

The Radical Skin Factor (RSF) distinguishes between cosmetic formulations acting as Radical Protector or Booster

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INTRODUCTION

The RSF (1,2) is an universal factor which characterizes the free radical status in the skin. This free radical status(3) is determined by internal and external oxidative stress(Fig. 1).

Different reasons like inflammations, autoimmune reactions, dysregulation of metabolism or ischemia are responsible for the internal oxidative stress. External oxidative stress can be induced by microbiological organisms, electromagnetic radiation or mechanical, thermal and chemical stress. The detection of free radicals in skin is a unique method for the characterization and evaluation of these different types of oxidative stress.

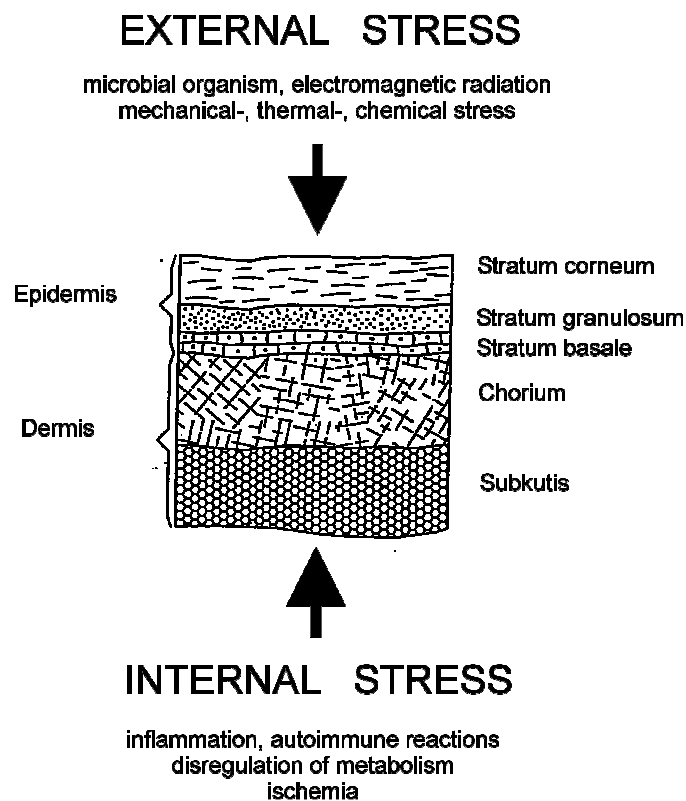


Fig. 1 Different forms of oxidative stress at the skin

Cosmetic products which are applied on the skin have an effect on the radical status of skin. These products can be subdivided in radical protectors or radical boosters (4). Radical protectors prevent the generation of free radicals in skin as external protective layer (first defence line - mainly realized by sunscreens) or eliminate the generated free radicals in skin (second defence line - mainly realized by antioxidants).

As radical boosters(5) substances are labelled which enhance the generation of free radicals (mainly realized by chemical active substances – selftanners, detergents , inorganic catalyzers).

The classification of all these products can be performed by the Radical Skin/Status Factor (RSF).

METHOD: Determination of the RADICAL STATUS of the SKIN using the RSF (RADICAL SKIN STATUS FACTOR) measurement

The assessment of the radical status of the skin is performed by the following procedure:

1. Generation of free radicals ($O_2 \cdot^-$, $\cdot OH$,...) in the skin by the irradiation with UV light especially UVB and UVA.
2. Detection of free Radicals in the skin is performed with the ESR(Electron Spin Resonance)Spectroscopy. The quantification of the short living free radicals(ms-ns) needs an indicator substance namely 2,2,5,5 tetramethylpyrrolidine-N-oxy(PCA) which reacts with the free radicals and enables by their accumulation an exact determination of the radical status of the skin.
3. The principle of the RSF determination consists in the measurement of the PCA signal intensity as a function of external treatment
4. The final calculation of the RSF is performed by analyzing the data of the untreated and treated skin

The treatment of the of skin can be ranged in two parts as radical protector or as radical booster corresponding to its effect on the free radical status. All products which are adapted for the protection against the generation of free radicals are labelled by a $RSF > 1$. Products which have a boosting effect on the generation of free radicals are characterized by a range of $0 > RSF < 1$. The RSF is a quality factor which can evaluate and classify skin care products corresponding to their influence on the free radical status of the skin.

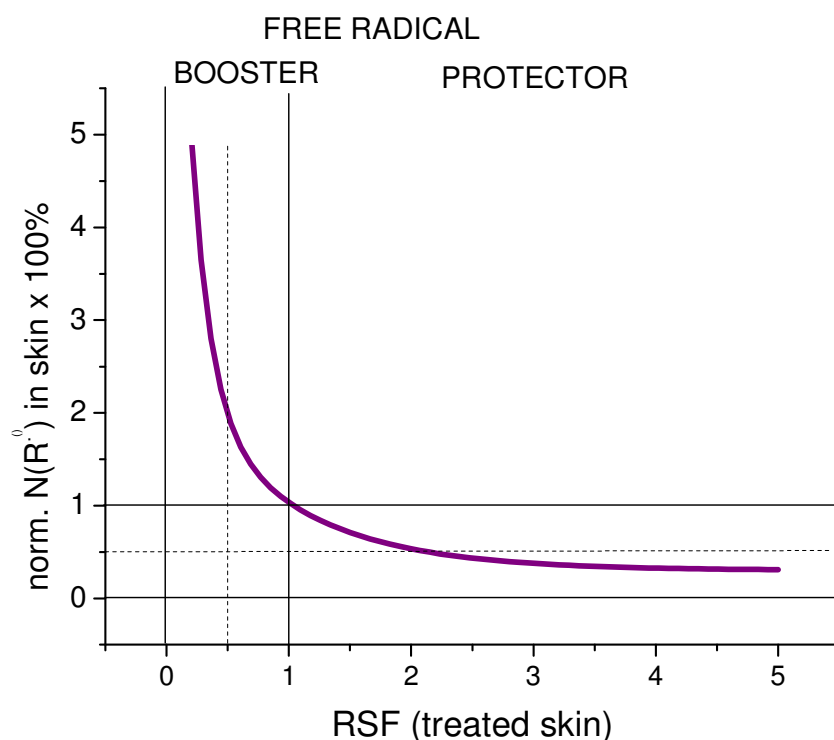


Fig.2 Diagram of the radical status (100% = normal status) as a function of the RSF of the applied treatment (physical, chemical or biological influence)

