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Adverse Effects of Microwaves

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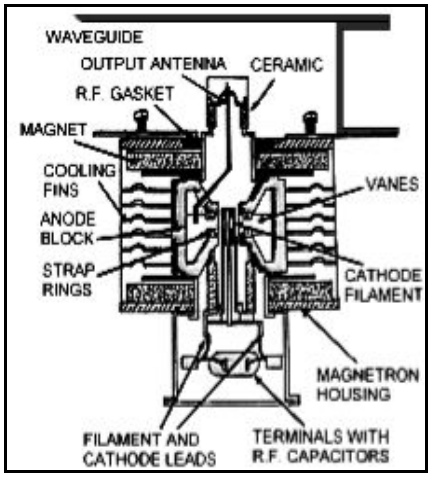
Abstract: This article is for the awareness of the readers about the ill-effects of Microwave cooking, causes especially the non-thermal effects. Potentially increases the production of carcinogens or mutagens in foods. Minerals, Vitamins, and nutrients of the food cooked by microwaves are reduced or altered so that the person meager benefit or the person's body intakes altered compounds that cannot be broken down. Degeneration of nerve impulses within the junction potentials of the cerebrum, breakdown of nerve electrical circuits and loss of energy fields in the neuro plexuses, loss of balance, Chest pains. An organic injury takes place in the cardiovascular system. Direct exposure causes the reproductive organs, in temporary sterility or degenerative changes have been reported in exposures involving research animals and man.

Introduction

The First Reports on dielectric heating of food materials appeared immediately after World War II. At that time, only capacitive dielectric heating in the 1-15-MHz frequency range was being considered. During the following 20 years, relentless experimentation led to a number of industrial applications at frequencies below 40 MHz; for example, in baking, finish drying, and thawing of foods [1]. Microwaves are very short waves of electromagnetic energy that travel with a speed of light (186,282 miles per second). Microwave ovens use microwave energy to heat or cook food with a conventional oven without applying external heat. The heart of every microwave oven is the high-voltage system which produces microwaves (an electromagnetic wave) or RF energy. The higher voltage components accomplish this energy by step-up of AC voltage to high voltage, which then converted to higher-level DC voltage. This DC power converted to RF energy cooks the food. Microwave energy is directed into the cooking chamber where the food is placed to be heated by dielectric heating. The nucleus of the high-voltage system is the magnetron tube. The fig. 1 illustrates the sectional view of a typical magnetron tube. The magnetron is a diode-type electron tube which produces required microwave energy of 2450 MHz. It is called a diode because it has no grid as in the ordinary electron tube. A magnetic field amid of the anode and the cathode serves as the grid. The basic internal structure of magnetron tube consists of the anode, the filament/cathode, the antenna and the magnets. Anode vanes are projected inside of the empty cylinder of iron. The open trapezoidal shaped areas, resonant cavities between vanes are that serve as tuned circuits and determine the tube's output frequency. The anode operates such that the alternate segments must be connected or strapped, so that each segment is alternating in polarity to its either sides. In effect, the cavities are connected in parallel with the output. The filament being the cathode of the tube positioned at the magnetron's center and which is backed by the large and rigid. The Electromagnetic field generated inside the microwave oven would lead to excitation, the mutual bombardment of polar molecules, ions present in the food. Now, the friction in the molecules manifests some heat and then leads to temperature rise. The major mechanisms' dipolar and ionic interactions are the causes for heat accumulating inside food [2].



(Fig: 1) Sectional view of a magnetron tube **(Fig: 2) Typical anode vane block**

