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Protective effect of corncob extract cream on guinea pig (*Cavia porcellus* sp) skin pigmentation exposed to ultraviolet B (UVB) rays

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ABSTRACT

Ultraviolet B (UVB) rays exposure causes skin inflammation and pigmentation lead to decrease skin lightness. Corncobs (*Zea mays*) contain flavonoids which can act as antioxidant to prevent free radicals and protect the skin pigmentation. This study aimed to evaluate the protective effect of corncob extract cream on skin pigmentation exposed to UVB rays. This pre-posttest control group study was applied to 25 guinea pigs (*Cavia porcellus* sp) randomly divided into five groups. Corncob extract cream was given every day 20 min before and 4 h after UVB exposure. The UVB exposure total dose was 780 mJ/cm^2. Mexameter examination was carried out on the 1st day and 28th day after treatment. There were significantly differences in the lightness level and the mean melanin index (MI) difference of guinea pigs before and after intervention on various groups ($p<0.05$). No significantly different of the MI between pre- and post-treatment was observed on normal control group (0.22) and negative control group (-1.06) ($p>0.05$). However, significantly different of the MI was observed on positive control group (-4.01), corncob 40% group (-2.72), and corncob 30% group (-2.03) ($p<0.05$). In conclusion, corncob extract cream can inhibit the skin pigmentation due UVB rays exposure.

ABSTRAK

Paparan sinar ultraviolet B (UVB) menyebabkan inflamasi dan pigmentasi kulit sehingga kecerahan kulit berkurang. Tongkol jagung (*Zea mays*) mengandung flavonoid yang dapat berperan sebagai antioksidan untuk mencegah radikal bebas dan melindungi pigmentasi kulit. Penelitian ini bertujuan untuk mengkaji efek protektif krim ekstrak tongkol jagung terhadap pigmentasi kulit akibat paparan sinar UVB. Penelitian dengan rancangan kelompok kontrol *pre-posttest* ini dilakukan pada 25 ekor marmut (*Cavia porcellus* sp) yang dibagi secara acak menjadi 5 kelompok. Krim ekstrak tongkol jagung diberikan setiap hari 20 menit sebelum dan 4 jam setelah paparan sinar UVB. Dosis total paparan UVB adalah 780 mJ/cm2. Pemeriksaan dengan mexameter dilakukan pada hari ke-1 dan hari ke-28 setelah perlakuan. Terdapat perbedaan bermakna tingkat kecerahan dan perbedaan rerata indeks melanin (MI) marmut antar kelompok sebelum dan sesudah intervensi ($p<0,05$). Tidak ada perbedaan signifikan MI antara sebelum dan sesudah pengobatan pada kelompok kontrol normal (0,22) dan kelompok kontrol negatif (-1,06) ($p>0,05$). Namun terdapat perbedaan signifikan MI pada kelompok kontrol positif (-4,01), kelompok tongkol jagung 40% (-2,72), dan kelompok tongkol jagung 30% (-2,03) ($p<0,05$). Simpulan, krim ekstrak tongkol jagung dapat menghambat pigmentasi kulit akibat paparan sinar UVB.

Keywords:
skin lightness;
corn cobs;
UVB rays;
melanin index;
in vivo

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INTRODUCTION

Most Asian women emphasize skin brightness because they believe bright skin is light.[1] Melanin, the pigment responsible for skin lightness, protects skin and hair cells from ultraviolet (UV) exposure.[2] Lightening products are commonly used to obtain lighter skin. Hence, the widely circulating skin-lightening creams or drugs in markets.[1] Throughout 2018, the National Agency of Drug and Food Control (NADFC) of Republic of Indonesia found 230 cosmetic products containing mercury.[3] Mercury is highly toxic to organs. In low doses, it causes allergy, irritation, and black spots, while in high doses, it could damage the renal, neurons, and brain.[4] Hydroquinone is a skin-lightening agent that inhibits melanogenesis. However, it potentially causes significantly ochronosis in long-term use in the dosage exceeds 2%.[5]

Corn (*Zea mays*) is widely cultivated in Indonesia. The fruit of this plant has a part called a corncob, which keeps the nutrition for corn seed growth. It is estimated at around 40-50% of total corn weight. To date, corncob waste is rarely used.[6] However, previous studies have reported that corncob extract possesses phytochemicals and a phenolic compound having potency as a singlet oxygen quencher and active sunscreen compound.[7,8]

Additionally, phenol and flavonoid were discovered to possess antioxidant activity.[9] A previous study about the antioxidant activity of corncob revealed that corncob extract with a concentration of 40% has a phenolic concentration of 81.53 mg/kg. Therefore, it has a free radical blocking activity.[10] As an antioxidant, flavonoids can neutralize free radicals (reactive oxygen species/ROS), which give electrons or hydrogen, causing a stable non-radical molecule.[10]

Guo *et al*.[9] reported that corncob and corn hair extracts comprise quercetin compounds that could ward free radicals off. One of the free radical sources is UV rays which causes skin changes such as pigmentation. The corn cob can be developed as a melanin pigment production inhibitor due to its antioxidant activity in cream and ability to increase the lightening skin effect. This study aimed to investigate the effect of 30% corncob extract and 40% on skin lightening of guinea pigs exposed to UVB.

