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Curcumin provides skin Protection against UV radiation

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Abstract

The aim of this study is to evaluate the UV-protective activity of nano-curcumin in a rat skin model and compare its results with a commercial sunscreen agent, phenylbenzimidazole-5-sulfonic acid (PBSA). Nano-curcumin were prepared and characterized by measuring their size distribution. The photoprotective potential was evaluated by histopathological examination of the skin. Results showed that skin group irradiated with UV showed a significant histopathological change, it showed skin thickening and necrosis of dermal collagen. On the other hand, treatment with nano-curcumin protected skin tissues against UV damage by restoring histopathology changes. The results revealed that nano-curcumin provide a significant protection to the skin tissues in comparison with conventional treatment by PBSA.

Keywords: Nano-curcumin; histopathological; Skin

1. Introduction

Ultraviolet (UV) radiation is part of radiation emitted by sun. UV is absorbed generally by skin epidermal cells. The prolonged UV exposure has a skin problem, like burns, crinkles, swelling, dermatitis, and aging. Subsequently, UV exposure can enhance skin cancers [1-4]. Skin is the greatest organ of human body. It acts as a barrier against the UV effect. Therefore, protecting skin from the harmful effects of UV is important. Sunscreens are common choices for UV protection. Sunscreens act by blocking UV via organic or inorganic molecules which absorb UV photons [5-7]. Consequently, they decrease the quantities of skin radiations absorption. However, there are some sunscreen formulations that have side effects.

Curcumin is a polyphenol compound. It has an antioxidant property. So, it has a pharmacological effect, as anti-inflammatory, antioxidant, anti-angiogenic, and anticancer [8-10]. But it is poor soluble in aqueous solution and hence has bad bioavailability.

Nanotechnology could serve drug loading and development especially natural extracts [11-13]. Nanomedicines can enhance their cellular uptake [14].

This study aspires to improve curcumin solubility and bioavailability by preparing nano-curcumin form and find its UV protection effect through study of histopathological changes.

2. Experimental

Curcumin, Lauric acid, sorbitan laurate, polysorbate 80, 2-phenyl benzimidazole 5-salfonic acid(pbsa) and isopropyl myristate were obtained from Sigma-Aldrich (Germany). Phosphate buffer (PBS) from MP Biomedicals, LLC (USA).

Formulation and Characterization of nano-curcumin.

Tween 80 (1.55 ml), isopropyl myristate (0.5 ml), Span 20 (75 µl) and lauric acid (50 mg) were mixed until receiving a transparent mixture, then curcumin (62.5 mg) was mixed into the solution by the magnetic stirrer, then 4.13 ml distilled water were added dropwise [15,16]. Nano-curcumin left for 24 h for equilibrium. The size of nano-curcumin was measured.

Ex-vivo skin UV irradiation study.

The experiment was carried out using fresh skin of adult rats. Skin hairs have been removed with forceps. Skin was cut into parts of about 3 × 3 cm and divided into 4 groups each group has 4 pieces [17].

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Groups	Treatment
Gp 1	Control (exposed for 4 hr in air, treated with 1 ml of pbs.
Gp2	Exposed for 4 hr to UV (UV lamps, 365 nm wavelength, 6 W), treated with 1 ml of pbs.
Gp 3	Treated with 1 ml of PBSA, exposed for 4 hr to UV (UV lamps, 365 nm wavelength, 6 W).
Gp 4	Treated with 1 ml of nano-curcumin, exposed for 4 hr to UV (UV lamps, 365 nm wavelength, 6 W).

Histopathological study.

After the end of the experiment, skin tissues of the groups were placed in 10% neutral formalin. Later, tissues were inserted in paraffin and divided by microtone then stained with hematoxylin and eosin (H&E) [18,19]. Tissues were observed by a light microscope (BX50, Olympus microscope, Tokyo, Japan).

3. Results and Discussion

Long exposure to UV is harmful to our skin. Recently, natural extracts approved as a sunscreen, as they have low toxicity for skin [20,21].

In this work, nano-curcumin was made and characterized by dynamic light scattering. As displayed in figure 1, the diameter of nano-curcumin is around 1000 nm with broad distribution.

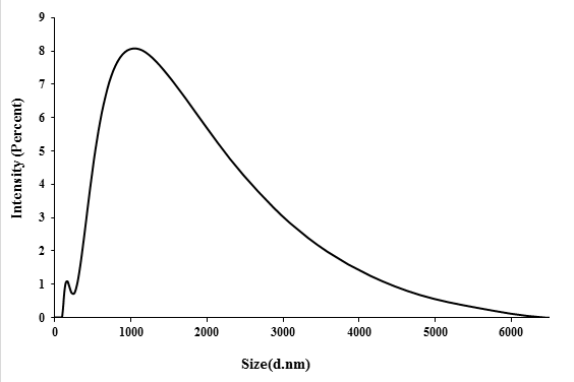

Fig. 1. Size distribution of nano-curcumin measured by dynamic light scattering.

The photoprotective effect of nano-curcumin was evaluated by histopathological study of skin.

Figure 2 shows the histopathological examinations of skin tissues, it shows normal dermal and epidermal layers in control samples (Fig.2 a). On the other hand, skin sample tissues exposed to UV for 4 hr (Gp. 2) show focal hyperplasia with hypertrophy of the epidermal cells (black arrow) and necrosis of the dermal collagen (blue arrow) (Fig.2 b). However, treatment of the skin by PBSA during exposure to UV shows thickening of stratum corneum (black arrow), and hypertrophy of epidermal cell layer (blue arrow) (Fig.2 c).

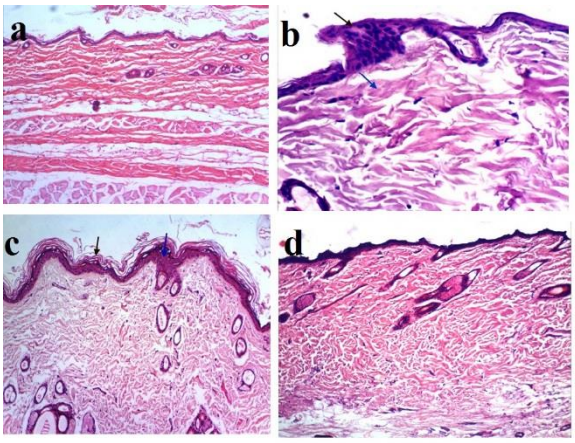

Fig. 2. Histopathological examination of H&E stained skin tissue sections (a) control (control (exposed to air for 4 hr, treated with 1 ml of pbs.), (b) Gp2 (exposed for 4 hr to UV (UV lamps, 365 nm wavelength, 6 W), treated with 1 ml of pbs.), (c) Gp3 (Treated with 1 ml of PBSA, exposed for 4 hr to UV (UV lamps, 365 nm wavelength, 6 W), (d) Gp4 (Treated with 1 ml of nano-curcumin, exposed for 4 hr to UV (UV lamps, 365 nm wavelength, 6 W), with a magnification ×100.

Figure 2d shows no histopathological changes when the skin was treated with nano-curcumin. These results prove that nano-curcumin can protect skin from UV over exposure by scavenging free radical [22]. It can be used as a safe alternative to PBSA, as the PBSA may break into small molecules due to excessive exposure to UV and cause damage to the DNA inside the cell [7].

4. Conclusions

From the current study, it can be concluded that nano-curcumin can be effective for photoprotection and can be used as an alternative of the chemical sunscreen agent (PBSA) in a way decreasing the side effects.

5. Conflicts of interest

"There are no conflicts to declare".

6. Acknowledgments

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