Whitening and Moisturizing Effects of Hydrolyzed Swiftlet Nest Extracts

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Abstract

Purpose: This research verified the skin whitening and moisturizing effects of hydrolyzed swiftlet nest extracts (HSNE) in vitro using human keratinocytes and melanoma. **Methods:** To confirm the antioxidant effect of HSNE, DPPH radical-scavenging activity was measured. To find out the whitening effect of HSNE, the genes related to melanogenesis, mRNA expression of tyrosinase (*TYR*), tyrosinase related protein (*TRP*) 1, 2 and microphthalmia associated transcription factor (*MITF*) were measured. We also measured the melanin contents after treatment of HSNE to confirm the anti-melanogenesis effect. Using reverse transcription polymerase chain reaction (RT-PCR), the genes related to moisturizing such as aquaporin (*AQP*) 3, hyaluronan synthase (*HAS*) 1, 2, and 3 were determined. The results of the tests were analyzed with student's t-test and expressed as mean±standard deviation. **Results:** DPPH radical scavenging effects of HSNE increased in a concentration dependent manner. The expression of melanogenesis-related genes were inhibited by the treatment of HSNE in a concentration-dependent manner (*MITF*, *TYR*, *TRP1*, and 2). Melanin contents also decreased with the treatment of HSNE. The expression of moisturizing-related genes (*HAS1*, 2, 3, and *AQP3*) increased in a concentration-dependent manner. **Conclusion:** It is confirmed that the hydrolyzed swiftlet nest extracts have skin whitening and moisturizing effects and can be used as a functional cosmetic raw material.

Keywords: Hydrolyzed swiftlet nest extracts, Moisturizing, Whitening, Anti-oxidant, Cosmetic raw material

Introduction

Swiftlet nest (Edible bird's nest) is made of the salivary secretion of specific swiftlets such as *Aerodramus fuciphagus* and *Aerodramus maximus* and most of edible bird's nest for consumption is harvested in the Southeast Asian region (Marcone, 2005). It has been used as a noble ingredient of an ancient Chinese delicacy. In particular, swiftlet nest soup has been consumed for a long time in Asia. Today, swiftlet nest is still a popular luxurious food supplement for women in the oriental area (Chan *et al.*, 2013).

In the personal care industry, swiftlet nest extracts are used as

an active raw material with International Nomenclature Cosmetic Ingredient (INCI) name of SWIFTLET NEST EXTRACTS.

The skin is an organ that surrounds the human body and protects the internal organs. Its functions are protection, regulation of body temperature, immune response, secretion, and regeneration. Among these functions, protection of the body from external stress and/or irritation, maintaining moisture, and supplying nutrients are most important (Kim & Lee, 2008). In most organisms, the skin barrier, which is very close to skin protection, is located outside the body, implying that the stratum corneum exerts protective effects for the body by acting as a wall that inhibits water and nutrient loss and is a defense against

bacteria, toxic materials, and/or UV radiation. Keratinocytes which are direct contact with environmental irritants, are under continuous stress from air pollutants and UV. Due to these irritants, cellular reactive oxygen species increase leading to a reduction in the moisturizing function of the skin, pigmentation, inflammation, and aging (Cross *et al.*, 1987; Kim *et al.*, 2012).

Melanocytes produce melanin pigment to protect skin cells from UV irradiation (Nordlund, 2007). However, UV irradiation induces inflammatory response, hormones, and stimulates melanocytes. Due to the overproduction of melanin, skin disorders such as freckles, solar lentigo, melasma, etc. (Nomakhosi & Heidi, 2018; Pandya & Guevara, 2000; Seo *et al.*, 2018). The overproduction of melanin causes skin disorders, albeit Asians in particular like to maintain a light skin color due to white skin regarded as wealth and beauty (Hu *et al.*, 2020). Therefore, anti-melanogenesis-related research has been increasing. The inhibition effects of melanogenesis-related genes such as microphthalmia-associated transcription factor (*MITF*), tyrosinase (*TYR*), tyrosinase related protein (*TRP*) 1, and *TRP2* are widely used to verify the anti-melanogenesis effect of active compounds (Cha, 2018; Levy *et al.*, 2006; Slominski *et al.*, 2004).

