Our Dermatology Online

Brief Report

A cyanobacterium, priorly stressed by chemical way, could represent the occult Tantra for tanning phototypes I and albinoes

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ABSTRACT

Background: Since the recent discover of seven UV-absorbing pigments (UVP), isolated from various marine organisms and identified as a series of mycosporine-like amino acids (MAAs), that are reputed to absorb in wavelengths ranging from 310 to 365 nm, spanning both UV-B and UV-A (320-400nm) portions of the solar spectrum (mycosporine-glycine, shinorine, porphyra-334, palythine, asterina-330, palythinol, usujirene and palythene). We have made up our mind to select one cyanobacterium (Aphanothece sacrum), admitted as cosmetic ingredient, apt to increase its amount of mycosporine-2-glycine, a natural sunscreen factor among the most efficient in nature, when undergoes to chemical stresses. **Material and Methods:** In two group of volunteers was used a gel made up with 2 g of Aphanotece sacrum powder in 1.5% karaya gum aqueous solution was prepared and gel with 2 g of Aphanotece sacrum powder following the above mentioned method in 1.5% karaya gum aqueous dispersion. Was evaluate the capacity of the cyanobacterium to protect skin from UVB rays under long exposure to artificial sun. **Results:** The cosmetic that reveals a SPF equivalent to 56 is able to minimize at all the chances of burning. Phototype I may be protected exclusively by inorganic powerds (titanium dioxide,barium sulphate,kaolin etc.), and thanks to the application of gel two it is possible to have a minimal tanning. **Conclusion:** We have tried to treat chemically the cyanobacterium (easily available on the market, as in Japan it is considered a common foodstuff) and let it be an exceptional sunscreen, able to protect even phototype I and albinoes.

Key words: Cyanobacterium; Aphanothece sacrum; Karaya gum; Phototype

INTRODUCTION

Since UV-radiation is readily absorbed by some important biomolecules such as DNA, protein and lipids and there has been extensive documentation of adverse effects of UV-B on marine algae, which include increase in mortality, reduction in growth and photosynthetic rates, inhibition of carbon and nitrogen assimilation, destruction of photosynthetic pigments and retardation of reproductive cell motility and so on, it is useful to focus our attention indeed to manifold adaptive ways by which UV-induced damage is mitigated. One of the mechanisms is the presence of UV-absorbing pigments (UVP). Compounds of these types have now been isolated from various marine organisms and identified as a series of mycosporine-like amino acids (MAAs). The MAAs are composed of a cyclohexenone ring attached with an amino acid side group. These compounds absorb in wavelengths ranging from 310 to 365 nm, spanning both UV-B and UV-A (320-400nm) portions of the solar spectrum, but transmit photosynthetically active radiation (PAR; 400-700nm), Seven MAAs have so far been isolated from marine macroalgae and identified as mycosporine-glycine, shinorine, porphyra-334, palythine, asterina-330, palythinol, usujirene and

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palythene. The role of MAAs as UV protectants is inferred from observations that their concentrations are correlated with the environmental UV fluences organisms can experience [1].

For instance a halotolerant cyanobacterium Aphanothece sacrum thrives in extreme salinity with accumulation of a potent osmoprotectant glycine betaine. Recently, this cyanobacterium was shown to accumulate sunscreen molecule mycosporine-2-glycine significantly at high salinity [2].

These A.A. and other researchers [3-5] investigated upon the effects of increase of nitrate and salinity in *Aphanothece sacrum* on the accumulation of glycine betaine and mycosporine-2-glycine. With elevated nitrate concentrations at high salinity, intracellular levels of both metabolites were enhanced. Six-fold high nitrate concentration increased the relative amounts of glycine betaine and mycosporine-2-glycine to be 1.5 and 2.0 folds compared with control condition.

Now, Aphanothece sacrum powder is available on the global market from Japan,it is not expensive since it is commonly employed as foodstuff and is admitted in INCI and is commonly used in Japan in cosmetics as: Absorbent; Emulsion stabilising; Film forming; Viscosity controlling. Albeit some suppliers disclaim its peculiar capabilities like: Moisturizing effect (10-fold higher mosisture retention capacity campared to hyaluronic acid); Function as a barrier to protect skin from external stimulus; Anti-inflammatory effect.

But nobody has hitherto studied the implications of its capacity to absorb the perilous UB rays so that it could be inserted in cosmetic items as well.

Aphanothece sacrum powder is available on the global market from Japan,it is not expensive since it is commonly employed as foodstuff.

Following the suggestions of the above mentioned A.A., Aphanothece sacrum powder was grown photoautotropically (70 μE m^{-2} sec^{-1}) in blue–green liquid (BG,that is a 0.13% bezalkonium chlride aqueous solution) containing 18 mM $NaNO_3$ and Turk Island salt solution, at 30°C for 14 days prior to the stress treatment. For high-nitrate-salt experiment, sodium nitrate concentration was increased from 18 mM (1X) to 54 mM (3X) and 108 mM (6X), respectively, and the concentration of NaCl in growth medium was changed from 0.5 to 2.0 M.

