



Review

Use of infrared-based devices in aesthetic medicine and for beauty and wellness treatments



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ABSTRACT

Infrared devices and technologies are used for weight loss, cellulite treatment, body remodeling, beauty treatments, and wellness. Infrared (IR) is a type of electromagnetic radiation that has the ability to stimulate living tissues resulting in numerous biological responses. Exposure to IR is perceived as heat and their mechanism of action is related to the absorption of energy by photoacceptor molecules. Adverse reactions have also been documented.

The studies, research papers and reviews of the last thirty years have been collected and examined and this review describes in more detail the main devices that use infrared: infrared thermal blankets, far-infrared thermal blanket, infrared lipo laser paddles, infrared lamps, far-infrared lamps, infrared saunas, far-infrared saunas, and infrared caps.

IR thermal blanket improves blood circulation and the metabolism of the whole body, accelerate the detoxification, trigger the consumption of calories and fat burning. It is an alternative treatment to saunas but more effective. IR lipo laser paddles are a non-invasive alternative to traditional liposuction that helps to remove fat accumulated in specific areas of the body. IR lamps increase the absorption of cosmetic products, improve local blood circulation and relieve muscle and joint pain. IR saunas have a relaxing effect and the same effects of the thermal blanket and the IR lamps. IR caps can stimulate hair follicles and hair regrowth.

Despite numerous studies, the precise mechanisms of action of the infrared need more research as well as the molecular targets that are directly or indirectly involved by their thermal effects and their non-thermal effects.

1. Introduction

The search for a better and more toned body shape that involves the reduction of fat deposits throughout the body or in specific areas, as well as the reduction of cellulite and, in general, all that orbits around the universe of strategies for weight loss and tissue toning (skin and subcutaneous tissues), it is the need that leads women, and more recently also men, to orient themselves on the solutions proposed by aesthetic medicine, both invasive and non-invasive, to beauty salons and slimming centres or gyms. In recent years more and newer technologies and tools have been spreading for slimming and toning and among these, there are the devices that use infrared rays.

The present review paper, for the first time, collects and summarizes the studies and scientific evidence of the main infrared technologies that are currently used in non-invasive aesthetic medicine, for body remodeling, and for body contouring, in beauty treatments and for

wellness.

2. Infrared: Biological response and side effects

The infrared (IR) is a type of electromagnetic radiation with wavelengths between 780 nm and 1000 μm and according to standard ISO20473:2007 is divided into three different bands even if other classification systems are known and used (Table 1). Near-infrared rays (NIR) take the wavelengths between 0.78 μm and 3.0 μm while the mid-infrared band (MIR) takes the wavelength between 3.0 μm and 50.0 μm . The portion of MIR between 4/6 μm and 14 μm is called the “growth ray” or “resonant frequency” because it is efficiently absorbed by living organisms and promoting their growth [3–5]. The last IR band is known as far-infrared (FIR) and it is often called “biogenetic radiation” or also “biogenetic rays” [6]. It collects all wavelengths between 50.0 μm and 1000.0 μm .

Abbreviations: BMP, photobiostimulation; FIR, far-infrared; IR, infrared; LED, light emitting diode; LLLT, low-level light therapy; LWIR, long-wavelength infrared; MIR, mid-infrared; MWIR, mid-wavelength infrared; NIR, near-infrared; PDT, photodynamic therapy; PIPBM, photo-infrared pulsed bio-modulation; ROS, reactive oxygen species; SWIR, short-wavelength infrared

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Table 1

Classification of IR radiation. Also shown the indications for use in aesthetic medicine and beauty treatments and possible adverse effects.