METHODS

Animal and experimental design

This was an experimental pretest-posttest control group study employed the guinea pigs were distributed into five groups using a simple random sampling technique. The number of guinea pigs (*Cavia porcellus* sp.) was 5 in each group based on the Federer sample size formula. A total of 25 guinea pigs were used in the study. All the guinea pigs were given 7 days for adaptation, including feeding and standard treatment before being enrolled in the experiment. The guinea pigs were divided into five groups namely the control normal group (G1) or the group without treatment, the negative control group (G2) or group was given basic cream, the positive control group (G3) was given hydroquinone cream, G4 group, the one who was given 30% corncob extract cream, and the G5 group, the one who was given 40% corncob extract cream.

Examination of the skin lightness

The cream was administered each day for 20 min before UVB exposure and 4 h after UVB exposure. To all groups, after hair removal, the dorsal skin of the guinea pigs was exposed to UVB radiation, with total UVB exposure was 780 mJ/cm^2 for 28 d.[11]

Lightness was measured by sticking the Mexameter probe to the guinea

pig's shaved skins until the melanin index (MI) was displayed on day one before the application of the cream (pre-treatment) and day 28 after the application (post-treatment). This probe ejects radiation that will be reflected by skin tissue and received by the probe's receptor. Radiation caught was interpreted as a MI (0-999 scale). This study was approved by the Medical Bioethics Research Committee, Faculty of Medicine, Universitas Islam Sultan Agung, Semarang (ref no: 383/XI/2020/ Komisi Bioetik on November 30th, 2020).

Statistical analysis

Data were presented as MI and analyzed using SPSS version 20. Normal distribution and homogenous data were analyzed using Shapiro Wilk test and Lavene's test. Normally distributed data were then analyzed using one-way Anova, continued by pair t test to evaluate the difference between pre- (1st day) and post-treatment (28th day) in each group.

RESULT

The MI on pre- (1st day) and post-treatment (28th day) is presented in TABLE 1. The lowest MI were observed on negative control (G2) both on pre- (222.39±19.18) and post-treatment (221.33±8.40). The highest MI were observed on positive control (G3) both on pre- (589.65±63.92) and post-treatment (585.64±64.21). Furthermore, no significantly different of the MI between pre- and post-treatment was observed on normal control group (0.22) and negative control group (-1.06) ($p>0.05$). Whereas, significantly different of the MI between pre- and post-treatment was observed on positive control group (-4.01), Corncob 40% group (-2.72), and Corncob 30% group (-2.03) ($p<0.05$).

The highest MI reduction after post-treatment compared to pre-treatment was observed on positive control group (-4.01), followed by Corncob 40% group (-2.72), and Corncob 30% group (-2.03) (FIGURE 1).

TABLE 1. Melanin index on 1st d and 28th day in each group

Group	MI on 1st day	MI on 28th day	Mean difference
Normal control (G1)	239.28±8.66	239.50±8.40	0.22
Negative control (G2)	222.39±19.18	221.33±8.40	-1.06
Positive control (G3)	589.65±63.92	585.64±64.21	-4.01*
Corncob 30% (G4)	345.48±72.75	343.48±73.58	-2.03*
Corncob 40% (G5)	461.11±63.25	458.39±61.13	-2.72*

*significantly different (paired t test $p<0.05$)