We have not detected the arousal of levels of glycine-betaine and mycosporine-2-glycine, since the paper was exhaustive and A.A. asserted that in this condition, glycine-betaine (GB) content was increased from ~7.5 to 29.5 μmol/g and then, under 6X nitrate condition, GB content was ~1.5 times higher than control condition after 15 days treatment.

The procedure was not complicated and not expensive at all.

MATERIALS AND METHODS

A gel made up with 2 g of Aphanotece sacrum powder (grown photoautotropically in blue–green liquid containing 18 mM $NaNO_3$ and Turk Island saltsolution, at 30°C for 14 days) in 1.5% karaya gum aqueous solution was prepared for the first series of experiments on 6 volunteers, and another gel made up with 2 g of Aphanotece sacrum powder following the above mentioned method in 1.5% karaya gum aqueous dispersion was used for the second series of experiments in order to evaluate the capacity of the cyanobacterium to protect skin from UVB rays under long exposure to artificial sun (owing to a normal sun lamp).

Every series of volunteers guarantees the real scrutinizing of the 6 kinds of phototypes, as in Table 1:

Here follows Table 2 where the Sun Protection factor advisable for each phototype is recorded:

We have selected 12 volunteers (A,B,C,D,E,F,G,H,I,L,M,N)

A and G belonging to phototype I
B and H belonging to phototype II
C and I belonging to photype III
D and L belonging to phototype IV
E and M belonging to phototype V
F and N belonging to phototype VI.
The first series of experiments comprised volunteers A,B,C,D,E,F
The second series of experiments comprised volunteers G,H,I,L,M,N.

The first series underwent to the application of the first gel (idest 2 g of Aphanotece sacrum powder (grown photoautotropically in blue–green liquid containing 18 mM $NaNO_3$ and Turk Island saltsolution, at 30°C for 14 days) in 1.5% karaya gum aqueous solution.

The second series underwent to the application of the second gel (idest 2 g of Aphanotece sacrum powder following the above mentioned method in 1.5% karaya gum aqueous solution).

The calculation of the SPF is obtained resolving the following equation:

$$SPF = \frac{\text{Minimal erythemal dose in sunscreen protected skin (MEDp)}}{\text{Minimal erythemal dose in unprotected skin (MEDu)}}$$

After two single experiments on C and I (corresponding to phototype III: Burns moderately: tans gradually) we have determined the SPF for gel number One, that is 18.

After two single experiments on B and H (corresponding to phototype II. Always burns easily: tans minimally) we have stated that the SPF of gel number Two is 56.

The experiments were carried for seven days (5,10,15,20,25,30 and 35 min of exposure every day) once a day onto the six volunteers of the first series and onto the six volunteers of the second series, by the aids of a normal sun lamp, after application of the gels (number one for the first series and number two for the second series).

RESULTS

In Table 3 it is possible to behold the results obtained after seven days of applications of the two gels and exposure to gradual exposure to the sun lamp.

Table III: Observations after one week of experimentations onto the 12 volunteers.

DISCUSSIONS

It is easy to comprehend that a cosmetic that reveals a SPF equivalent to 56 is able to minimize at all the chances of burning.

It is welknown, indeed, that phototype I may be protected exclusively by inorganic powerds (titanium dioxide,barium sulphate,kaolin etc.), even though thanks to the application of gel two it is possible to have a minimal tanning.

Table 1: The series of phototypes in Man

Phototype I	Always burn easily: never tans
Phototype II	Always burns easily: tans minimally
Phototype III	Burns moderately: tans gradually
Phototype IV	Burns minimally: always tans well
Phototype V	Rarely burns: tans profusely
Phototype VI	Never burns, deeply pigmented

Table 2: Fitzpatrick's Classification of Skin Phototypes

Phototype	Recommended SPF
I	>40
II	20-40
III	7-20
IV	6-15
V	5-10
VI	4

Table 3: Observations after one week of experimentations onto the 12 volunteers

Volunteer (gel n.One)	Observations after one week	Volunteer (gel n.Two)	Observations after one week
A	Burns hard: no tans	G	Burns minimally, tans moderately
B	Burns hard: tans minimally	H	No burns, tans moderately
C	Burns moderately: tans minimally	I	No burns, tans profusely
D	Burns minimally: tans well	L	No burns, tans well
E	No burns: tans well	M	No burns, tans well
F	No burns, already pigmented	N	No burns

This is the most suggestive impression we can argue, after these trials:

There is no way to protect phototype I, using natural or chemical sunscreens.

CONCLUSIONS

Pre-treated Aphanotece sacrum (2%) is sufficient to avoid burns in phototype I and guarantees always a long lasting tanning for almost all the phototypes.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from all patients for being included in the study.

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