IR (μm)	Use in aesthetics	Possible side effects	IR Classification (μm)		
			ISO20473:2007	CIE	Academic [2]
0.78 to 1000	FACE AND SCALP: double chin reduction, control hair loss; FACE& BODY: photorejuvenation (LD-IR), vasodilatation of peripheral capillaries, improve metabolism, activation of fibroblasts, wound healing, detoxification; BODY: cellulite, fatty deposits, general and localized weight loss, fatigue, pain, muscle recovery; PSYCHE: relax, sleep quality	ROS (\blacktriangle), free radicals (\blacktriangle), photoaging (HD-IR), thermal injury	NIR	IR-A	NIR
			0.78–3.0	0.78–1.4	0.78–1.4
				IR-B	SWIR
				1.4–3.0	1.4–3.0
			MIR	IR-C	MWIR
	3.00–50.0	3.0–1000.0	3.0–8.0		
			LWIR		
			8.0–15.0		
		FIR		FIR	
		50.0–1000.0		15.0–1000.0	

Low dose IR (LD-IR): < 50 mW/cm²; High dose IR (HD-IR): > 100 mW/cm² [1].

IR can be absorbed by living organisms [7] and the examination of the scientific literature shows that the biological effects of NIR and FIR are much more studied than MIR rays. So for MIR rays the effects and the mechanisms of their action are very little known.

Exposure to the IR is perceived as heat [8]. IR rays are used in thermotherapy which uses the heat, generally at a temperature above 323.15 K (50 °C), for therapeutic or analgesic purposes. IR rays are also used in phototherapy for their thermal effects and also for their non-thermal effects [9–11].

The mechanism of action of IR light is related to the absorption of energy by photoacceptor molecules (also known as endogenous chromophores) (Table 2), including water molecules, in heat-related and

nonheat-related effects, with the conversion of IR rays into biological signals [9,10,28,29], including the increase in intracellular and extracellular temperature (photothermal effect), that are the cause of all photophysical and photochemical events and photobiological responses in all skin layers, from the epidermis to the dermis, and in the subcutaneous tissues. Water, in particular, is able to absorb infrared radiation, and this can produce changes in molecular rotation and in molecular vibrational energy that influence the tertiary conformations of biological structures such as intracellular and extracellular proteins and enzymes but also ionic channels [9,10,28,30]. These changes may trigger specific signaling pathways that can activate the transcription factors, modify cells transcriptome and determine changes in gene

Table 2

Chromophores. The table shows the photoacceptor molecules that are stimulated by the different IR bands, the cellular targets and IR devices that are currently used.

Beam	Primary effect: photoacceptor (in addition to water)	Secondary effect: pathways/ macromolecules	Tertiary effect	Cell target	Refs.	Device	
RED + NIR	Lipids	(?)	Activation of a wide range of transcription factors leading to improved cell survival, increased proliferation and migration and new protein synthesis [12]	Adipocyte	[13]	(1) Lipo laser pads	
	Cytochrome C oxidase (CCO)	cAMP + cytoplasmic lipase		Fibroblast	[14–16]	(2) IR lamps	
	(?)	ATP (\blacktriangle) + ROS (\blacktriangle) + NF-kB (\blacktriangle)			[16–18]	(3) Thermal blanket	
	(?)	MEK/ERK 1/2 + Matrix metalloproteinase (MMPs): MMP-1, MMP-3, MMP-12 (\blacktriangle HD-IR or \blacktriangledown LD-IR)			[1,8,19,20]	(4) IR caps	
	(?)	TGF- β 1 (\blacktriangle)			[21]		
	Melanin	(?)			Keratinocyte/Melanocyte	[22]	
	Hemoglobin	Hb/HbO ₂			Red cell	[13]	
	Myoglobin	(?)		Myocyte	[21,23]		
MIR	(?)	(?)		(?)	--	(1) Thermal blanket	
FIR	(?)	Endothelial nitric oxide synthase (eNOS) + NO		Vascular endothelium	[24]	(1) Thermal blanket	
	(?)	MAP kinases (p38) + extracellular signal-regulated kinases (ERK)			[25]	(2) FIR thermal blanket	
	(?)	TGF- β 1 (\blacktriangle)		Fibroblast	[26]	(2) FIR saunas	
	(?)	Notch1 signaling pathway		Keratinocyte	[27]	(3) FIR lamps	

 \blacktriangle Activation; \blacktriangledown Inhibition; (?) Unknown.

expression [31,32]. Furthermore, FIR can break clusters of water molecules into smaller groups [33] with fluid dynamic cascade effects on intracellular water and extracellular water contained in tissues or present in blood and lymph thus the flow of liquids in the tissues, in the blood and lymphatic vessels is improved and, with the simultaneous action of the heat, also increased. Despite what has just been said, the exact and exhaustive mechanism of action of the IR rays and their direct or indirect biological effects are still poorly understood.

