

# Relax Far Infrared Energy

## More effective than Near Infrared!

**Far-infrared rays penetrate deeper into mammary tissue and induce a higher skin blood flow in comparison to infrared irradiation**

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***Abstract: Far-Infrared rays (FIR) and infrared rays (IR) generate heat and were claimed to be benefit to wound healing. We compare the differences of light penetration and human skin blood flow between FIR and IR irradiation.***

### INTRODUCTION

Earlier studies have shown that FIR and IR radiation could promote wound healing in mice, increase skin blood flow and a deeper light penetration. However, no comparison data exist in the English literatures. We compare the light penetration in excised porcine tissue and in mice, and the human skin blood flow affected by FIR and IR.

### MATERIAL AND METHODS

**Experiments setup** FIR heaters which emit 4-14 $\mu$ m rays was a gift from Chung Cheng Electric Heating Co., Taiwan. PAR38 infrared lamp (wavelength of 700-2000 nm, Philips, Holland) was used for IR irradiation. During irradiation, multiple channel measuring system with 14 thermocouple inputs (PCI4351, National Instruments, US) were attached onto skin and provided a continuous records of skin temperature. An area of 2 $\times$ 2 cm was irradiated during all experiments by blocking with an aluminum foil with a square opening.

**Determination of light penetration *in vitro*** Thermal couples were inserted into different anatomical layers (skin surface, dermoepidermal junction, upper-, middle- and lower- layer of the subcutaneous fat, middle of the muscular layer) of excised domestic pig skin with underlying muscle. It was placed in 37° water bath to mimic constant temperature *in vivo*. Radiators (IR or FIR) were set at a distance to keep skin surface temperature at 47°.

**Determination of light penetration *in vivo*** To prove whether FIR could penetrate deeper in live tissue, BALB/c mice were irradiated with FIR and IR. Thermal couples were put into mouse anus or skin surface to monitor temperature. Skin surface temperature was kept at 40° for 20 minutes.

**Laser Doppler measurements of human skin blood flow** Periflux 4001 (Perimed AB, Sweden) was used to measure forearm, inner aspect blood flow in 4 volunteers. Data was collected before and immediately after irradiation until the temperature dropped to the baseline. The skin surface was kept around 40-42° by adjusting the distance of the lamps to skin. All experiments were repeated at least twice.

## RESULTS AND DISCUSSION

**FIR rays penetrated deeper in isolated skin tissue** Only FIR irradiation could penetrate 3cm depth from skin surface (middle of subcutaneous fat) as revealed by an increment of 2° from the baseline (Fig. 1). The results implied that FIR has better penetration in pig skin than IR.

**FIR rays penetrated deeper in mice** In FIR treated group, the difference was about 1° higher than the IR group (Fig. 2). The results suggested FIR irradiation could penetrate deeper and induced a systemic regulatory effect on body temperature.

**FIR irradiation enhanced skin blood flow in human skin** Fig. 3 showed the skin blood flow measured by laser Doppler was increased in both FIR and IR treatments. However, it took a longer time for the skin blood flow back to baseline in the IR irradiation group (Fig. 4).

The results showed that FIR and IR might cause different biological effect in mammary tissue, both *in vitro* and *in vivo*. FIR increase more blood flow in human skin than IR irradiation. The deeper vessels might be heated and dilated by FIR irradiation. The results suggested FIR irradiation might benefit to patients with poor wound healing due to compromised circulation.

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