

In your home

The In your home set of articles article is separated into 8 sections, each of which can be individually downloaded. It is a 'work in progress' incorporating new information whenever time permits.

Section 4 Cooking

1. Introduction; powerfrequency (ELF) EMFs; radiofrequency (RF) EMFs; measuring EMFs; the importance of timing
2. Appliances A-C; air conditioners, amateur radio transmitters, amplifiers, electric guitars and keyboards, aquarium, baby monitors, bath hoists, battery operated equipment, battery re-charging mats, beds, blood glucose monitors, bottle warmer, bra, burglar alarm, camcorder, carbon monoxide detectors, CD player, central heating, motor-controlled chairs, clock radio, clothes dryer, coffee grinder, coffee maker
3. Computers; monitors (Visual Display Units or VDUs), wired and optical mice, health effects, laptop computers, wireless enabled laptop, PDA (Personal digital assistant), computer wireless LAN (local area network), Schools' reactions, parents, broadband, computer games consoles, tablets, computers and Electrical Hypersensitivity (EHS), protection devices against EMFs from computers
4. Cooking; electric ovens and hobs, microwave cooking, barbecues, deep fat fryers
5. Appliances D-H; dehumidifier, dishwasher, doorbell, electric (el) blankets, el can opener, el clock, el drill, el guitar, el kettle, el knife, el lawn mowers, el shavers, el shower, el toothbrush, el vehicles, electricity meter, exercise machine, extractor fan, fan, fax machines, fire alarm, fitness devices, floor polisher, food processor, foot spa, foot & hand warmer, fridge, fridge/freezer, hair curlers/tongs, hair dryers, headphones, hearing aids
6. Appliances H-S; heart pacemakers, heaters, central heating boilers, heating pads, hi-fi, etc., hostess trolleys, immersion heater, iron, Jacuzzi, musical keyboard, lift, loudspeaker, magnetic field therapy mats, meters, mixer & blender, music centre, nightlights, pagers, PDAs, pencil sharpeners, personal alarms, personal radios, pet fences, photocopiers, plasma balls, power tools, printers, projectors, radar, radios, radio transmitters, sandwich maker, sauna, scanner, security systems
7. Appliances S-Z; sewing machines, smoke detector, sockets, solar panel water heating, solar photovoltaic panels, soldering irons, spinners, stairlift, static electricity, sun beds, sun lamp, tea maker, telephone, television, TV and radio transmitters, TENS unit, toaster, toys, transformers, trouser press, tumble drier, typewriters, vacuum cleaners, vagina speakers, washing machines, washer/dryer, waste disposal unit, water filters, water heater, water softener, water supply, wheelchairs, wristwatches
8. Grounding & 93 references

Cooking (electric ovens & hobs)

If you are concerned about electric, magnetic and radiofrequency fields from the appliances in your home, you can measure them with an ELF meter, or RF meter available to buy or hire from [EMFields](#).

The standard electric cooker, which has an oven, grill and top plates, gives off high magnetic fields when it is operating. These can be as high as several microtesla close to. Half a metre away the fields can still be as high as $0.2\mu\text{T}$. Pregnant women should keep their distance, as the highest field levels can be in the area of the growing child. Prepare uncooked food in advance and keep away, as far as possible, while it is cooking.

Children's normal playing area should be at least 1.5 metres away from the front of the cooker, whilst the cooker, especially the oven, is on.

Fan assisted ovens, double ovens, toaster ovens, grills, time switches, etc. give off significant magnetic fields. Bear in mind the distance away from the body, particular areas to watch (breasts in women with family susceptibility to breast cancer; genital area for men who are concerned about testicular or prostate cancer), and whether you are pregnant, or you or your partner are wanting to become pregnant, or have immune system problems. Be aware of the height and distance of time switches. Keep a reasonable distance away whilst they are working. Caution is needed with regard to *all* electrical appliances.

The fields from a separate hob are lower than those of a cooker, about $0.1\mu\text{T}$. Pregnant women are not advised to stand in front of it for longer than necessary, however.

Ceramic and halogen hobs generate similar levels of magnetic fields as conventional open-ring electric hobs.