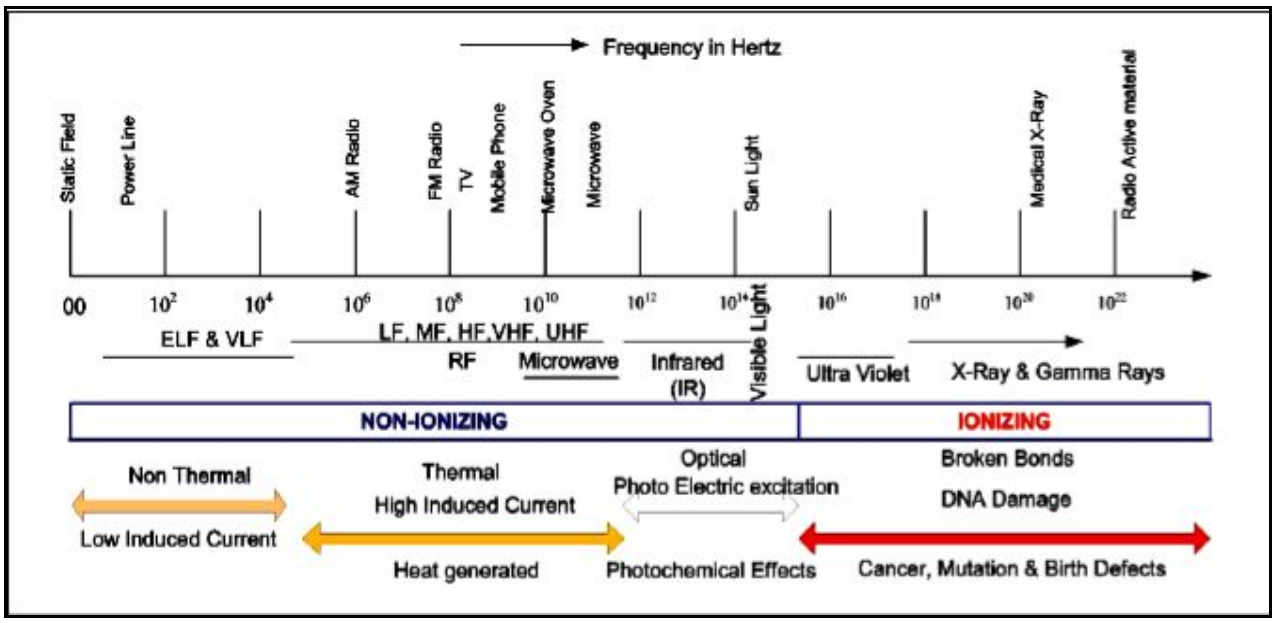


Fig:3· Electromagnetic spectrum[3]

The lower end of the spectrum is non-ionizing Electromagnetic Radiation (EMR), with energy levels below that required for effects at the atomic level. [3]. Examples of non-ionizing radiations are stated

Table: 1· Range of Electromagnetic Spectrum [3]

Spectrum of Electromagnetic Radiation	**Frequency Range**
Static fields from direct current	0 Hz
Low-frequency waves from electric power	50-60
Extremely Low Frequency (ELF) and Very Low Frequency (VLF)	up to 30 kHz
Radio Frequencies (RF) including Low Frequency (LF) Medium Frequency (MF) High Frequency (HF) Very High Frequency (VHF) Ultra High Frequency (UHF) Microwave (MW)	30 kHz to 300 GHz

Millimeter wave	
Infrared (IR) light, Visible light and Ultraviolet (UV) light	above 300 GHz

When microwave energy been absorbed, polar molecules (water) inside the food start rotating in vector of the alternating field. The water as it's a dipole with a positive charge at one end and negative about the other. Alike the magnetic action, the dipoles orient them while subjected by the electromagnetic field. The rotation of the dipole generates heat for cooking. Apart from water molecules, other dipoles like ionic compounds and dissolved salts in food also gets accelerated because of the electromagnetic field as well gets collided among further other molecules and produces heat [4, 5, 6,42]. Therefore, the composition of food gets affected by the way it gets heated up within the oven. Highly moisture contented food thus gets heated faster since the interactions of dipoles.

As Ion concentration and dissolved salts rise, the rate at which heating occurs also increases as the ionic interaction takes place by the microwaves. Oil molecules being less polar than water and also non-ionic, but food of high oil content get heated up rapidly than water, as the "specific-heat" of water is about twice that of oil [7,42].

Conventional oven cooks' food by hot air surrounding the food but the microwave oven cooked food is heated due to alternating electromagnetic field. The human body's behavior in stimuli to microwaves is complex. The microwave energy conversion into heat causes principal damage to living organisms, specifically to the eyes. Recent research supports that the thermal and also the non-thermal effects are being very substantive.