The biological IR responses have instead been much more documented, and they generally include: enhancement of peripheral blood circulation, promotion of vasodilatation, blood flow, capillary dilatation and blood perfusion [6,34], reduction of blood pressure [35], reduction of oedema [36], enhancement of metabolism [6], recruitment, activation and proliferation of fibroblasts and increase the collagen synthesis, disposition and regeneration [26,37], improvement of wound healing and enhancement of endothelial repair [6,26,27], the increase of fat burning and the reduction of fat deposits, so help in losing weight and in inhibiting obesity [5,6,14,38,39], reduction of intravascular lipids deposition and risk of arteriosclerosis [40], the control of cellulite [38,41–43], aid in photorejuvenation (reduction of pigmented lesions, fine lines and wrinkles) and photoprotection against UV-induced damage [44,45], stimulation of different types of neural cells and nerves with sedative and analgesic effects [46,47], alleviating fatigue and pain and improving muscle recovery and relaxation in athletes and shown positive effects on general disorders of the locomotor system [47–52], show an anti-inflammatory effect [1,6], increase relaxation, reduce insomnia, alleviate depression and improve sleep quality [6,53,54], control of hair loss of the scalp and regrowth of vellus [55,56].

The possible side effects related to the use of IR are the following: thermal injury, heat stress responses, indirectly or directly stimulation of the production of reactive oxygen species (ROS) or free radicals [37] with the trigger of the mechanisms related to photoaging [57].

However, considering the wide application of IR rays in devices for aesthetic treatments, more studies are needed to clarify or confirm their adverse reactions, in particular if these reactions can be related to the time range (i.e. the duration of single treatments), the interval between treatments (i.e. the number of sessions and the pause time between them), the wavelength used (i.e. NIR, MIR, FIR or a mix of them) or the area of application (i.e. the size of irradiated area or body district). The contraindications that instead limit their use are: pregnancy, epilepsy, active tuberculosis, malignancy, acute inflammation, severe coagulation disorders and cachexia [58].

3. Non-invasive IR technologies

The infrared-based technologies are numerous, as well as numerous and heterogeneous are the materials and substrates used in their construction and which include those necessary for the generation and distribution of infrared and components suitable for the contact with human skin. The search for new and better materials for these technologies is an ever-expanding field of interest and in this context, the nonlinear optical (NLO) materials probably shall be the main components of the future photoelectric technologies [59,60].

3.1. IR thermal blanket

The thermal blanket, also called “IR cover” or “hot blanket” or “sauna wrap” or “sauna blanket”, is an electrical device that emits IR rays and it consists of electric resistances covered with a special protective material, generally waterproof nylon or polyvinyl chloride (PVC) covered by a layer of polyurethane (PU), which prevents the penetration of any liquid or body’s secretion to the inside [61]. It is made by a single sector or up to three sectors, divided into upper body, mid-body, and lower body areas and it is easy to maintain and clean. It is possible to perform a digital temperature control and adjust it independently thanks to a digital thermometer that is inserted into the

blanket to ensure the proposed temperature.

A classic electric blanket warms the human body by convection and conduction from the outside of the skin due to the heating of the air, while the mechanism of action of the thermal blanket is based on the radiation and on the development of endogenous heat in the skin and in the subcutaneous tissues [62] due to absorption of IR by water molecules and their consequent vibration (heat-related effect). It also differs from IR emitting materials for clothing because the type of discharge and the materials used are different. In addition, warm air allows heat to penetrate a few millimeters into the skin, while IR heat can penetrate into the skin from about 2 cm to 7 cm [38] and the depth of penetration depends on their wavelength, i.e. it decreases with the increasing of wavelength [8].

