreas	7.7317	7.7310	7.7305	7.7299	7.7295
Stomach	7.7316	7.7310	7.7304	7.7299	7.7294
Testis	7.7317	7.7311	7.7306	7.7302	7.7297
Vitreous Humor	7.7314	7.7304	7.7296	7.7288	7.7279

Table 2 Penetrated electric field inside different human tissues at frequency 190 kHz

Tissue of human body	Penetrated electric field (E_z) in (V/m) at frequency (f) = 190 KHz at depth (0.1mm-0.5mm)				
	0.1mm	0.2mm	0.3mm	0.4mm	0.5mm
Bladder	7.7316	7.7311	7.7307	7.7302	7.7298
Blood	7.7314	7.7307	7.7300	7.7293	7.7286
Blood vessel	7.7316	7.7310	7.7305	7.7300	7.7295
Body fluid	7.7311	7.7301	7.7292	7.7282	7.7273
Brain white matter	7.7318	7.7314	7.7311	7.7308	7.7304
Cerebella spinal fluid	7.7310	7.7299	7.7288	7.7277	7.7266
Eye sclera	7.7315	7.7308	7.7303	7.7296	7.7290
Fat	7.7319	7.7315	7.7313	7.7311	7.7308
Gall bladder	7.7313	7.7305	7.7297	7.7289	7.7282
Gall bladder Bile	7.7312	7.7302	7.7293	7.7283	7.7274
Gland	7.7315	7.7308	7.7302	7.7295	7.7290
Heart	7.7316	7.7312	7.7308	7.7303	7.7300
Lung outer	7.7316	7.7311	7.7306	7.7301	7.7296
Lung inner	7.7317	7.7314	7.7310	7.7306	7.7303
Lymph	7.7315	7.7308	7.7302	7.7295	7.7290
Mucous membrane	7.7318	7.7314	7.7312	7.7308	7.7306
Muscle	7.7316	7.7310	7.7305	7.7299	7.7295
Pancreas	7.7315	7.7308	7.7302	7.7295	7.7290
Stomach	7.7315	7.7307	7.7302	7.7294	7.7289
Testis	7.7316	7.7309	7.7304	7.7297	7.7293
Vitreous Humor	7.7311	7.7301	7.7292	7.7282	7.7273

Table 3 Penetrated electric field inside different human tissues at frequency 210 kHz

Tissue of human body	Penetrated electric field (E_z) in (V/m) at frequency (f) = 210 KHz at depth (0.1mm-0.5mm)				
	0.1mm	**0.2mm**	**0.3mm**	**0.4mm**	**0.5mm**
Bladder	7.7316	7.7311	7.7306	7.7301	7.7296
Blood	7.7314	7.7306	7.7299	7.7291	7.7284
Blood vessel	7.7316	7.7310	7.7305	7.7299	7.7292
Body fluid	7.7311	7.7300	7.7291	7.7280	7.7269
Brain white matter	7.7318	7.7314	7.7311	7.7307	7.7303
Cerebella spinal fluid	7.7309	7.7297	7.7286	7.7275	7.7263
Eye sclera	7.7315	7.7307	7.7302	7.7295	7.7288
Fat	7.7319	7.7315	7.7313	7.7310	7.7307
Gall bladder	7.7313	7.7304	7.7296	7.7287	7.7279
Gall bladder Bile	7.7311	7.7300	7.7292	7.7281	7.7271
Gland	7.7314	7.7307	7.7301	7.7299	7.7287
Heart	7.7316	7.7311	7.7310	7.7302	7.7298
Lung outer	7.7316	7.7311	7.7306	7.7301	7.7295
Lung inner	7.7317	7.7313	7.7308	7.7306	7.7302
Lymph	7.7314	7.7307	7.7301	7.7294	7.7284
Mucous membrane	7.7318	7.7314	7.7312	7.7308	7.7304
Muscle	7.7316	7.7310	7.7303	7.7298	7.7292
Pancreas	7.7314	7.7307	7.7301	7.7294	7.7284
Stomach	7.7314	7.7307	7.7301	7.7294	7.7287
Testis	7.7315	7.7309	7.7303	7.7297	7.7290
Vitreous Humor	7.7311	7.7300	7.7291	7.7280	7.7269

