Non-Thermal Bioelectromagnetic Effects Explained

John is proud of his machine for harvesting ripe apples. It works by shaking the tree with just the right force. If it is too weak, no apples fall off, if it is too strong, they all fall off, but if it is just right, only the ripe ones fall off and can be harvested. If you can follow this, you will be able to see easily how weak electromagnetic fields can give biological effects without generating significant heat.

Their effect is to reduce the stability of the delicate membranes that surround living cells and divide them into compartments. They are made mostly of negatively charged molecules interspersed with positively-charged ions that help to bind them together. Divalent ions (ions with two charges) such as calcium are better at binding than monovalent ions (having only one charge) such as potassium. Bawin and her co-workers in 1975 showed that electromagnetic fields can selectively remove calcium from cell membranes, which would reduce their stability. This has been repeated in other laboratories and has been found to occur only with very weak radiation and is restricted to certain "amplitude windows", above and below which there is no effect.

The explanation is simple if we remember John's apple harvester. The alternating electromagnetic fields "shake" the cell membranes, with the negatively-charged structural components and the positive binding ions moving in opposite directions. If the field is too weak, nothing happens. If it is too strong, all the ions are driven off and then back onto the membrane with each cycle. But if it is "just right" only the more strongly charged ions (such as divalent calcium) are affected and are selectively removed. Their place is then taken by less-affected monovalent ions such as potassium. This occurs mainly with low frequency alternating fields or radio-frequency fields that are amplitude-modulated or pulsed at a low frequency.

This effect is important because the loss of these calcium ions weakens the membranes so that they are more likely to tear and develop temporary holes, making them permeable even to large molecules such as enzymes. The leakage of digestive enzymes from lysosomes (membrane-bound organelles that normally digest waste) into the rest of the cell is almost certainly responsible for the fragmentation of DNA caused by prolonged exposure to mobile phone radiation in human and animal cell cultures. This genetic damage has been reported in several studies and is likely to cause cancer, a reduction in fertility (both of which are now becoming apparent) and possible mutations in future generations. There is no reason to believe that Wifi is any safer. Although the signal is weaker, this does not necessarily mean it is safer. Because the effect only occurs in specific "amplitude windows", a weaker signal could even be *more dangerous*, especially since the router radiation is continuous.

An important consideration for teachers is that the radiation from Wifi could make neurones leak, the effect being to increase their internal calcium concentration, which will accelerate the production of action potentials. This can improve the response-time to simple stimuli, but will also generate spurious action potentials that could result in confused thought and an inability to concentrate on complex tasks like classroom learning. The likely immediate outcomes of Wifi in schools may be symptoms similar to Attention Deficit Hyperactivity Disorder (ADHD) in some of the more electrosensitive pupils. For more information and references, please visit http://tinyurl.com/2nfujj and http://tinyurl.com/32nu71

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