KIDS-CSCR02-035

# Clinical Study Report

## A Clinical Study for Determining the Sun Protection Factor of "GLUTANEX Sun stick"

**Requestor: Nexus Pharma Co., Ltd.**

**May 31, 2023**

Korea Institute of Dermatological Sciences

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# Authentication

Korea Institute of Dermatological Sciences are commissioned by “Nexus Pharma Co., Ltd.”. for A Clinical Study for Determining the Sun Protection Factor of “GLUTANEX Sun stick”, and approve it under Institutional Review Board (IRB), and perform the study in accordance with the JCIA, SPF Test Method of Cosmetics Europe (ISO24444:2019) and the Standard Operating Procedures (SOP) of Korea Institute of Dermatological Sciences and report the result as follows.

**May 31, 2023**

| | | | |
|---|---|---|---|
| Research Organization | Korea Institute of Dermatological Sciences | | (corporate seal) |
| President | Director of Korea Institute of Dermatological Sciences Adjunct Professor of Konkuk University, Doctor of Science | In Sook An | (seal) |
| Principal Investigator | Director of Korea Institute of Dermatological Sciences Adjunct Professor of Konkuk University, Doctor of Science | In Sook An | (seal) |
| Researcher | Senior Researcher of Korea Institute of Dermatological Sciences, Master of Engineering | Woncheol Kim | (seal) |

# Quality assurance confirmation

□ Test Title: A Clinical Study for Determining the Sun Protection Factor of “GLUTANEX Sun stick”

□ Product code: KIDS-CSCR02-035

□ IRB certification number: KIDSIRB-2023-354

This test is conducted in accordance with the JCIA, SPF Test Method of Cosmetics Europe (ISO24444:2019) and the Standard Operating Procedures (SOP) of Korea Institute of Dermatological Sciences. We assured that this report is accurately reflected by the study result.

| Test title | A Clinical Study for Determining the Sun Protection Factor of “GLUTANEX Sun stick” | | | | |
|---|---|---|---|---|---|
| Date | Item | Quality Assurance Checklist | Quality Assurance Check Result | Approval date | Remark |
| February 06, 2023 | Test plan | Test planning | Approved | February 06, 2023 | |
| February 13, 2023 ~ March 03, 2023 | Test progress | Test process | Approved | March 03, 2023 | |
| March 03, 2023 | Data analysis | Data check (raw data) | Approved | March 06, 2023 | |
| May 30, 2023 | Draft report | Draft report review | Approved | May 30, 2023 | |
| May 31, 2023 | Final report | Final report review | Approved | May 31, 2023 | |

We certify that this research report is created based on the test result,
and reflects the test data accurately.

**May 31, 2023**

President In Sook An (seal)

Quality Assurance Ga Ram Kim (seal)

# Report Summary

| | |
|---|---|
| Test Title | A Clinical Study for Determining the Sun Protection Factor of “GLUTANEX Sun stick” |
| Research Organization | Korea Institute of Dermatological Sciences<br>6F, H Business Park Building A, 25 Beobwonro 11-gil,<br>Songpa-gu, Seoul, Republic of Korea |
| Requestor | Nexus Pharma Co., Ltd.<br>6F, 71, Gonghang-daero 45-gil, Gangseo-gu, Seoul, Republic of Korea |
| Test Product | GLUTANEX Sun stick |
| Formulation | Solid stick |
| Test Period | February 06, 2023 ~ May 31, 2023 |
| Methods | This test is conducted in accordance with the JCIA, SPF Test Method of Cosmetics Europe (ISO24444:2019) and the Standard Operating Procedure (SOP) of Korea Institute of Dermatological Sciences.<br><br>1) Selection of subjects: Healthy female and male, aged from 20 to 60 years old<br>2) Product Application: Evenly apply 2.00 ± 0.05 mg/cm$^2$ amount to the test area.<br>3) Application areas: 35 cm$^2$ (7 cm x 5cm)<br>4) Waiting time after product application: 15-30 minutes<br>5) Test device: Multi-port Solar Simulator 601-300W<br>6) Assessment Methods: Evaluate the response of minimal erythemal dose (MED) within 16 -24 hours after UV irradiation<br>7) Statistical criterion: Check whether 95% of confidence interval is within ± 17% of mean SPF. |
| Results | The Sun Protection Factor (SPF) of "GLUTANEX Sun stick" was **56.0 ± 5.1**. The skin adverse reaction was not observed during the entire test processes. |
| Principal Investigator | In Sook An, Ph.D. |
| Researcher | Il Hong, Woncheol Kim, Tae Yeop Kim, Ye Bin Jung, Eun Min Park |
| Dermatologist | Won Ung Shin, Kyung Goo Lee |
| Quality Assurance Director | Ga Ram Kim, Ph.D. |
| Report Date | May 31, 2023 |

## I. Background

Exposure of the skin to ultraviolet ray may cause sun burn or skin photoaging and the increase of skin epidermis thickness, and affect Langerhans cell due to DNA destruction, causing abnormalities in the immune system or skin cancer. Due to these various hazards to the skin of ultraviolet rays, various studies and products are being developed to protect the skin from ultraviolet rays. This study intends to conduct the Clinical Study for Determining the Sun Protection Factor of test product.