Table 4- SAR in W/kg inside different human tissues at the frequency 148.5 kHz

Tissue of human body	S.A.R. in (W/kg) at frequency (f) = 148.5 KHz at depth (0.1mm-0.5mm)				
	0.1mm	**0.2mm**	**0.3mm**	**0.4mm**	**0.5mm**
Bladder	0.0127869	0.0127856	0.0127842	0.0127833	0.0127819
Blood	0.0398164	0.0398092	0.0398030	0.0397968	0.0397942
Blood vessel	0.0183843	0.0183820	0.0183796	0.0183777	0.0183753
Body fluid	**0.0887740**	**0.0887511**	**0.0887327**	**0.0887143**	**0.0886937**
Brain white matter	0.00486070	0.00486019	0.00485994	0.00485957	0.00485931
Cerebella spinal fluid	**0.118359**	**0.118325**	**0.1183011**	**0.1182705**	**0.1182429**
Eye sclera	0.0303184	0.0303130	0.0303090	0.0303051	0.0303012
Fat	0.00159252	0.00159266	0.00159253	0.00159249	0.00159241
Gall bladder	0.0522402	0.0522294	0.0522199	0.0522118	0.0522037
Gall bladder bile	**0.0829558**	**0.0828365**	**0.0828193**	**0.0828022**	**0.0827850**
Gland	0.0307344	0.0307289	0.0307249	0.0307201	0.0307169
Heart	0.0132156	0.0132142	0.0132128	0.0132115	0.0132104
Lung outer	0.0158272	0.0158252	0.0158239	0.0158223	0.0158207S
Lung inner	0.0253752	0.0253726	0.0253706	0.0253693	0.0253667
Lymph	0.0310299	0.0310243	0.0310203	0.0310155	0.0310123
Mucous membrane	0.005361	0.005360	0.0053605	0.0053602	0.0053599
Muscle	0.021197	0.0211943	0.021191	0.021188	0.021186
Pancreas	0.0310299	0.0310243	0.0310203	0.0310155	0.0310123
Stomach	0.0306452	0.0306230	0.0306182	0.0306143	0.0306103
Testis	0.0254866	0.0254826	0.0254793	0.0254767	0.0254734
Vitreous Humor	**0.0887740**	**0.0887511**	**0.0887327**	**0.0887143**	**0.0886937**

Table 5- SAR in W/kg inside different human tissues at the frequency 190 kHz

Tissue of human body	S.A.R. in (W/kg) at frequency (f) = 190 KHz at depth (0.1mm-0.5mm)				
	0.1mm	**0.2mm**	**0.3mm**	**0.4mm**	**0.5mm**
Bladder	0.0128475	0.0128458	0.0128445	0.0128428	0.0128415
Blood	0.0400055	0.0399982	0.0399910	0.0399837	0.0399765
Blood vessel	0.0184270	0.0184241	0.0184217	0.0184194	0.0184170
Body fluid	**0.0887731**	**0.0887501**	**0.0887294**	**0.0887065**	**0.0886858**
Brain white matter	0.0046490	0.00496439	0.00496439	0.00496400	0.00496310
Cerebella spinal fluid	**0.118353**	**0.118319**	**0.118285**	**0.118252**	**0.118218**
Eye sclera	0.0305328	0.0305272	0.0305233	0.0305178	0.0305130
Fat	0.00159670	0.00159654	0.00159645	0.00159637	0.00159625
Gall bladder	0.0522381	0.0522273	0.0522165	0.0522056	0.05221962
Gall bladder bile	**0.0828515**	**0.0828300**	**0.0828108**	**0.0827893**	**0.0827700**
Gland	0.0308814	0.0308758	0.0308710	0.0308654	0.0308614
Heart	0.0137163	0.0137149	0.0137135	0.0137117	0.0137106
Lung outer	0.0160824	0.01608038	0.01607830	0.01607622	0.01607414
Lung inner	0.0258475	0.0258455	0.0258429	0.0258402	0.0258382
Lymph	0.0311784	0.0311727	0.0311679	0.0311622	0.0311582
Mucous membrane	0.00639596	0.00639530	0.00639497	0.00639430	0.00639397
Muscle	0.0217345	0.0217312	0.0217312	0.0217250	0.0217227
Pancreas	0.0311784	0.0311727	0.0311679	0.0311622	0.0311582
Stomach	0.0307197	0.0307134	0.0307094	0.0307031	0.0306991
Testis	0.0257313	0.0257267	0.0257234	0.0257187	0.0257160
Vitreous Humor	**0.0887731**	**0.0887501**	**0.0887294**	**0.0887065**	**0.0886858**