In this device the whole human body, excluding the head and the neck, is wrapped in the blanket and heated for a time between 30 and 60 min, on average 40 min, and not less than 20 min, with temperatures between 298.15 K and 358.15 K (25–85 degrees Celsius), on average 323.15 K – 333.15 K (50–60 degrees Celsius). Before a cycle of treatments, the classic situation is to find a subcutaneous tissue with numerous hypertrophic and hyperplastic adipocytes, disorders in the organization of the extracellular matrix of the dermis and hypodermis and anomalies in the capillary network. Every single treatment develops endogenous heat, increases the production of sweat, calories and fat are burned and so, after a cycle of treatments, it is possible to detect an interesting reduction of fat deposits, a reorganization of the extracellular matrix and a more efficient organization of the capillary network. This allows improving blood circulation and the metabolism of the whole body, accelerate the detoxification, trigger the consumption of calories and fat burning [38,62]. Generally, before being wrapped in the blanket, the body is first wrapped in a thin sheet of HDPE film (cartene) that has the function of hindering sweating and therefore make the slimming treatment more effective because more calories will have to be burned in order to sweat [62].

The more recent evolution of the IR thermal blanket is the hot-stone thermal blanket, a device identical to the first but which incorporates ultra-small FIR radiating ceramic stones or crystals like tourmaline, serpentine or jade. These stones, energized by the heat of the body and/or by the device itself, emit electromagnetic radiation in the FIR region [63–65].

Tourmaline is a polar crystalline material that has a good pyroelectric and piezoelectric effect and can emit MIR wavelength from 4 to 14 μm [5,66], while jade can produce a high strength photoelectric effect, it forms a magnetic field and can emit MIR in the wavelength range from 8 to 15 μm [66]. Both stones emit MIR in the window of the growth rays that are well absorbed by living tissues and, therefore, enhance the benefits obtained with the use of the IR blanket.

Nowadays the IR thermal blanket is an alternative treatment to IR saunas but more effective, however, it cannot be used if the person presents one or more of the diseases and problems listed below, in addition to the general ones already listed on IR and if the primary care physician or specialist decides otherwise: respiratory diseases, serious high or low blood pressure, haemophiliacs, skin diseases, heart diseases, after consuming or during consumption of alcohol. The legislation of a specific country may also include other exclusions of use.

3.2. IR lipo laser paddles

This device, also known as “soft laser” [16], is widely used in aesthetic treatments and in phototherapy. Its mechanism of action is based on photobiostimulation (BPM), also called low-level light therapy (LLLT), when the light beam is applied continuously [18] or on photo-infrared pulsed bio-modulation (PIBPM) when the pulsed mode is applied [28] and it not to be confused with the photodynamic therapy (PDT), which is based on the effect of light to excite the exogenous chromophores delivered in the skin, i.e. photoactivate a photosynthetizer, to produce toxic reactive oxygen species (ROS) [45,67].

This device is used only by qualified therapists for laserlipolysis, for example in a slimming centre [38], and it is a non-invasive alternative to traditional liposuction that helps to remove accumulated fat and lose weight and it is used for localized non-surgical body remodeling, body contouring and liposculpture, i.e. for the treatment of cellulite and to reduce the size and fat deposits of specific parts of the body such as the abdomen, the male chest, the hips, the lower back, the upper back, the arms, the buttocks, the knees, the calves, the inner thighs, the outer thighs and the double chin [38,62,68]. It has been shown that it is possible to mobilize with a single lipolaser treatment about 52 g of fats and to lose about 2 cm (2.4 cm for accuracy) of circumference from one cycle of treatments of a single area of the body such as the abdominal area [69].