Magnetic induction hobs work on a different heating principle. High EMFs are generated by the cooker on purpose, and these EMFs induce currents to flow in the pans themselves, which cause them to heat up. The top of the cooker stays relatively cool and is heated by contact with the hot pan. It is important not to place cutlery or other metal objects on the hob; there is a risk of these heating up and the danger of burning. To prevent damage to items which are susceptible to magnetic fields, such as credit cards, pocket calculators, etc, do not leave them in the immediate vicinity of the hob. Do not use the appliance as a resting place for anything else.

When cooking with a **magnetic induction hob**, the whole body is highly exposed to EMFs and hands' and arms' exposure exceeds the normal ICNIRP (not very precautionary) levels, which are set high and only protect against gross acute (immediate) effects. Induction hobs operating at 20 kHz can generate field levels 3 times higher than ICNIRP levels. Many measuring instruments (including the EMFields ELF meter) do not read above 2 kHz, so these field levels would not be picked up.

A few use 100 Hz derived from the mains supply, but most now use higher-frequency EMFs, usually between 18-23 kHz and 60-100 kHz, to induce currents into the pan. EMF current conduction (in metal and in people) is proportional to frequency. 1 microtesla at 50 KHz induces 1000 times stronger currents than the same magnetic flux level at 50 Hz. For young people (and pet animals) whose more sensitive hearing will be able to detect this level, cooking using an induction hob could well be accompanied by a rather unpleasant whine.

There are two main types of hob: those that only work with cast iron and stainless steel pans, and higher-frequency ones that can also heat aluminium and copper pans. The EMFs they produce around the pan usually considerably exceed international ICNIRP magnetic field guidance levels

(up to 16 times above have been measured). Takenori Ueda of the Japan Offspring Foundation reports that induction hobs emit the highest level of radiation among all household electric appliances.

Some induction hobs only emit power when they detect a metal plate (e.g. cooking pan base) above them to heat, some emit fields whether or not there is something metal to heat. Small-base pans will leak magnetic fields around them.

A study in [2009](#), by Sakurai found no detectable cellular genotoxicity as a result of exposure to magnetic fields for 2 hours from an induction heating hob.

Whilst there is not a unanimous agreement that EMFs are linked to health problems, neither the government nor industry seems willing to make attempts to limit EMF exposure from induction hobs, both sides agreeing about the safety of the hob, while saying it is the responsibility of the other party to communicate possible risks.

Induction hobs are being installed as a first option in new build houses in some European countries.

Slow cookers usually use very low power and do not pose a significant EMF hazard.

The fields from a **cooker hood** motor are high, about $0.26\mu\text{T}$ half a metre away. Limit the time you spend in front of a cooker hood when it is dark, as high fields near head height inhibit the production of melatonin, necessary for good health, for the following night-time period.

Microwave Cooking

How microwaves cook food

Microwaves generated from the magnetron bombard the food, causing the polar molecules to rotate at the same frequency millions of times a second. The oxygen of water molecules reacts most sensitively. All this agitation creates molecular friction, which heats up the food. The friction also causes substantial damage to the surrounding molecules, often tearing them apart or forcefully deforming them. This is contrary to conventional heating of food where heat transfers convectionally from without to within. Cooking by microwaves begins within the cells and molecules where water is present and where the energy is transformed into frictional heat.

In addition to the violent frictional heat effects, called thermic effects, there are also athermic effects which have hardly ever been taken into account. These athermic effects are not presently measurable, but they can also deform the structures of molecules and have qualitative consequences.

For example the weakening of cell membranes by microwaves is used in the field of gene altering technology. Because of the force involved, the cells are actually broken, thereby neutralizing the electrical potentials, the very life of the cells, between the outer and inner side of the cell membranes. Impaired cells become easy prey for viruses, fungi and other microorganisms. The natural repair mechanisms are suppressed and cells are forced to adapt to a state of energy emergency -- they switch from aerobic to anaerobic respiration. Instead of water and carbon dioxide, the cell poisons hydrogen peroxide and carbon monoxide are produced."

The same violent deformations that occur in our bodies, when we are directly exposed to radar or microwaves, also occur in the molecules of foods cooked in a microwave oven. This radiation results in the destruction and deformation of food molecules. Microwaving also creates new

compounds, called radiolytic compounds, which are unknown fusions not found in nature. Radiolytic compounds are created by molecular decomposition - decay - as a direct result of radiation.