Table 6 - SAR in W/kg inside different human tissues at the frequency 210 kHz

Tissue of human body	S.A.R. in (W/kg) at frequency (f) = 210 KHz at depth (0.1mm-0.5mm)				
	0.1mm	**0.2mm**	**0.3mm**	**0.4mm**	**0.5mm**
Bladder	0.0128748	0.0128731	0.0128714	0.0128698	0.0128681
Blood	0.0401098	0.0401015	0.040094	0.040085	0.040078
Blood vessel	0.018444	0.018441	0.018439	0.018436	0.018433
Body fluid	**0.088773**	**0.088747**	**0.0887271**	**0.088701**	**0.0886766**
Brain white matter	0.00500899	0.00500847	0.00500808	0.00500756	0.00500704
Cerebella spinal fluid	**0.118350**	**0.118313**	**0.118289**	**0.1182460**	**0.1182093**
Eye sclera	0.030644	0.030637	0.030633	0.030628	0.030622
Fat	0.00159839	0.00159823	0.00159814	0.00159802	0.0015979
Gall bladder	0.0522381	0.0522259	0.0522151	0.0522029	0.0521921
Gall bladder bile	**0.0828493**	**0.0828258**	**0.0828086**	**0.0827850**	**0.0827636**
Gland	0.0309552	0.0309496	0.03094483	0.0309392	0.0309336
Heart	0.0139334	0.0139316	0.0139312	0.0139283	0.0139269
Lung outer	0.0161946	0.0161925	0.0161904	0.0161883	0.0161858
Lung inner	0.0260499	0.0260472	0.0260438	0.0260425	0.0260998
Lymph	0.0309552	0.0309496	0.03094483	0.0309392	0.039336
Mucous membrane	0.00681615	0.00681544	0.00681509	0.00681438	0.00681368
Muscle	0.0219981	0.0219947	0.0219907	0.0219889	0.0219845
Pancreas	0.0309552	0.0309496	0.03094483	0.0309392	0.0309336
Stomach	0.0307560	0.0307583	0.0307536	0.0307480	0.0307424
Testis	0.0258640	0.0258600	0.0258560	0.0258520	0.0258473
Vitreous Humor	**0.088773**	**0.088747**	**0.088727**	**0.088701**	**0.088676**

incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It can be defined as

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) \text{----------} (4)$$

$$SAR = \frac{d}{dt}\left(\frac{dW}{\rho dV}\right)$$

By using Pointing vector theorem for sinusoid ally varying electromagnetic fields. We get

$$SAR = \frac{\sigma E_z^2}{\rho} \text{----------} (5)$$

Where σ the conductivity of the material and E_z be the field inside that material.

This relation represents the rate at which the electromagnetic energy is converted into heat through well-established interaction mechanisms. It provides a valid quantitative measure of all interaction mechanisms that are dependent on the intensity of the internal electric field (Roje, V., 2003). The amount of heating produced in a living organism depends primarily on the intensity of the radiation once it has penetrated inside the body.

RESULT AND DISCUSSION

The electric field and specific absorption rate of the tissues due to the signals of frequency 148.5 kHz, 190 kHz & 210 kHz are taking for this study. These radiations produce an electric blanket around the people. These incident electric fields penetrate inside the human body. The incident electric