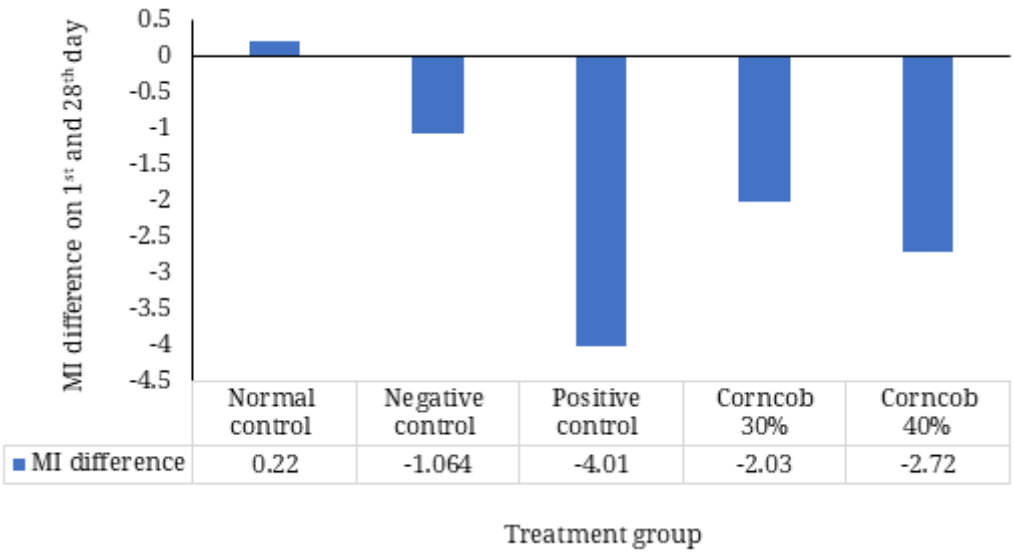

FIGURE 2. Melanin index mean difference between 1st and 28th d in all groups

DISCUSSION

UVB-induced ROS can induce cytokine secretion, stimulating melanocytes to produce excess melanin pigment which be transported to keratinocytes in all epidermal skin layers and cause black skin color or skin pigmentation.[12,13] Photoprotection and sunscreens protective against both UV and visible light are recommended by medical doctor. A lot of preparations originally from conventional drugs, herbal medicine, and cosmetic products are available in the market to protect the skin pigmentation. Skin melanin index is often used to evaluate the effectiveness of the photoprotection of a preparation.

The mean MI after post-treatment compared to pre-treatment on positive control group (-4.01), corncob 40% group (-2.72), and corncob 30% group (-2.03) significantly reduced ($p<0.05$). Although the MI difference after administration of the corncob 40% and 30% creams were lower than that after administration of hydroquinone creams (positive control), however they were higher than that after administration of the basic cream (negative control). It was indicated that the administration of the corncob creams can inhibit melanin pigment production due to UV light exposure.

Hydroquinone is the most frequently used photoprotection or skin lightening. Hydroquinone is a strong tyrosinase inhibitor, currently known as the gold standard for hyperpigmentation therapy.[14,15] Hydroquinone, a depigmenting compound, prevents dihydroxyphenylalanine conversion into melanin by inhibiting the tyrosinase enzyme as a competitive inhibitor.[15,16] The IC_{50} values for hydroquinone in the mushroom tyrosinase inhibition cover a wide range from 1.113 to 680 μmol/L.[14] The lowest IC_{50} value indicates a very strong potential as a tyrosinase inhibitor compared to the anti-tyrosinase potential of other compounds. However, the long use of hydroquinone with dosage over 2% may cause side effects such as irritation, rebound phenomenon, and ochronosis.[5]

Corncob (*Zea mays*) acts as food storage, supplying corn seed growth as long as it is attached to the cob and has active substances that can potentially be used as active antioxidant compounds.[17,18] It contains active phenolic substances in the form of flavonoid. Flavonoid is used as a potential phytochemical antioxidant that can fend off free radicals.[10] Flavonoid has a good affinity with tyrosinase enzymes and prevents dopachrome and melanin formation lead to inhibit skin pigmentation.[19] Quercetin in corncob extract and corn hair can deflect free radicals. One of the free radical sources is UV light which can cause changes in the skin, including pigmentation.[9]

Some herbal preparations have been studied to evaluate their skin ligthness activity. Trifena *et al.*[20] reported *in vitro* antioxidant activity and *in vivo* skin lightness effectiviy on the momen volunteers of a cream containing combination of mangosteen peel extract (*Garcia mangostana* L.) and gotu kola herbs extract (*Centella asiatica* L.). Furthermore, Sesamol, an active component in sesame seeds, has been reported as a potent depigmenting agent in the animal model. Sesamol was proven reduce UVB-induced tyrosinase, TRP-1, TRP-2, and MITF expression in the epidermis of the skin.[21]

Some limitations were identified in this study. The guinea pigs used have a variety of skin colors which could affect preliminary study results. Furthermore, only two dosage variations of corncob extract were used in this study. These dosages are lower than the commonly used dose in a lightening cream. Therefore, further study with higher dosage is needed in order to find a dose that equivalent with hydroquinone. Quercetin levels as chemical marker in corncob extract was not also determined in this study.

CONCLUSION

In conclusion, corncob (*Z. mays*) extract cream can inhibit the skin pigmentation of guinea pig exposed to UVB rays. Although, its activity at 40% extract dose is lower than hydroquinone, however it is higher than the basic cream. A further study with higher extract dose is needed to obtain effect dose that similar with hydroquinone. Specific standardization of the extract using chemical marker is also needed.

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