Physical Effects of the Microwave Cooking:

A. Thermal Effects

Effect that biological results because of the microwave exposure is the basically thermal response due to the absorption of energy and conversion of the same into heat. Exposures to the parts body which cannot dissipate heat viable thermal injury by microwaves. When by an external source, some significant load is on the human body's thermo-regulatory system, thermal stress occurs. It results biologically in increased levels of corticosterone and triglycerides. Experiments show the body to be responsive is the alike the same way either loading by absorption of EM energy or due to body heated in a water bath. This Also does alterations of Lymphocyte mitogens level, and leukocytes count, which are the basic cells in immune system [8]. The Body's Immunological reflexes get affected by the rises in temperature and by thermal loading. In cases, this ability heals lesions rapidly, and also in treatment of fractures the RF heating is applied. Furthermore, so the artificially introduced chemicals by microwaves curb the reaction of the body.

B. Athermal effects:

Interaction of EM fields directly with the body, rather than via thermal effects [9]. Four distinct non-thermal effects have been tabulate Viz .,

1) Pearl chain formation
2) Forces in non-homogeneous fields
3) AC electrophoresis and
4) Orientation of non-spherical particles

The pearl chain phenomenon is derived analogous to the formation of pearl chain formed when a dc magnetic field is applied of oil droplets with water. It refers to the small particles in the body suspended in a fluid (blood or other fluid) whose dielectric constant is different from that of the particles. In this circumstance, the particles become electrically polarized when they are subjected to alternating high frequency field. Tiny electrical dipoles are formed which cause the particles to align with the electric field, giving the appearance, under magnification, of strings of pearls. Another report [10] has described the unexpected response of paramecia swimming in random directions in a medium. Upon the application of radio frequency energy the paramecia would swim parallel to the electric field, and a change in the frequency caused them to turn and swim

at right angles to the electric field. These observations were made with pulsed power in the frequency range of 30 MHz[11].

Chemical Effects of the Microwave Cooking:

A. Changes in the Molecular levels of Human system:

The high temperature cooking processes (grilling, baking and thrawing) induces the creation of potential carcinogens. These concerns about microwave cooking increase in the production of carcinogens or mutagens inside the food items [12]. Microwaving of the milk and some of the cereals, results in conversion of some amino acids as carcinogens. In microwave exposed plants Carcinogenic free radicals were produced and it occurred particularly in root vegetables. Some of the Alkaloids got converted into carcinogens for an extremely short exposure on raw cooked items or on vegetables [13].

The creation of the chemicals such as heterocyclic amines (HCAs), nitrosamines and polyaromatic hydrocarbons (PAHs) are of the picky concern among the carcinogens. Studies been conducted on the formation of these chemicals to compare the effect of microwave cooking with other conventional methods, shows that microwave cooking did produced traces of HCAs, nitrosamines or PAHs in meat .*If the human cell is heated to more than 41.6°C, denaturation of proteins (or baking) occurs. This is a biological effect which results of cell death, is irremediable also an obviously health risk [14].* The distribution of field inside the microwave oven, is so significant and has been studied by using a range of approaches, for the most part remarkably by some numerical methods (such as FEM and FDTD) [15,16]. Various experiments and measurements have been conducted to identify the field distribution and unevenness [17]. Inside the cooking cavity, the electromagnetic fields created are of not homogeneous distribution and thus leading to food being unevenly heated [4]. The uneven heating processes thus turn out food items with hot or cold spots, in turn may rise to microbiological food security concern [6].

B. Loss of the nutritive value in microwaved food:

In every microwaved food tested, Microwaving formulates the vitamins and minerals as useless and decreases the bio accessibility of the numerous nutrients. It also renders meat proteins worthless. Immune system deficiencies through lymph gland were reported due to continual ingestion of microwaved food causes and blood serum alterations [18]. A study illustrates the collapse of vitamin B-12 to inactive degradation products in foods which were microwaved.

During microwaving, also there's a problem due to discharge of potentially toxic molecules into the food from the design of packaging to help brown food. This comprises items like French fries, pizza, popcorn, waffles, and breaded fish [19].