After some 20 years of research into their use, Soviet Russia banned the use of microwave ovens for heating food in 1976 as they decided that the dangers outweighed the benefit of speed. They were allowed again from 1987 when, under Perestroika, Gorbachev allowed many business pressures to change problematic Russian regulations that did not fit in with "Western Free-Trade" practice.

Some Russian researchers have reported a marked acceleration of structural degradation leading to a decreased food value of 60 to 90% in all microwaved foods tested. They found significant decreases in the bio-availability of B complex vitamins, vitamin C, vitamin E, essential minerals and lipotropics (substances that prevent abnormal accumulation of fat). This was confirmed in a Japanese study when they found that approximately 30-40% of vitamin B12 was lost in foods cooked by microwaves (Watanabe [1998](#)). B12 deficiency is one of the factors that can cause dementia.

Dr C Garcia-Viguera (2003, [2007](#) (lead author Lopez-Berenguer)) found that broccoli lost 97% of its antioxidants (vitamin C) when microwaved. There were also reductions in phenolic compounds and glucosinolates. Mineral levels remained stable. In general, the authors concluded, "*the longest microwave cooking time and the higher volume of cooking water should be avoided to minimise losses of nutrients.*" She suggested that this may apply to other vegetables, but they were not tested. It was felt that the results could have implications for public health.

Scientists at China Agricultural University's College of Food Science & Nutritional Engineering in Beijing looked at different forms of cooking and their production of acrylamide, a cancer-causing chemical. They found that microwaving food produced more acrylamide than boiling or frying (at 180°C), and that 750 Watt ovens produced more acrylamide than 500 Watt ovens (Yuan [2007](#)). However, scientists at the University of Mersin's Department of Food Engineering (Turkey) used a microwave oven to pre-cook french fries to reduce the cooking time needed, as the volume of acrylamide produced is related to length of frying time. The reduction in acrylamide was 36% @ 150°C; 41% @ 170°C; and 60% @ 190°C.

There seems to be a growing body of evidence that suggests that human breastmilk or baby formula is changed if heated in a microwave. The vitamin content is depleted and certain amino acids are converted into related substances that are biologically inactive. Some of the altered amino acids are poisons to both the nervous system and the kidneys. Paediatrician John Kerner and colleagues at Stanford University found that milk lost lysozyme activity, antibodies, and fostered the growth of more potentially pathogenic bacteria. Others found that microwaving human breast milk destroyed 98% of its immunoglobulin-A antibodies and 96% of its liposome activity (which inhibits bacterial infections). This breast milk was heated from frozen, which does not happen usually, we would imagine, except under special circumstances, such as in hospitals. It is unclear whether the breast milk in question may have been affected by other factors, such as maternal stress, under these circumstances.

In the early 1990s a hospital in Minneapolis, Minnesota, distributed pamphlets warning people against using microwave ovens to heat infant formulas because they altered the food.

"Although microwaves heat food quickly, they are not recommended for heating a baby's bottle. The bottle may seem cool to the touch, but the liquid inside may become extremely hot and could burn the baby's mouth and throat. Also, the buildup of steam in a closed container, such as a baby bottle, could cause it to explode. Heating the bottle in a microwave can cause slight changes in the milk. In infant formulas, there may be a loss of some vitamins. In expressed breast milk, some protective properties may be destroyed. Warming a bottle by holding it under tap water, or by setting it in a bowl of warm water, then testing it on your wrist before feeding may take a few minutes longer, but it is much safer."

A Bohmert, the anthroposophist, reported the following *“water samples were heated, some in a microwave oven and others conventionally, and then left to cool before use. These water samples were used to bring grain to germination. The grain in contact with microwaved water was the only one that did not germinate.”*

Microwave cooking has been shown to heat food unevenly, which means that some of the food is not heated sufficiently to kill all the bacteria or parasites that might be present. This uneven heating also creates hotspots in foods that release synthetic oestrogens found in certain plastics (Gittleman). Frozen hamburgers, fish and warmed-up dishes all may have cool areas in them that could promote the growth of pathogens. Live unkilld microbes may remain to grow in an unrefrigerated dish.

Microwave ovens from various suppliers were used to cook naturally contaminated whole chickens according to the manufacturers' instructions. Many yielded visible *Listeria* bacteria after microwave cooking (FAC).