Fats (triglycerides) are released in the interstitial space from the fat cells not due to fat cell death but due to the opening of pores in their cell membranes which permit the fat intracellular content to go from inside to outside of the cell; however, IR lipo laser paddles are not able to stimulate lipolysis [69,70]. The cells in the interstitial space and the capillaries remained intact [70], while the destiny of released fats can be of three types: (a) they can be metabolized for energy; (b) they can be taken up in the lymphatic system and enter the bloodstream (without increasing the risk of developing atherosclerosis) or, without periodic treatments, (c) they can be reesterified and thus redistributed into fat depots typical of that person's fat distribution [69,70].

Paddles are applied directly to the skin and allowed to act for a certain time, usually between 20 and 40 min and it is common to carry out repeated treatments twice a week for 4 weeks for a total of 8 treatments [69], although a series of treatments can include up to 10–12 total sessions. The number of sessions depends on the amplitude of the adipose tissue to be treated and on the result to be obtained. Treatments with this time frame lead to cumulative effects in weight loss [69] but in any case, it is recommended not to exceed 15 total sessions and to intersperse the cycles of treatments with appropriate rest periods.

Each pad has a variable number of light-emitting diodes (LEDs), that are low-power light sources that emit in the red-to-NIR optical region. The wavelengths emitted are generally between 635 nm and 650–680 nm and correspond to the red light of the electromagnetic spectrum, however there are also paddles emitting at a wavelength between 760 nm and 1200 nm, i.e. between the red light tail and the NIR band [62]. Some devices can also emit in other wavelength windows, but always between the red light and the NIR band.

Generally, the maximum irradiance is equal to 10 mW/cm^2 and fluency is between $1.2\text{--}3.6 \text{ J/cm}^{-2}$. These parameters allow the PBM to have a stimulating effect on cells and tissues, a result that is not achieved at higher doses [67,69]. Furthermore, these results are obtained thanks to the principle of the hormesis, i.e. they are directly induced or the result of compensatory biological processes following an initial disruption in homeostasis [71]. This phenomenon is based on the Arndt-Schulz biological law which states how a weak stimulus can excite physiologic activity, a moderately strong stimulus can empower it, a strong stimulus can retard it and a very strong stimulus can inhibit physiologic activity [70]. From this, it can be deduced how the use of low-power light, low fluence (J/cm^2) and low irradiance (mW/cm^2), is able to stimulate the body's life processes instead of damaging them or inhibit them [67,71]. However, unlike other similar devices, treatment with IR paddles is not able to improve the metabolism, so in addition to the treatment sessions the subject will have to follow an appropriate diet and change the lifestyle habits, in particular to settle the sedentary lifestyle and follow a physical exercise program aimed at consolidating and maintain the results obtained during the individual sessions.

Side effects have rarely been seen, such as erythema lasting more than 24 h after a single treatment. In addition, skin damage was found with the direct application on the skin of the paddles with the development of ulcerations in the irradiated area, which does not occur if they are kept separate from the skin and placed a few millimeters away from the skin surface [72].

3.3. IR heat lamps

IR quartz heat lamps consist of a tungsten filament in a quartz envelope [73] and they have various shapes from the classic bulb shape to the helical shape and the linear shape. They are widely used for heating the skin of the face and the body, in particular IR lamps in banks are more often used to treat large areas of the body or the whole body. They are also used to increase the absorption of cosmetic products applied to the skin, to improve local blood circulation, to relieve muscle and joint pain and for heating hair and scalp i.e. for permanent wave setting and colouring.

IR lamps are easy to use, requires no gel and may be used through clothing or directly on the skin.

The effect of radiation is as high as the area to be treated is nearer to the lamp. However, the device must be at a distance at which the heat is perceived as comfortable by the user and the time of each treatment with the lamps is generally equal to 20 min and twice a week.

A large proportion of the output of IR quartz heat lamps is emitted as IR [73], but under the term IR lamps fall lamps that produce a wide range of wavelengths, i.e. lamps that have mixed emission in the MIR, NIR and in the tail of the red light, IR lamps with a coloured filter applied that emit in a specific range of wavelengths and the more expensive lamps with FIR emission only, also called FIR emitting heat lamps [6].