The determination of the RSF is an ex vivo measurement which is performed on skin biopsies using the Electron Spin Resonance Spectroscopy. Its application is determined by testing active formulations boosting or protecting the radical processes in the skin. Every application of a skin formulation is followed by a renewed determination of the RSF assessing its effect on the skin.

APPLICATION: Dermatological Substances influencing the Free Radical Status of Skin

Different products were tested for their effect as Radical Protector or Radical Booster at the skin. The products for radical protection are designated by their antioxidative Power AP(6), their reaction time t_r and their content in the final formulation. The applied substances were applied for 20 minutes on the skin and resulted in $RSF > 1$ and corresponding radical protection of $R\bullet\downarrow = 33\%$ for Caffeic acid, $R\bullet\downarrow = 29\%$ for Herbalia grape and $R\bullet\downarrow = 47\%$ for Aspalathox Gold (Tab.1).

1. RADICAL PROTECTORS against internal and external caused oxidative stress

Substance in the formulation	AP (AU)	t _r (min)	Conc. in formulation	RSF	R • ↓
caffeic acid	2.000.000	0.16	0.18 %	1.5	33%
Polyphenol 2 Herbalia Grape	300.000	0.9	0.3 %	1.4	29%
Polyphenol 1 Aspalathox Gold	120.000	1.2	0.5 %	1.9	47 %

Tab. 1 Topical application of antiradical Formulations - Antioxidants(Extracts) application time: 20 min.

2. RADICAL BOOSTERS for enhancing the radical stress in the skin

For the demonstration of the effect of substances which work as a booster for the generation of free radicals in the skin different detergents and surfactants were used(Fig. 3).



Fig. 3 Detergents/Surfactants

The measured values of RSF < 1 of skin after 30 minutes treatment time with a formulation containing the highest concentration as possible is represented in Fig. 4. The boosting effect reaches from a radical increase of 20 % for a hair shampoo up to 300 % for the surface active agent sodium dodecyl sulfate (SDS).

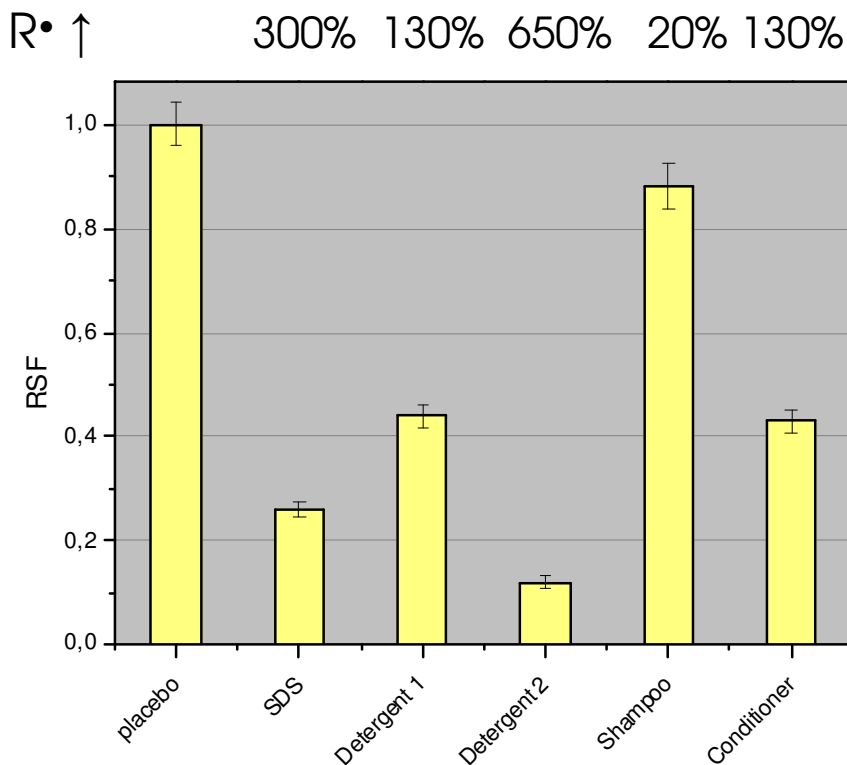


Fig. 4 RSF of skin after 20 min. application of different detergents/surfactants

CONCLUSION

Free radicals/ROS are primary factors in skin damage and premature skin aging.

The free radical status of the skin can be detected by spin probe assisted ESR spectroscopy which enables the quantification of radical processes in the skin. These measurements are the basis for the evaluation of cosmetic and pharmacological skin care products, as antioxidant creams as well as surface active agents with a radical boosting effect like detergents/surfactants or self-tanners up to further external and internal applied substances influencing the radical process in skin.

The RSF as a measurement parameter is an universal standard (7) for the classification of products influencing radical processes in the skin.

The RSF extends from radical protection ($RSF > 1$) up to radical boost ($RSF < 1$).

The RSF as a form of used quantitative ESR becomes to a tool for quality control of dermatological active products !

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