Keratinocytes are the most abundant type of skin cell. Keratinocytes keep moisture via the production of intracellular lipids (Kim & Kim, 2017). Hyaluronic acid is synthesized from hyaluronan synthase, which is a well-known moisturizing factor (Volpi *et al.*, 2009), and aquaporin (AQP) 3 is also related to skin moisturizing. AQP3 is a water channel and aging related to skin dryness is a result of decreasing of AQP levels (Li *et al.*, 2010; Shim, 2021).

In the present study, the effect of hydrolyzed swiftlet nest extracts (HSNE) on anti-melanogenesis and moisturizing were verified using skin cells *in vitro* to confirm the possibility of HSNE as a cosmetic raw material.

Materials and Methods

Hydrolyzed swiftlet nest extracts (HSNE)

HSNE was obtained from Shenzhen Mannay Cosmetic Co., Ltd (Shenzhen, China). The HSNE is prepared via enzyme treatment of swiftlet nest, which is gathered from the Southeast Asian area (Indonesia and Malaysia). The contents of N-acetylneuraminic acid (NANA), an active compound of HSNE is about 10% of the

weight of swiftlet nest extracts (Wong *et al.*, 2018; Chan *et al.*, 2018).

Cell culture

Human epidermal keratinocytes (HEKa) were purchased from Thermo Fisher Scientific (USA); human melanoma (SK-MEL2) cells were purchased from the Korea Type Culture Collection. HEKa was cultured in basal medium (Medium 154, Gibco, USA) supplemented with human keratinocyte growth supplement (HKGS; Gibco) and 100 units/mL of streptomycin (Sigma-Aldrich, USA). SK-MEL2 were cultured in Dulbecco's Modified Eagle's Medium (DMEM; Gibco) added with 10% Fetal Bovine Serum (FBS; Gibco) and 100 units/mL of streptomycin (Sigma-Aldrich, USA). Cells were incubated at 37°C under 5% CO₂.

Cell viability

MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide, Sigma-Aldrich, USA) assay was carry out to assess the cytotoxicity. Cells were seed in 96-well-plates with 1.0×10^5 cells/well and cultured for 24 h and cultured another 24 h after treatment of the samples. Cells were washed with phosphate buffered saline (10 mM, pH 7.4) and 150 µL of MTT (final concentration 0.5 mg/mL) was treated for 4 h. Formed formazan was dissolved with 150 µL of dimethyl sulfoxide (DMSO; Ducheфа, Netherlands) for 15 min and we measured the absorbance at 570 nm.

DPPH free radical-scavenging activity assay

The free radical-scavenging activity of HSNE were determined using 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay. Briefly, 50 µL of the diluted HSNE were mixed with 100 µL of 0.1 mM DPPH solution. DPPH solution without the test sample was used as a control. Next, the absorbance was measured at 515 nm after the mixture was incubated for 30 min at room temperature. The antioxidative activity was calculated using the formula below and expressed as the percentage of DPPH radical elimination, $[(A_{blank} - A_{sample}) / A_{blank}] \times 100 (\%)$

Where A_{blank} is the absorbance of the blank DPPH solution and A_{sample} is the absorbance of the DPPH solution after the addition of HSNE.

Cellular melanin contents

Two hundred nM of α -melanocyte stimulating hormone (α -MSH; Sigma-Aldrich, USA) and test samples were treated in

cultured SK-MEL2 and cultured for 48 h at 37°C under 5% CO₂. Cells were harvested using trypsin-EDTA and centrifuged at 12000 rpm for 10 min. One molar NaOH was added to dissolve melanin on cell pellets.