Russian investigations were published by the Atlantis Raising Educational Center in Portland, Oregon. Carcinogens were formed in virtually all foods tested. No test food was subjected to more microwaving than necessary to accomplish the purpose, i.e., cooking, thawing, or heating to insure sanitary ingestion. Here's a summary of some of the results:

- Microwaving prepared meats sufficiently to insure sanitary ingestion caused formation of d-Nitrosodienthanolamine, a well-known carcinogen.
- Microwaving milk and cereal grains converted some of their amino acids into carcinogens.
- Thawing frozen fruits converted their glucoside and galactoside containing fractions into carcinogenic substances.
- Extremely short exposure of raw, cooked or frozen vegetables converted their plant alkaloids into carcinogens.
- Carcinogenic free radicals were formed in microwaved plants, especially root vegetables.

Biological changes

Microwave exposure caused a higher degree of protein unfolding than usual thermal stress at the same temperature (George [2008](#)).

Chemical leakage of packaging

Heat susceptors are visible thin, gray strips or disks of metallized plastic that absorb microwave energy and turn the surface of the package into a very hot little frying pan (reaching temperatures of 300-500 degrees F), that can make microwaved foods brown and crisp or crunchy.

The grease-repelling papers used for some microwavable packaged foods, in particular microwavable popcorn, may be responsible for the levels of PFOA, a suspected carcinogen, in the blood of most Americans.

Haldimann ([2007](#)) found increased concentration of antimony (which in small doses can cause headaches, dizziness and depression), as a result of cooking with polyethylene terephthalate (PET) oven-proof trays (used to package ready-to-eat meals). Claire Nelson received a top science prize from the American Chemical Society for research demonstrating that subjecting common plastic wrap to microwave cooking would produce DEHA (diethylhexyl), an identified carcinogen, and transfer it into the food.

It is not recommended that food containing fat in a plastic container should be heated in a microwave oven. Dr Edward Fujimoto of Castle Hospital demonstrated that the combination of fat, high heat and plastic could produce dioxins, very potent carcinogens.

Susan Brewster, Associate Professor of Food Chemistry at the University of Illinois, worries about the possibility that certain plasticizers could act as endocrine disruptors, which means they can

potentially mimic or compete with human hormones. If they do, then that could affect such things as fertility or someone's risk of getting cancer.

Park (2006) found that not all microorganisms were destroyed by microwave radiation and could have implications for the design of containers to be used for cooking in the home microwave oven.

Microwave and powerfrequency radiation from a microwave oven

The oven equipment gives off high (over one microtesla) powerfrequency EMFs from the cables and the motor. These extend for about a metre.

Microwave radiation leaks from the seal around the door and through the glass of microwave ovens. The water molecules in the body of someone standing close by will be agitated to some degree by the microwave radiation. Eyes are particularly vulnerable, as they contain large amounts of fluid and a lower blood supply to take away any heat. This is important to bear in mind with regard to children whose height and curiosity could lead to them watching the changes induced in microwave cooking from too close a distance.

Current regulations require that a microwave oven leak no more than 1 milliwatt per square centimetre (mW/cm²) when it leaves the factory, and 5 mW/cm² after a period of use. We do not know if these levels are really safe and believe microwave ovens should be used with caution. Since microwave emissions can change with normal use, ovens should be checked regularly, preferably annually, to pick up any microwave leakage from the seals.

Even when the microwave oven is working correctly, the microwave levels within the kitchen are likely to be significantly higher than those from any nearby cellular phone base-stations. Remember also that microwaves will travel through walls if the microwave oven is against an inside wall.

One study (Liu 2007) found that women using a microwave oven were at increased risk of early spontaneous abortion.

Exposing pregnant rats to 2450 MHz resulted in a significantly increased activity level in the adult offspring in a study by Jensh (1997).

Barbecues

These are rarely electrical and, anyway, are only used for short periods and so will not pose a problem.

Deep-fat fryer

The fryer will give off high EMFs as the oil is heated. Used infrequently, it shouldn't be a problem. If the work surface on which it is placed is at a height which is critical due to pregnancy or a tendency to prostate cancer in the family, take extra care. Regularly re-heated oil is more likely to cause health problems because of trace carcinogenic compounds which are generated at the high temperatures and left in the oil and which then attach themselves to the food.