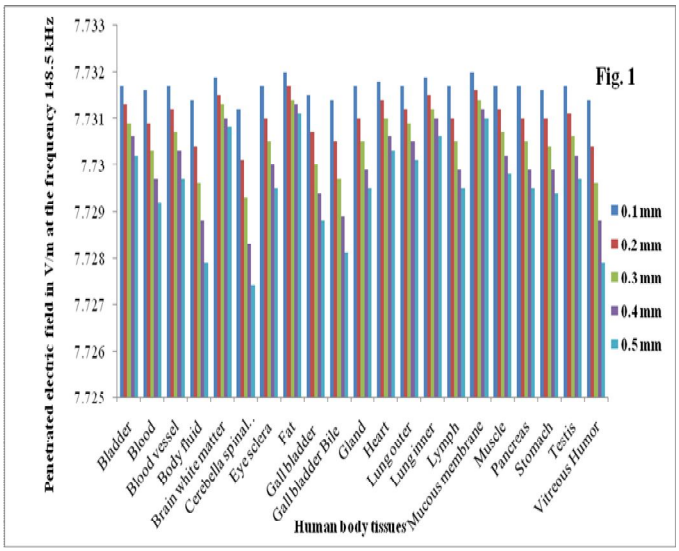
Fig. 1
Penetrated electric field in V/m at the frequency 148.5 kHz
7.733
7.732
7.731
7.73
7.729
7.728
7.727
7.726
7.725
0.1 mm
0.2 mm
0.3 mm
0.4 mm
0.5 mm
Bladder
Blood
Blood vessel
Body fluid
Brain white matter
Cerebella spinal..
Eye sclera
Fat
Gall bladder
Gall bladder Bile
Gland
Heart
Lung outer
Lung inner
Lymph
Mucous membrane
Muscle
Pancreas
Stomach
Testis
Vitreous Humor
Human body tissues

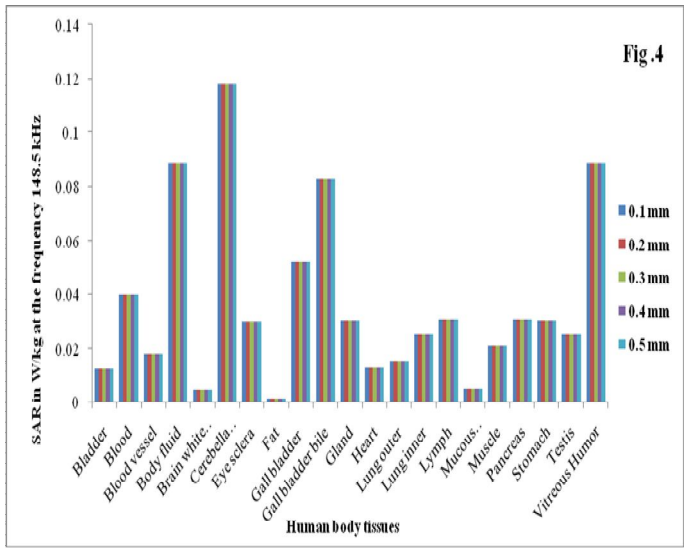
Fig .4
SAR in W/kg at the frequency 148.5 kHz
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.1 mm
0.2 mm
0.3 mm
0.4 mm
0.5 mm
Bladder
Blood
Blood vessel
Body fluid
Brain white..
Cerebella...
Eye sclera
Fat
Gall bladder
Gall bladder bile
Gland
Heart
Lung outer
Lung inner
Lymph
Mucous...
Muscle
Pancreas
Stomach
Testis
Vitreous Humor
Human body tissues

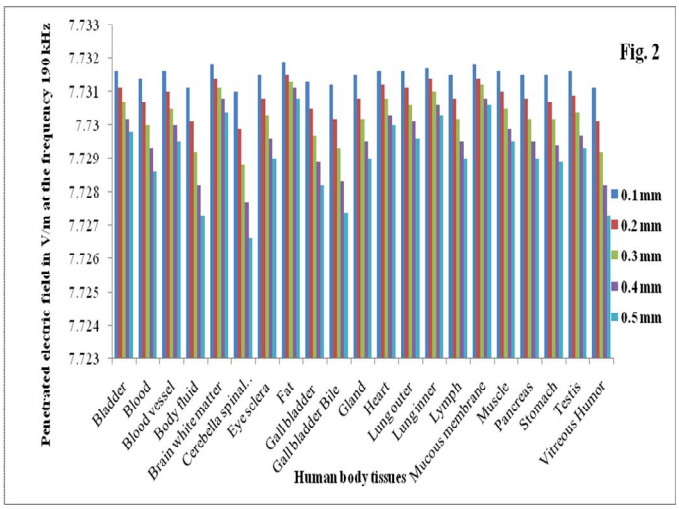
Fig. 2
Penetrated electric field in V/m at the frequency 190 kHz
7.733
7.732
7.731
7.73
7.729
7.728
7.727
7.726
7.725
7.724
7.723
0.1 mm
0.2 mm
0.3 mm
0.4 mm
0.5 mm
Bladder
Blood
Blood vessel
Body fluid
Brain white matter
Cerebella spinal..
Eye sclera
Fat
Gall bladder
Gall bladder Bile
Gland
Heart
Lung outer
Lung inner
Lymph
Mucous membrane
Muscle
Pancreas
Stomach
Testis
Vitreous Humor
Human body tissues