Reverse transcription (RT)-PCR

Isolated RNA was converted into cDNA using the PrimeScript 1st strand cDNA Synthesis Kit (TransGen, China). The converted cDNA was used as a template for amplification using PCR primers (Bioneer, Korea). The specific forward and reverse primers for each gene are presented in Table 1. Subsequently, the PCR products were loaded on a 1% agarose gel and evaluated using image analyzer (BioRad, USA).

Results

Antioxidant effect of HSNE

A DPPH assay was used to confirm the effect of HSNE on free radical scavenging. The results showed that the anti-oxidant effects of HSNE increased in a dose-dependent manner (Figure 1).

Cytotoxicity

The effect of HSNE on cell viability was evaluated after treatment for 24 h with HSNE at concentrations of 0, 100, 500, 1000, 2000, and 5000 µg/mL. As shown in Figure 2, the cell viability of HEKa and SK-MEL2 cells were slightly decreased but in up to 5000 µg/mL of extracts, the viability of both cells were measured about 83% and 85% respectively; hence, it was considered non-cytotoxic (Figure 2).

Figure 1. Effects of HSNE on DPPH free radical-scavenging activity.

DPPH free radical-scavenging activity of HSNE was examined. Quercetin (1000 µg/mL) was used as a positive control (PC). The results are expressed as the mean±SD of three independent experiments. *Statistically significant ($p<0.05$). HSNE, hydrolyzed swiftlet nest extracts; DPPH, 2,2-diphenyl-1-picrylhydrazyl.

Effects of HSNE on melanin synthesis in SK-MEL2 cells.

The melanin contents of SK-MEL2 cells were verified after treatment with HSNE to assess the skin-whitening effects of HSNE. The results showed that α-MSH induced melanin contents were increased while the melanin contents of the cells after treatment of HSNE were reduced: 158.83 µg/mL with 100 µg/mL extracts, 129.93 µg/mL with 200 µg/mL extracts, 115.47 µg/mL with 500 µg/mL extracts, and 103.15 µg/mL with 1000 µg/mL extracts compared to α-MSH treated cells, whereas positive control, 4-n-butylresorcinol, resulted in melanin synthesis level of 95.57 µg/mL (Figure 3).

Table 1. Primer sequence

Primer	Forward sequence	Reverse Sequence
<i>GAPDH</i> ^{*1}	TCA GAA GGA CTC CTA TGT GG	TCT CTT TGA TGT CAG CAC G
<i>GAPDH</i> ^{*2}	CTG GCA CCC AGC ACA ATG AAG	ACC GAC TGC TGT CAC CTT CA
<i>TRP1</i>	CTT TCT CCC TTC CTT ACT GG	TGG CTT CAT TCT TGG TGC TT
<i>TRP2</i>	TGA GAA GAA ACA AAG TAG GCA CAA	CAA CCC CAA GAG CAA GAC GAA AGC
<i>TYR</i>	CAT TTT TGA TTT GAG TGT TCT	TGT GGT AGT CGT CTT TGT CC
<i>MITF</i>	TCG GAT CAT CAA GCA AGA AC	CCG AGG TTG TTG GTA AAG GT
<i>HAS1</i>	GAC TCC TGG GTC AGC TTC CTA AG	GTA GAA CAG ACG CAG CAC AG
<i>HAS2</i>	GCT ACC AGT TTA TCC AAA CG	GTG ACT CAT CTG TCT CAC CG
<i>HAS3</i>	GGA AAG CTT GGC ATG TAC CGC AAC AG	AGA GGA GGG AGT AGA GGG AC
<i>AQP3</i>	TGC AAT CTG GCA CTT CGC	GCC AGC ACA CAC ACG ATA A

^{*1} for SK-MEL2; ^{*2} for HEKa; *GAPDH*, glyceraldehyde-3-phosphate dehydrogenase; *TRP*, tyrosinase related protein; *MITF*, microphthalmia-associated transcription factor; *HAS*, hyaluronic acid synthase; *AQP*, aquaporin

Figure 2. Cell viability of HSNE treated cells.

