Original Article

Prospective of *Monascus* Pigments as an Additive to Commercial Sunscreens

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Abstract

Red and yellow pigments from *Monascus purpureus* (NMCC-PF01) were evaluated to enhance sun protection factor (SPF) of commercial sunscreens and *Aloe vera* extract. The extracted *Monascus* pigments contain rubropunctamine (red pigment) and the mixture of monascin and ankaflavin (yellow pigment) as major components. Antioxidant activity and *in-vitro* safety of the pigments were assessed by ferric reduction potential and DPPH radical scavenging assays, human keratinocytes (HaCaT), and erythrocytes (RBCs) cytotoxicity assay, respectively. In results, SPF of commercial sunscreens showed an increase of 36.5% with red pigment compared to the 13% increase by yellow pigment. The *in-vitro* studies showed 67.6% ferric reducing potential and 27% DPPH radical scavenging activity, neither cytotoxic effect against human keratinocytes nor haemolytic activity. These results confirmed the safe nature of the *Monascus* pigments; however, *in-vivo* studies merit further research. In conclusion, screened pigments from *Monascus purpureus* may act as potential candidates to increase SPF of commercial sunscreen naturally.

Keywords

SPF, commercial sunscreens, *Monascus* pigments, antioxidant, *Aloe vera* extract

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Ultraviolet (UV) radiation can damage the skin by multiple modes like mutations in cell DNA, the formation of reactive oxygen species, changes in histochemistry of cell, increased expression levels of the p53 gene, and/or influencing the immune system.[1] Increased consciousness about skin exposure to ultraviolet radiation has tempted the use of commercial sunscreen products. The commercial sunscreen is generally composed of organic, inorganic UV absorbers like aminobenzoates, cinnamates, avobenzone, oxybenzone, and oxides of zinc, titanium, iron. However, increasing side effects of some sunscreen components has made it indispensable to search for natural photoprotectants.[2] The most commonly utilizing sunscreen ingredients such as oxybenzone linked to sun exposure triggered allergic reactions, generating free radicals, which may be associated with cell damages.[3,4] While the nanoscale TiO_2 and ZnO are responsible for the generation of a substantial amount of reactive oxygen species, which upon UV illumination causes modifications in nucleic acid bases and eventually cell death.[5,6] Consequently, it is the need of an hour to look for other options to replace harmful components of sunscreens.

Nature is an abundant source of metabolites, considering the fact that UV damage is not only limited to humans but also to microbes. In continuation of our research on natural UV protectants,[7] we targeted pigments from *Monascus purpureus,* which are well known for their multifaceted use in food coloration and range of other bioactivities. The selection of these pigments was rationalized on their variable bioactivity after linking with different amino acids.[8] This amino acid-based derivatization of *Monascus* pigments may change their absorption maxima in the UV region. Here we sought to study the ability of food-grade pigments from *Monascus purpureus* (NMCC-PF01) (i) to increase the SPF of commercially available sunscreens, (ii) evaluation of their antioxidant potential, and (iii) cytotoxicity testing on human keratinocytes and erythrocytes cells.

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