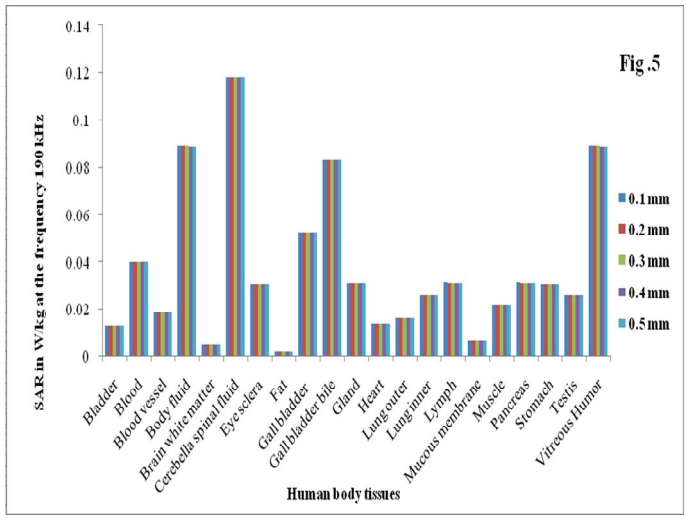
Fig .5
SAR in W/kg at the frequency 190 kHz
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.1 mm
0.2 mm
0.3 mm
0.4 mm
0.5 mm
Bladder
Blood
Blood vessel
Body fluid
Brain white matter
Cerebella spinal fluid
Eye sclera
Fat
Gall bladder
Gall bladder bile
Gland
Heart
Lung outer
Lung inner
Lymph
Mucous membrane
Muscle
Pancreas
Stomach
Testis
Vitreous Humor
Human body tissues

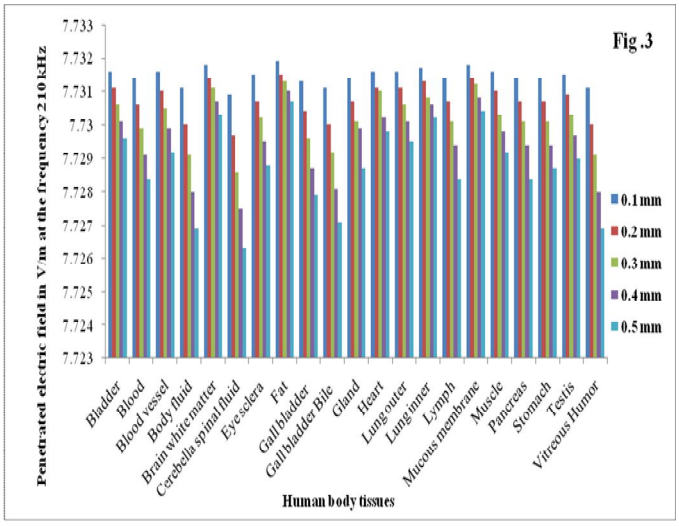
Fig .3
Penetrated electric field in V/m at the frequency 210 kHz
7.733
7.732
7.731
7.73
7.729
7.728
7.727
7.726
7.725
7.724
7.723
0.1 mm
0.2 mm
0.3 mm
0.4 mm
0.5 mm
Bladder
Blood
Blood vessel
Body fluid
Brain white matter
Cerebella spinal fluid
Eye sclera
Fat
Gall bladder
Gall bladder Bile
Gland
Heart
Lung outer
Lung inner
Lymph
Mucous membrane
Muscle
Pancreas
Stomach
Testis
Vitreous Humor
Human body tissues