Cells were treated with HSNE at concentrations of 100, 500, 1000, 2000, and 5000 µg/mL for 24 h. Cytotoxicity was measured using the MTT assay. The results are expressed as the mean±SD of three independent experiments. A, HEK293 cells; B, SK-MEL2 cells. *Statistically significant ($p < 0.05$). HSNE, hydrolyzed swiftlet nest extracts; HEK293, human epidermal keratinocytes; SK-MEL2, human melanoma.

Figure 3. Melanin production of HSNE treated SK-MEL2 cell.

Cells were treated with HSNE at concentrations of 100, 200, 500, and 1000 µg/mL. 4-n-butylresorcinol (20 µM) was used as a positive control (PC). The results are expressed as the mean±SD of three independent experiments. *Statistically significant ($p < 0.05$). HSNE, hydrolyzed swiftlet nest extracts; SK-MEL2, human melanoma.

Effects of HSNE on gene expression levels of melanogenesis-related genes (*TYR*, *TRP1*, *TRP2*, and *MITF*)

The effects of HSNE on *TYR* mRNA expression were studied using RT-PCR. We found that the expression of *TYR* mRNA in SK-MEL2 cells was inhibited in a concentration-dependent manner. *TYR* mRNA expression levels in α-MSH treated cells were measured at 100.22% with 100 µg/mL extracts, 99.08% with 200 µg/mL extracts, 38.52% with 500 µg/mL extracts, and 37.12% with 1000 µg/mL extracts compared to α-MSH treated cells, whereas 4-n-butylresorcinol resulted in a *TYR* mRNA expression level of 40.69% (Figure 4A).

Similarly, the expression of *TRP1* mRNA in SK-MEL2 cells

was inhibited in a dose-dependent manner. *TRP1* mRNA expression levels in α-MSH treated cells were measured at 99.15% with 100 µg/mL extracts, 81.38% with 200 µg/mL extracts, 81.12% with 500 µg/mL extracts, and 63.88% with 1000 µg/mL extracts compared to α-MSH treated cells, whereas 4-n-butylresorcinol resulted in a *TRP1* mRNA expression level of 38.43% (Figure 4B).

HSNE inhibited the expression of *TRP2* mRNA in SK-MEL2 cells. *TRP2* mRNA expression levels in α-MSH treated cells were measured at 99.59% with 100 µg/mL extracts, 97.74% with 200 µg/mL extracts, 85.68% with 500 µg/mL extracts, and 88.30% with 1000 µg/mL extracts compared to α-MSH treated cells, whereas 4-n-butylresorcinol resulted in a *TRP2* mRNA expression level of 51.21% (Figure 4C).

MITF mRNA expression was similarly inhibited by HSNE in SK-MEL2 cells. *MITF* mRNA expression levels in α-MSH treated cells were measured at 90.14% with 100 µg/mL extracts, 79.81% with 200 µg/mL extracts, 58.29% with 500 µg/mL extracts, and 62.50% with 1000 µg/mL extracts compared to α-MSH treated cells, whereas 4-n-butylresorcinol resulted in a *MITF* mRNA expression level of 86.04% (Figure 4D).

Effect of HSNE on moisturizing related gene expression (*HAS1*, *HAS2*, *HAS3*, and *AQP3*)

RT-PCR was used to study the effects of HSNE on *HAS1* mRNA expression were studied using RT-PCR. We found that the expression of *HAS1* mRNA in HEK293 cells was activated in a concentration-dependent manner. *HAS1* mRNA expression levels were measured at 110.86% with 100 µg/mL extracts,

Figure 4. Effect of HSNE on melanogenesis-related mRNA expression.

