Box 1. The electromagnetic radiation spectrum

The electromagnetic spectrum spans a broad range of wavelengths, from X-rays to radio waves, with characteristic frequencies and energies (Figure I). As a result, each type of radiation has unique properties, and must be considered independently. In general, radiation below the visible wavelengths carries enough energy to ionize molecules and atoms, and be lethal to microorganisms. Except for a few rare resistant microorganisms, ultraviolet (UV) irradiation leads to the formation of highly reactive radicals, and directly damages DNA beyond repair. Because of the ionizing power of radiation below the visible spectrum, it is unlikely to be relevant in cell–cell communication. By contrast, radiation above the low infrared has broader wavelengths than the average size of microbial cells, and is therefore unlikely to be relevant for signaling. This narrows down the electromagnetic radiation that could serve as an information carrier for microbial cell–cell communication to the visible (400–750 nm) and near-infrared (750–2500 nm) region of the spectrum, also known as biophoton emission. Ultraweak UV photon emission (mitogenetic radiation) has been reported as a microbial signal [80], yet these studies often used detection systems lacking the sensitivity required for measurements in the UV region. Thus, whether this type of radiation can function as an information carrier in microorganisms remains to be determined.

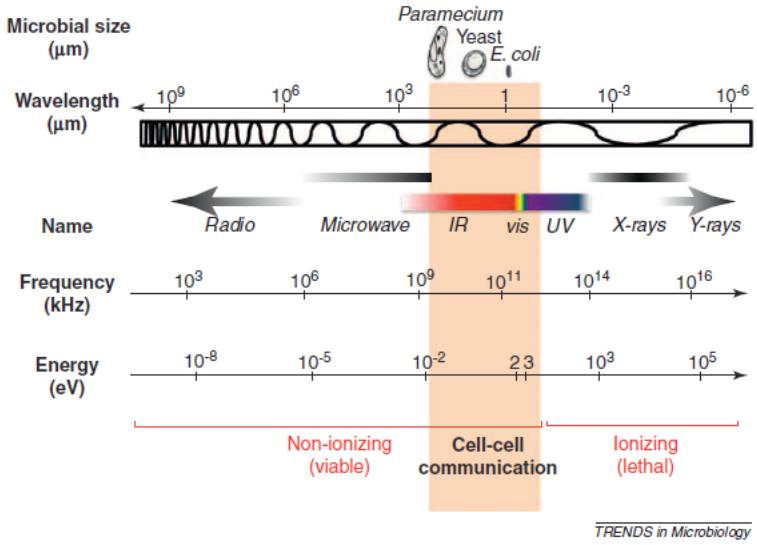

Figure I. The electromagnetic spectrum. Microbial sizes (for the unicellular protozoan *Paramecium*, a *Saccharomyces* yeast cell and the bacterium *E. coli*) and radiation wavelengths (μm) are shown on top. The name of the radiation, its frequency (kHz) and the energy of the photons (electron volts, eV) are shown below. Scales are approximate. The shaded area of the non-ionizing radiation shows the region of the spectrum that is likely to be relevant to microbial cell–cell communication.