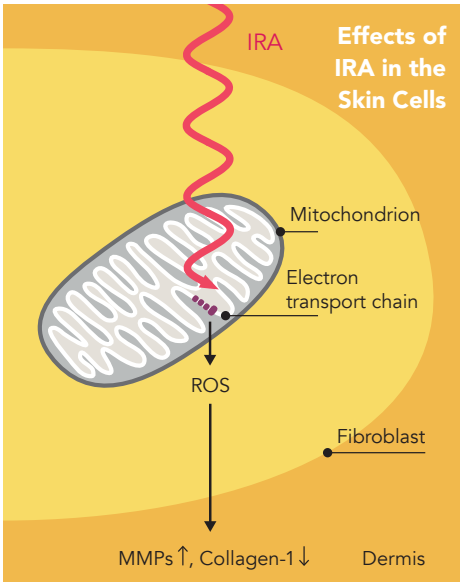
mibelle GROUP biochemistry

Powerful Protection Against IR-induced Photo-ageing

Mibelle Biochemistry presents InfraGuard - to help protect the skin against infrared (IR) radiation

Infrared radiation causes photo-ageing

Recent studies showed that infrared (IR) radiation is involved in photo-ageing of the skin. IR is the long wavelength part of the solar radiation which reaches the earth surface. The solar spectrum is divided into ultraviolet (UV) radiation (290 - 400 nm), visible light (400 - 760 nm) and IR radiation which is subdivided into near IR (760 - 1400 nm) and far IR. Only near infrared, also called IRA, penetrates deep into the skin reaching the subcutis whereas longer wavelength IR is absorbed in the epidermis producing heat. UV radiation which is of higher energy than IR radiation induces photochemical effects such as DNA damage. Further it is known that exposure of skin to UV induces the expression of matrix metalloproteinases (MMPs), enzymes responsible for collagen degradation and consequently skin ageing. In 2008, the Krutmann research group showed that IR radiation also induced an upregulation of the matrix metalloproteinase-1 (MMP-1) in human skin. They found that IR radiation leads to the formation of reactive oxygen species (ROS) in the mitochondria of fibroblast cells. It seems that IR is absorbed by components of the electron transport chain in the inner membrane of the mitochondrion. Thereby ROS are formed which finally leak into the cytoplasm where they induce upregulation of MMP expression. Mitochondria are cellular organelles and represent the powerhouses in our cells. Their respiratory activity based on the electron transport chain generates power in the form of chemical energy. Absorption of IR radiation in the electron transport chain directly affects energy production. Both increased expression of MMP enzymes as well as compromised energy production in mitochondria are responsible for the skin ageing effect of IR radiation.



InfraGuard: its composition

InfraGuard [INCI: Caesalpinia Spinosa Fruit Pod Extract, Propylene Glycol, Helianthus Annuus Sprout Extract, Sodium Benzoate, Phenoxyethanol and Aqua/Water] combines an extract of sunflower shoots with Caesalpinia spinosa tannins. InfraGuard is designed to protect the skin specifically against the harmful effects of IRA: the sunflower shoot extract was found to support overall health of mitochondria and the Caesalpinia spinosa tannins are highly efficient, stable antioxidants. Sunflowers produce an array of secondary plant metabolites mainly for defense against fungal pathogens and insect herbivores. The shoots of a plant are known to be the richest in secondary metabolites. Caesalpinia spinosa is a small tree native to the Andes area in South America. The fruits are 10cm long pods containing 4 - 7 black seeds. The pods are very rich in hydrolysable tannins with gallic acid as a main constituent. The tannins are used in the manufacture of leathers for furniture. Tannins have antimicrobial and astringent effects and are known as very efficient antioxidants.

InfraGuard: its mechanism of action

As outlined in the introduction, absorption of IR radiation compromises mitochondrial efficiency and therefore cellular energy production. The sunflower shoot extract was tested for stimulatory effects on energy production. Reconstructed epidermis tissue models were cultured in a medium with 2% of the sunflower shoot extract. After 4 weeks' culture, the cellular energy level (ATP) in a control medium was reduced compared to freshly reconstructed epidermis. But the epidermis cultured in the sunflower shoot extract medium contained significantly more ATP. This is a strong indication for improving the efficiency of mitochondria and therefore protecting the skin against IRA.

The technique of electron spin resonance (ESR) spectroscopy was used to analyse the antioxidant activity of InfraGuard. The method measures the reducing activity against the stable test radical diphenyl-picryl-hydrazyl. The method allows to analyse both the reduction potential as well as the reaction time, the kinetic component. The result is called 'antioxidative power' (AP). The unit 1 corresponds to the activity of pure vitamin C. InfraGuard was found to be almost as active as vitamin C. But the latter is known to be very unstable once in solution. InfraGuard outperforms other natural antioxidants such as resveratrol or green tea by a factor of ten or more.

Primary human fibroblast cells were used as a cell model to demonstrate that InfraGuard

can block mitochondrial and total cellular ROS production after IR radiation. A fluorescent dye served as a probe to detect ROS. The cells were exposed to IR radiation for 1 hour at 33°C in presence or not (control) of InfraGuard. Then immediately fluorescence was recorded during 60 minutes in a microplate reader. In control cells, IR radiation induced an increase in mitochondrial ROS of 82%. Treatment with InfraGuard not only completely protected the mitochondria against IR radiation exposure but even decreased the ROS concentration far below the level of not exposed cells. Regarding total cellular ROS, an increase of 89% was detected in control cells whereas in treated cells the increase amounted to only 19%. IR radiation-induced formation of mitochondrial ROS was found to cause upregulation of MMP expression. Experiments done with primary human fibroblast cells showed that InfraGuard could completely prevent the formation of MMP-1 after exposure to IR radiation. Dexamethasone was used as positive control.

InfraGuard: clinically proven results

For a clinical trial, 32 volunteers were selected who spent summer holidays in a warm, sunny climate for 2 - 6 weeks. The 26 women and 6 men, 35 - 61 years old, applied twice daily during the entire holiday an SPF30 sun cream with 2% InfraGuard onto the inner side of the forearm. The same cream without InfraGuard (placebo) was applied onto the other forearm. Before and after the holidays, skin firmness, elasticity, TEWL (skin barrier) and density (DermaScan® C) were measured. After the holiday, the skin barrier and density deteriorated on the skin area where only the sun cream was applied. Use of 2% InfraGuard not only protected the skin, but even improved it in all the mentioned parameters. The ultrasound pictures clearly showed a reduction in regions of low dermal density. The results firmly demonstrate the *in vivo* relevance of IR exposure in skin ageing. Particularly creams with UV sunscreens which are used when being exposed to sunlight for longer periods should be combined with an active for protection against IR radiation.

Conclusion

Not only UV but also IR radiation is responsible for skin photoageing. Whereas UV rays can directly damage molecules, the effect of IRA is indirect. IRA penetrates much deeper into the skin, down into the dermis and the subcutaneous adipose tissue where it induces formation of ROS in the mitochondria. The consequences are 1. mitochondrial impairment and 2. synthesis of MMP enzymes which degrade collagen and elastin fibres. InfraGuard targets both consequences: Caesalpinia spinosa tannins as strong, stable antioxidants block formation of ROS and the extract of sunflower sprouts helps to support mitochondrial efficiency.

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Increase of Skin Density with InfraGuard despite Sun Exposure