Cells were treated with HSNE at concentrations of 100, 200, 500, and 1000 µg/mL. 4-n-butylresorcinol (20 µM) was used as a positive control (PC). A, *TYR*; B, *TRP1*; C, *TRP2*; D, *MITF*. The results are expressed as the mean±SD of three independent experiments. *Statistically significant ($p < 0.05$). HSNE, hydrolyzed swiftlet nest extracts; *TYR*, tyrosinase; *TRP*, tyrosinase related protein; *MITF*, microphthalmia-associated transcription factor.

120.91% with 200 µg/mL extracts, 132.82% with 500 µg/mL extracts, and 142.46% with 1000 µg/mL extracts compared to normal state cells, whereas hyaluronic acid resulted in a *HAS1* mRNA expression level of 152.26% (Figure 5A).

Similarly, the expression of *HAS2* mRNA increased in a dose-dependent manner. *HAS2* mRNA expression levels were measured at 129.79% with 100 µg/mL extracts, 136.57% with 200 µg/mL extracts, 144.93% with 500 µg/mL extracts, and 153.35% with 1000 µg/mL extracts compared to normal state cells, whereas hyaluronic acid resulted in a *HAS2* mRNA expression level of 163.52% (Figure 5B).

HSNE also affect the expression of *HAS3* mRNA. *HAS3* mRNA expression levels were measured as 121.74% with 100 µg/mL extracts, 140.89% with 200 µg/mL extracts, 146.84% with 500 µg/mL extracts, and 162.75% with 1000 µg/mL extracts compared to normal state cells, whereas hyaluronic acid resulted in a *HAS3* mRNA expression level of 158.62% (Figure 5C).

The expression of *AQP3* mRNA was similarly improved by HSNE. The expression levels of *AQP3* mRNA were measured at

110.63% with 100 µg/mL extracts, 125.45% with 200 µg/mL extracts, 140.72% with 500 µg/mL extracts, and 158.11% with 1000 µg/mL extracts compared to normal state cells, whereas hyaluronic acid resulted in a *AQP3* mRNA expression level of 150.82% (Figure 5D).

Discussion

Swiftlet nest has been used for a long time. From the beginning of the Tang dynasty, swiftlet nest has been an important item in Chinese cuisine and pharmacy (Marcone, 2005). In the present study, we evaluated the effect of hydrolyzed swiftlet nest extracts on skin whitening and moisturizing were measured.

HSNE showed antioxidant effect in a dose-dependent manner (Figure 1). Using rat models, Yida *et al.* (2015) reported that the swiftlet nest attenuates high fat diet-induced oxidative stress. Guo *et al.* (2016) showed that NANA administration decreased

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Figure 5. Effects of HSNE on HAS1, 2, 3, and AQP3 mRNA expression.

Cells were treated with HSNE at concentrations of 100, 200, 500, and 1000 µg/mL. Hyaluronic acid (50 µg/mL) was used as a positive control (PC). A, *HAS1*; B, *HAS2*; C, *HAS3*; D, *AQP3*. The results are expressed as the mean±SD of three independent experiments. *Statistically significant ($p < 0.05$). HSNE, hydrolyzed swiftlet nest extracts; HAS, hyaluronic acid synthase; AQP, aquaporin.

oxidative stress by increasing antioxidant enzymatic activity and protein expression of paraoxonase 1 and 2. Hydrolyzation of the swiftlet nest extracts maximizes the NANA contents compared to those of non-hydrolyzed extracts (Wong *et al.*, 2018).

Using melanogenesis-related genes such as *MITF*, *TYR*, *TRP1*, and *TRP2*, HSNE was shown to exert anti-melanogenesis effects in human melanoma cells.

MITF is a transcriptional regulation factor and triggers major proteins for the synthesis of melanin; Tyrosinase, TRP1, and TRP2, and these proteins synthesize melanin in melanosome from tyrosine through DOPA, DOPA chrome, and DOPA quinone. *MITF* mRNA expression was inhibited with the treatment of HSNE, 62.50% of *MITF* mRNA was expressed with the treatment of 1000 µg/mL HSNE compared to those treated with α-MSH only (Figure 4D).