Generally, the tungsten filament runs at about 2400 K (about 2127 degrees Celsius) and it produces IR radiation with an output peak at 1200 nm [73] but the emission window is commonly between 660 nm (red light) and 1400 nm (NIR) with virtually no radiation below 600 nm [73]. The lamps can be mounted in closed cabins that take the name of IR saunas.

3.4. IR saunas

The saunas are cabins with heating elements, IR lamps or ceramic IR emitting panels [6], that are able to generate heat and in which people can relax, sit or stand for a certain time, generally between 15 and 45 min. The IR saunas are a heterogeneous category of devices that include NIR saunas, MIR saunas, FIR saunas and also, in general, all IR full-spectrum saunas. What differentiates them is the type of emission source and the presence of appropriate filters. In any case, they show the general biological effects on living tissues of the entire infrared spectrum.

NIR saunas utilize the lowest temperature of all saunas, i.e. between 95°C and 110°C , and use reddish incandescent quartz bulbs with emission between 600 and 1200 nm, i.e. from the red light tail to a portion of NIR band. FIR saunas have heating elements that can be heated up to a temperature of $300\text{--}400^\circ\text{C}$ and are used both for medical treatments and for aesthetic treatments due to the ability of these wavelengths to penetrate deeply into the skin [28], even up to 7 cm [38], and this can help to reduce body weight through the consumption of calories and the loss of sweat.

The heat exchange between the body and the internal environment of the cabin is almost purely radiative [6]. It is known that in 30 min of FIR sauna it is possible to lose from 400 to 600 calories, however this does not change the percentage of fat but has a detoxifying effect and can reduce cellulite [38]. In addition, FIR saunas have shown a positive effect on fatigue reduction and muscle recovery in athletes after training sessions [74].

Similar to these devices are the Waon therapy and the Enseki sandbath. The former differs for the treatment procedure and for the type of emission covering the full bands of IR light [28], while the latter is more like a real sandbath but with FIR rays [75].

FIR saunas compared to traditional saunas have proven to be better devices not only in relaxation but also in the treatment of various physical disorders [28,38,74].

3.5. IR caps

These devices, also called thermo-stimulators, have the shape of a helmet that can be comfortably held overhead over the hair for a suitable and effective time, generally 20 min, twice a week and from 12 to 26 weeks of use, although it is possible to extend a single treatment up to 30 min. They are indicated for the thermo-stimulation of the scalp as adjuvant tools for the treatment of alopecia, receding hairline, balding and thinning hair and to stimulate hair follicles and hair regrowth both for men and for women [55,56].

The helmet consists of LEDs that emit generally in the wavelengths between 630 and 670 nm [56], i.e. in the red tail of visible light, however more effective wavelengths are also used, such as at 785 nm and 830 nm, i.e. in the NIR band [76]. Generally, the fluency is between 1.27 J/cm² and 1.91 J/cm², but some devices use fluency up to 3–4 J/cm². Like the IR lipo laser paddles devices, even in this case the mechanism of action is based on PBM, but the exact molecular effects of IR in hair growth are not known. It is hypothesized that these devices can stimulate the epidermal stem cells in the hair follicle bulge and so cause the shifting of the follicles into anagen phase [55], but other studies are needed to clarify the phenomenon, as well as the requirements for the best efficacy on the different colours of human hair, such as black, brown, blond, red, grey, and white [76].

Similar to these devices are the hand-held devices, like brushes equipped with LEDs or made entirely by LEDs, which are passed in contact with the hair and scalp for a time generally between 8 and 20 min.

All these devices are easy to use, non-invasive, painless and do not produce side effects [56].