Unhealthy changes significantly came in the blood serum of those participants who took microwaved cooked-food. These changes could cause the deterioration in the human systems such as a reduced in values of hemoglobin and cholesterol, mainly in the values and ratios of HDL (good cholesterol) and LDL (bad cholesterol) [20, 21]. Significant decrease arouse also in lymphocytes, after eating the food cooked through the microwaves. The signs of pathogenic effects (Leukocytes), are seems to be greater than before by consuming the microwave cooked food [22]. Dwindle in vitamins C&E, essential lipotropics in every food. Essential energy of foodstuffs vanished to (60-90) % by microwaved food [23].

The human body obtain no benefit take up misrepresented compounds that cannot be broken down due reduced or altering of Minerals, vitamins, and nutrients of all microwaved food. Cancerous free radicals are created in the minerals are altered in vegetables into while cooked in microwaves, Also causing in stomach and intestinal tumor growths. This cause for the fast increase of colon cancers in United States of America [24].The investigational results demonstrates enormous degradation in the oils, such that the polar compounds values higher than 26% at the most intense handling. Indicating a higher extent of oxidative degradation in microwaved food than in conventionally heated oils, significantly higher amounts of polar compounds, of triglyceride oligopolymers were found, [25].

C. Microbiological risks associated with microwave cooking

In comparable with conventional methods provided the appropriate temperature and time which Conclusively several studies shows about the effectiveness of microwave cooking in killing microorganisms and spores [*4,26,27*]. To both cooking methods, the temperature-time relationship applies and it is usually recommended that raw animal food should be heated to least for 15 seconds at 75°C to kill any food borne pathogen that may be present in the food. Studies indicated opposite results can be recognized due to uneven heating of the foods which might have been evaded by methods of covering the food all through microwaving [*28*]. When introducing, Illuminant emitting bacteria, in the blood serum and showing to the micro wave radiation they to detect the energetic changes in the blood serum. Significant increases were observed in the luminescence of such bacteria when the people have munched through the microwaved food [*29*].

Effects of the Microwave Cooking by Food Contact Materials for Microwave Cooking:

Paper and board absorbs certain amount of the microwave energy. *On the other hand, it is non*-ideal for microwaved food since the strength of paper might get affected while wet and not all kinds of paper are appropriate for microwaving of food. Results state that food covered with waxed papers/ bags may be infected with waxed hydrocarbons after microwaving [30].A study tells that migration of DEHA from PVC films to food in microwave oven may be elevated under particular conditions and well thought-out that it may not be proper to use PVC films for lining dishware or casing foods in microwave oven[4].

Biological Health *Issues Associated with Microwave Cooking*

Microwave can cause slight changes in heating the bottle with the milk. In infant milk, formulas might get alterations can become a loss of various vitamins. In articulated breast fed milk, some defensive properties might have been ruined [31].Continually eating food processed from a microwave oven causes permanent brain damage by shorting electrical impulse in brain, causing the depolarizing/de-magnetizing the brain tissue. The body is incapable of metabolizing unknown by-products produced by microwaving the food. Male/female hormone secretion is shut down and/or changed by frequently consumption of microwaved foods. The prolonged intake of microwaved foods induces cancerous cells to arise in the blood stream. Eating microwaved food roots for the memory loss, lack of concentration, emotional unsteadiness, and diminishes the intelligence. Lymphatic disarray were observed, pertaining to immunity to prevent some kinds of cancers, rates of stomach and intestine cancer were observed to be increased, high rates of digestive problems and progressive failures in the excretory systems were observed.[13]. Radioactivity in the atmosphere caused “blinding effects” formation, in turn increases the alpha and beta particles saturation in food, resulting to shifting in elemental food stuffs, and by the current metabolism of food reasoning for disorders in the digestion and deterioration of the immunity in the body. Nerve impulses gets falling apart of within the junction potentials of the cerebrum, nerve electrical circuits breakdown and in the nueroplexuses the energy fields losses, loss of balance and inside the ascending reticular activating system flow of bioelectric powers. There is residual effects prolonged of the magnetic settlements in the lymphatic system and nervous system, disturbance in brainwave (alpha, theta and delta) basis to negative psychological effects like slow down in intellectual processes, memory loss, disturbed sleep due to exposures in transmission stations or to the cooking apparatus[23].