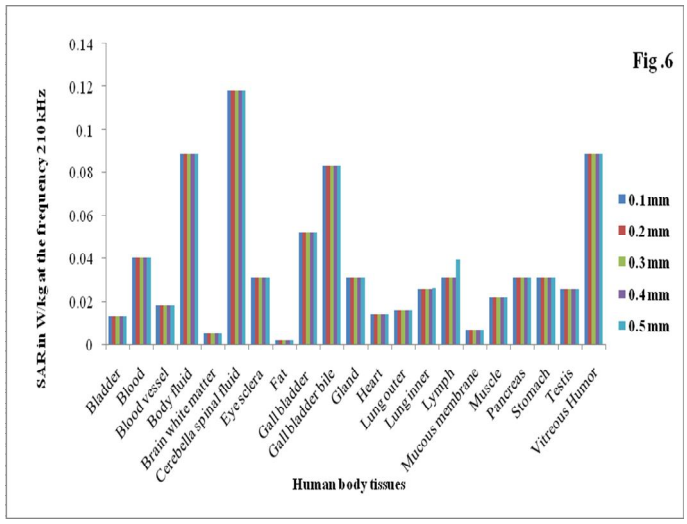
Fig .6
SAR in W/kg at the frequency 210 kHz
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.1 mm
0.2 mm
0.3 mm
0.4 mm
0.5 mm
Bladder
Blood
Blood vessel
Body fluid
Brain white matter
Cerebella spinal fluid
Eye sclera
Fat
Gall bladder
Gall bladder bile
Gland
Heart
Lung outer
Lung inner
Lymph
Mucous membrane
Muscle
Pancreas
Stomach
Testis
Vitreous Humor
Human body tissues

fields around the radiators are calculated by eq. 2. This electric field penetrates inside the human body and penetrated electric field inside the tissues are calculated by eq.(3). The calculated penetrated electric field due to 148.5, 190 and 210 kHz are represented in tables 1, 2&3 respectively. The variations of electric field with respect to the different tissues are given in figures 1, 2 and 3 for the frequencies of 148.5,190 and 210 kHz respectively.

According to ICNIR guidelines, the safe limit of electric field is 6.1V/m. The data of above given tables 1 and 2&3 represent that the induced electric field in selected tissues become greater to the safe limit which is mentioned in ICNIRP guidelines. When this electric field penetrated inside the tissues, the energy is absorbed by the tissues. Specific absorption rate (SAR) of the selected tissues are calculated by eq. 5 and represented in table 4&5 and 6 due to the electromagnetic waves of frequencies 148.5,190 and 210 kHz respectively. The variation of SAR with respect to selected tissues for 148.5,190 and 210 kHz are shown in figures 4&5 and 6 respectively. These tables also represent that the tissue of the persons who are living near at the sea cost radio broadcasting, absorb the given amount of energy. According to some international agencies as WHO, ICNIRP, the specific absorption rate (SAR) becomes harmful after 0.08W/ kg, of the whole body weight. It means that, if SAR becomes greater to 0.08 W/kg. It may be harmful for the tissues life of the human body. The safe limit is taken from ICNIRP guidelines. When the calculated data of SAR which is given in tables 4 & 5 and 6 is compared with the safe limit, it is observed that the given frequencies of electromagnetic radiation which is taken for this study is harmful for the health of body fluid, cerebella spinal fluid, gall bladder bile, and vitreous humor tissues respectively. The radiator generally situated in populated area and very near to the general public and workers. Thus the calculations are made only for 100 m distance from the antenna.

CONCLUSION

The above calculations and analysis represent that the signals (148.5 kHz, 190 kHz & 210 kHz) of given frequencies are harmful for the tissues of body fluid, cerebella spinal fluid, gall bladder bile and vitreous humor. This study is done only for some selected tissues. Thus if study will be done for some more tissues of the body, it may be possible that the health's of the tissues will become more negative. Thus it is suggested that people should keep away from those radiators emitted frequencies of 148.5 kHz,190 kHz & 210 kHz radiation or we can say that these types of radiators should located away from the populated area.

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