4. Discussion and conclusion

Infrared rays are widely used in aesthetic treatments. It has been collected what is known about the main devices currently used for the face and body treatments. IR thermal blanket, IR lipo laser paddle, IR lamps, IR saunas, and IR caps are the main devices that the consumer can find in slimming centres, in beauty centres, in gyms, by the physioesthetic operator or in the centres of aesthetic medicine and physiotherapy that also use non-surgical and non-invasive treatments.

The infrared rays are absorbed by living tissues, however there are conflicting opinions about their depth of penetration into the skin which varies between 2 and 3 cm [77], or between 3 and 4 cm [74] or between 2 and 7 cm [38], or up to 23 cm for NIR rays [78], depending on the study considered. In addition, a part of the studies in the literature indicate that the NIR and MIR rays are more penetrating and are more absorbed by the skin, unlike the FIR rays that seem to be less penetrating [79] according to what reported by Schieke et al., i.e. the depth of IR penetration decreases with increasing of their wavelength [8]. NIR is considered the band with the greatest penetration that can reach up to 10 cm of depth in the tissues [80], or up to 23 cm in accordance with Whelan et al. [78], while other studies support the high penetration of FIR rays, which seem to be able to penetrate living tissues even up to 4 cm deep [6] or more, even up to 7 cm [38].

In any case, regardless of the depth of penetration, the whole body benefits from the treatment with infrared rays, because after a certain time the heat spreads to the inside of the body. The thermal effects of infrared (thermal and photo-thermal effects), related only to heat, affect the whole body and explain the benefits of thermotherapy, while the non-thermal effects related to infrared (photo-chemical effects) have the only action in the directly irradiated areas of the skin including subcutaneous tissues, in relation to their wavelength, and explain the benefits and indications of phototherapy.

The devices that act on the whole body are the IR thermal blanket and the IR sauna and between the two the most powerful seems to be the IR thermal blanket, especially the hot-stone thermal blanket, which combines the benefits of the classic device with those of hot-stones. In

addition, the IR thermal blanket requires less space than the IR sauna and can also be used in the aesthetics cabins because it does not require a dedicated place. In the IR sauna, it is also necessary to take into consideration the distance of the subject from the emission source, depending on the size of the cabin, which does not apply to the IR thermal blanket. The IR sauna, however, turns out to be the optimal device for those who may feel oppressed by being confined inside the IR thermal blanket.

The IR devices that can be used for partial treatments on specific areas of the body or on the face or scalp are IR lipo laser paddles, IR heat lamps, and IR caps.

IR heat lamps are usually used for beauty treatment of the face and to relieve pain from specific areas of the body; on the contrary, IR lipo laser paddles can be used only for localized treatments on the body, in particular for slimming treatments. In the same session, all the three devices mentioned above can be used in combination to treat different areas and problems because they do not interact with each other and they have different purposes.

Unfortunately, the effect of IR in weight loss is widely known to the public and therefore most of the advertising in the world of beauty treatments is done in this regard, neglecting all the other beneficial effects on the body and the psyche. In this specific case, i.e. in a process aimed at weight loss and toning, it is necessary to combine the effect given by the devices that act on the whole body, such as the IR thermal blanket, with devices that act locally on fat deposits, such as IR lipo laser paddles, and associate them with an optimal lifestyle made of correct eating habits and physical activity to promote the harmony of body shapes, reduce stress, bring well-being, achieve and maintain a complete and holistic state of health.

In conclusion, the use of IR is safe and is useful for health, beauty and body contouring and has beneficial effects on the skin. All the devices listed in this review, i.e. IR thermal blankets, IR lipo laser paddles, IR heat lamps, IR saunas and IR caps, can be used both by users who have specific problems, for example for weight loss and toning treatments, both by athletes who want to define better the body or reduce the time of muscle recovery or simply from all for the interesting relaxing effect and improvement of the quality of sleep. However, despite numerous studies in the scientific literature, the precise mechanisms of action of the infrared need more research as well as the molecular targets that are directly or indirectly involved by their thermal effects and their non-thermal effects.

Declaration of Competing Interest

The author is employed in the Prestige company and has received a salary also for the research activities for the preparation of this review.

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