Effects on Human by Direct Exposure to Micro Waves

With increasing application of electrical systems in households, and at work places throughout time, the setting of humans has modified basically. Thanks to the widespread use of domestic microwave devices like ovens, cellular phones the portion of the population exposed to high frequency magnetic force fields, like radio frequencies (RF) and microwaves, has augmented apace[32]. Outpouring from a worn or broken seal round the oven’s door will permit radiation outpouring which may produce associate in nursing unsafe condition [3]. Heating of solely water in an exceedingly clean cup victimization microwaves could lead to superheated water, i.e. water reached temperature over the boiling purpose while not showing to boil. Any disturbance of the water e.g. movement of the cup or addition of different ingredients, would result in eruption of boiling water out of the cup and inflicting injuries. To avoid superheated water, one ought to avoid excessive heating of water or liquids within the microwave, or let the water indicate a minimum of thirty seconds before moving it or place different ingredients into the water [33]. The vinyl polymer vapor emitted from the resins is harmful to humans Associate in Nursing becomes an inhalation hazard. Additionally, the vinyl polymer vapor within the cavity of the microwave kitchen appliance is also heated by the high-voltage electrical device round the oven. This might

lead to flashing. Even though this doesn't happen, the high concentration of the vinyl polymer vapor within the kitchen appliance cavity could result in associate in nursing explosion. Another risk is posed by the hardening agent, alkyl group alkyl group organic compound peroxide (MEKP). Once interacted with microwaves, with the ensuing reaction, the MEKP may at will ignite [34]. Experimental studies show that the exposure to high frequency fields has no cancer result within the sense of initiating a tumor cell, however exposure to high frequency fields could indirectly promote tumor growth or facilitate the absorption of cancer substances into the cell [35, 36]. Theoretical approaches to organic chemistry mechanisms of tumor induction initiated by high frequency fields Of interest group is that the lens of the attention, wherever exposure could lead to the assembly of cataracts,[37] and the generative organs, in this temporary sterility or chronic changes are according in exposures involving analysis animals and man[38,39,40]

As though to support the overall theory of Presman, variety of alternative Russians [41] attribute a large form of effects to microwave irradiation. A partial listing, supported by clinical knowledge, includes:

1. Eye cataracts, and eye disease.
2. Ductless gland sensitivity, in some cases, a small increase within the volume of the gland.
3. Bradyeardia, associate interference with the natural rhythm of heart contractions, retardation it down.
4. Body substance regulation. Increase of amine content of the blood by factors of 2 or more.
5. Dissociation between individual macromolecule factors of the plasma.
6. Chest pains.
7. Organic injuries of the vascular system.
8. Shriveled sensitivity of the attention and therefore the nose (sight and smell).
9. A large form of nervous reactions, as well as headaches, sleepiness, irritability, fatigue, labored respiration, and miscellaneous low level pains, like tingling and throbbing.

It's alleged that just all of those symptoms disappear at once when the victims are assigned to alternative work or given drawn-out vacations.

Conclusion:

Thus these evident prove right the exposure of Microwaves in any of the kind tends to the abnormalities in the human either directly or indirectly, by some kind it leaves levy to be paid by the victims by some kind or the other to their bodily functions. Understanding well about this, it's wise to obscure from the dreadful problematic agent Microwaves, in our cooking mainly and in mobile and satellites communication, which can be replaced by other possible alternatives. The scope of finding new alternatives to Microwaves in their present day application, lies totally in the hands of the Scientists and Nobel laureates, much of their work is required here to attend the burning issue the attacks the mankind at large, in some walks of their life of one who uses the microwave applied appliances. The author suggest that until such current alternatives are identified and made viable to commercial use, the people in general can think of conventional methods of life just prior to usage of microwaves or at the best minimize the use of the Vicious giant Microwaves which pollutes the near and dear surroundings of the consumers too.

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