The mRNA expressions of *TYR*, *TRP1*, and *TRP2* were also decreased with the treatment of HSNE in melanoma. At the concentration of 1000 µg/mL of HSNE, the *TYR*, *TRP1*, and

TRP2 mRNA expressions were measured at 37.12%, 63.88%, and 88.30% compared to those treated with α-MSH only, respectively (Figure 4A, B, and C).

TRP1 is known for its dihydroxyindole carboxylic acid oxidase activity. It is also involved in stabilizing tyrosinase (Sarangarajan & Boissy, 2001) TRP2, DOPachrome tautomerase, catalyzes the conversion of DOPachrome to 5,6, dihydroxyindole-2-carboxylic acid. HSNE inhibited α-MSH induced melanogenesis with downregulation of melanogenesis-related gene expression such as that of *TYR*, *TRP1*, and *TRP2*.

HSNE showed anti-melanogenesis effects in the inhibition of melanogenesis related mRNA expression also confirming that HSNE inhibits melanin production. As shown in Figure 3, melanin production was inhibited with HSNE in a concentration-dependent manner. SK-MEL2 cells treated with 1000 µg/mL HSNE produced 103.15 µg/mL melanin, which was approximately reduced to about 38% lower levels of α-MSH treatment only.

Sialic acid is a main active compound found in swiftlet nest and NANA is a major sialic acid structure detected in swiftlet nest that can be obtained from the hydrolysis of swiftlet nest (Chan *et al.*, 2013; Marcone, 2005; Pozsgay *et al.*, 1987; Van der Ham *et al.*, 2007). In swiftlet nest, there are two forms of NANA: loosely attached on the surface of swiftlet nest (free NANA) and/or covalently bound to glycan molecules and linked to protein mass (conjugated NANA). With hydrolyzation steps in the manufacturing process of the swiftlet nest extracts, the free NANA contents in the extracts are maximized (Wong *et al.*, 2018).

Previous studies found that the digestion of swiftlet nest with simulated gastric fluid fully released NANA in a free form and the digested swiftlet nest extracts showed strong inhibition of tyrosinase activity (Chan *et al.*, 2015; Chan *et al.*, 2018; Wong *et al.*, 2018).

Moisturizing is the most essential function of cosmetics and is related to maintenance of the skin barrier and a healthy skin. Hyaluronic acid synthase (HAS) is a well-known enzyme that synthesizes hyaluronic acid in mammals (Itano & Kimata, 1996; Kim *et al.*, 2004). Volpi *et al.* (2009) reported that HAS1 produces small amounts of high molecular weight hyaluronic acid, HAS2 produces significantly higher molecular weight hyaluronic acid and HAS3 is the most active of the hyaluronic acid synthases, yet produces low molecular weight hyaluronan chains. AQP water channels regulate transcellular water flow (Day *et al.*, 2014). In particular, AQP3 is abundantly expressed in the basal epidermal cell layer in mammals (Sougrat *et al.*, 2002) responsible for water and glycerol transport throughout the stratum corneum layer and is required for the maintenance of skin moisture (Volpi *et al.*, 2009).

In the present study, RT-PCR was used to evaluate the moisturizing effects of HSNE. HSNE showed upregulation of *HAS1*, *HAS2*, *HAS3*, and *AQP3* in a dose-dependent manner as shown in Figure 5. With treatment of 1000 µg/mL HSNE, *HAS1*, *HAS2*, *HAS3*, and *AQP3* mRNA expression were measured at 142.46, 153.35, 162.75, and 158.11% compared with a normal cell, respectively. Lai *et al.* (2021) reported the digested (hydrolyzed) swiftlet nest extracts showed moisturizing effect in vitro and ex vivo models and the effects were better than that of non-hydrolyzed extracts due to sialic acid and water-soluble molecules by promoting the filaggrin gene expression.

From these results, it is confirmed that moisturizing related genes, *HAS1*, *HAS2*, *HAS3*, and *AQP3* mRNA expression are increased with HSNE treatment.

Conclusion

HSNE is effective in skin whitening with inhibition of melanogenesis related gene expression such as *MITF*, *TYR*, *TRP1*, and *TRP2*. Moreover, it has a moisturizing effect with an upregulation of moisturizing related genes (*HAS1*, *HAS2*, *HAS3*, and *AQP3*). HSNE can be used as a functional cosmetic raw material focused on whitening and moisturizing.

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Author's contribution

YJK, YSK, and HL designed the study and drafted the manuscript. YJK, YSG, and HL carried out the biochemical assays and revised the manuscript. WC and YSG performed the statistical analysis and helped to revise the manuscript. YJK and HL participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

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국문초록

하이드롤라이즈드금사연둥지추출물의 미백 및 보습 효과

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목적: 본 연구는 hydrolyzed swiftlet nest extracts (HSNE)의 피부 미백 및 보습 효과를 확인하고자 한다. **방법:** HSNE의 항산화 효과를 확인하기 위해 DPPH 라디칼 소거 활성 평가 및 미백 관련 유전자인 tyrosinase (TYR), tyrosinase related protein (TRP) 1, TRP2 및 MITF의 발현을 확인하였다. 또한 melanin 생합성 저해 활성을 확인하여 HSNE의 미백 효과를 확인하였다. 보습 효과를 확인하기 위하여 관련 유전자인 hyaluronan synthase (HAS) 1, 2, 3 및 aquaporin (AQP) 3의 발현을 revers transcription-PCR을 통해 확인하였다. 실험 결과는 평균치와 표준편차로 나타내었고, 결과는 *t*-test를 사용하여 분석하였다. **결과:** HSNE는 DPPH 라디칼 소거 활성을 증가시켜 항산화 작용을 보였다. 또한 TYR, TRP1, TRP2 및 MITF의 발현을 감소시키고 melanin 생합성을 억제함으로써 미백효과를 지니는 것을 확인하였다. HAS1, 2, 3 및 AQP3의 발현을 증가시켜 피부 보습 효과를 지니는 것을 확인하였다. **결론:** Hydrolyzed swiftlet nest extracts는 피부 미백 및 보습 효과를 갖는 기능성 화장품 원료로 적용 가능하다.

핵심어: 하이드롤라이즈드금사연둥지추출물, 보습, 미백, 항산화, 화장품원료

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中文摘要

水解小雨燕窝提取物的美白保湿作用

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目的: 本研究使用人角质形成细胞和黑色素瘤在体外验证水解小雨燕窝提取物 (HSNE) 的皮肤美白和保湿效果。**方法:** 为了确认HSNE的抗氧化作用, 测量了DPPH 自由基清除活性。为了找出HSNE的美白效果, 测量了与黑色素生成相关的基因、酪氨酸酶 (TYR)、酪氨酸酶相关蛋白 (TRP) 1、2和MITF的mRNA表达。并测量了HSNE处理后的黑色素含量, 以确认抗黑色素生成作用。使用逆转录聚合酶链反应 (RT-PCR), 确定了与保湿相关的基因, 例如水通道蛋白 (AQP)3、透明质酸合成酶(HAS)1、2 和3。测试结果用student's *t*-test分析并表示为平均值±标准差。**结果:** HSNE的DPPH自由基清除作用以浓度依赖性方式增加。此外, 通过降低TYR、TRP1、TRP2和MITF的表达, 抑制黑色素生物合成, 证实具有美白作用。保湿相关基因 (HAS1、2、3 和 AQP3) 的表达以浓度依赖性方式增加, 证明其保湿效果。**结论:** 经证实水解小雨燕窝提取物具有美白保湿作用, 可作为功能性化妆品原料。

关键词: 水解小雨燕窝, 保湿, 美白, 抗氧化, 化妆品原料