## II. Purpose

The purpose of this test is to determining the Sun Protection Factor (SPF) of "**GLUTANEX Sun stick**" commissioned by "**Nexus Pharma Co., Ltd.**" in accordance with the JCIA and SPF Test Method of Cosmetics Europe (ISO24444:2019).

## III. Test Period

February 06, 2023 ~ May 31, 2023

## IV. Research Organization

Name of research organization: Korea Institute of Dermatological Sciences

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Email: wckim@skinresearch.or.kr

Homepage: www.skinresearch.co.kr

Researcher: Woncheol Kim

## V. Requestor

Name of requestor: Nexus Pharma Co., Ltd.

Monitor: Yookyung Hyun

Address: 6F, 71, Gonghang-daero 45-gil, Gangseo-gu, Seoul, Republic of Korea

Tel: +82 2-2658-2408

Email: ykhyun@nexus-pharma.com

# VI. Test methods

This test is conducted in accordance with the JCIA, SPF Test Method of Cosmetics Europe (ISO24444:2019) and the Standard Operating Procedures (SOP) of Korea Institute of Dermatological Sciences.

## 1. Selection criteria of subjects

### 1.1 Selection criteria

- Healthy female and male aged 20 to 60 years without skin disease and individual typology angle (ITA°) of 28 or higher was selected using a spectrophotometer (CM-26d, KONICA MINOLTA, INC.). ITA° is calculated by Formula 1 and expressed as an integer according to the ISO24444:2019 guideline. The mean ITA° of all study subjects was 41° to 55°, and the subjects are divided into three ITA groups (28° to 40°, 41° to 55°, and ≥56°), and at least 3 individuals should be included in two or more groups.

$$\text{ITA°} = \left\{\text{Arc Tangent}\left[\frac{L^* - 50}{b^*}\right]\right\} 180/3.1416 \qquad \text{(Formula 1)}$$

- After fully listening to explanation about the purpose and procedures of the study, schedule, compensation, and anticipated adverse reactions, the subjects filled out the "informed consent form" and "questionnaires for selection of subject" and participated in the test.
- Healthy subjects without serious diseases including skin diseases which can affect the test result.

**Table 1. Individual typology angle (ITA°)**

| Skin color | ITA° value Range |
|---|---|
| Very Light | ITA°>55° |
| Light | 40° < ITA° ≤ 55° |
| Intermediate | 28° < ITA° ≤ 40° |
| Tan (or matt) | 10° < ITA° ≤ 28° |
| Brown | -30° < ITA° ≤ 10° |
| Black | -30° ≥ ITA° |

### 1.2 Exclusion criteria

In case of any of followings, we excluded from the subjects.

- Female who are pregnant or breastfeeding or likely to be pregnant.
- Subjects who have the history of photo-allergy or photosensitization
- Subjects who have used skin ointment containing steroids for the treatment of skin diseases for one month or more.
- Subjects who have skin diseases such as sensitive, irritative, atopy diseases
- Subjects with skin disorders such as spots, acne, erythema, scars in the area where artificial ultraviolet ray is irradiated.
- Other Subjects who are judged to be improper by the researcher

### 1.3 Criteria for dropout

Even if the selection criteria is satisfied but in case of any of followings, we dropped out such a person.

- In case of unexpected adverse events occur at the test area,
- If the subject is exposed to excessive ultraviolet rays on the test area during the course of the test, or if the result is disturbed due to excessive drinking or smoking,
- If the test is judged to be difficult to continue due to the personal circumstances of subject,
- If excessive exposure to UV rays on the test area during the course of the test makes it difficult to accurately determine the minimal erythemal dose (MED), it is excluded from the calculation of the results.

### 1.4 Data rejection criteria

The number of valid subject results shall be 10 to 20, and up to 5 people can be excluded in the following cases. If more than 5 data are excluded for the following reasons, all test results are rejected and test conditions are reset and the test is repeated.

- There is no erythema response on any UV exposure subsite applied with standard reference sunscreen.
- There is erythema on all subsites applied with standard reference sunscreen or test product.
- There are random erythema responses on subsites applied with standard reference sunscreen or test product (randomly absent responses)

### 1.5 Details that are informed to the subjects

In addition to the contents of this test, unexpected risks and skin adverse reactions due to participation in the test are fully explained.

- The purpose of test is to evaluate the sunscreen effect of cosmetics.
- Our company is commissioned to evaluate the sunscreen effect from cosmetic manufacturers.
- By signing the "informed consent form", subject agrees to voluntarily participate in this test, and can refuse to participate in the test at any time, and there is no penalty for rejection.
- About the overall test process for UV protection evaluation
- There may be individual differences in the erythema reaction and pigmentation reaction of the skin caused by UV exposure.
- There is a possibility of causing an adverse reaction during the test, so there are restrictions on the subjects
- Matters regarding risks or adverse skin reactions and side effects processing from this test

## 2. Test product

### 2.1 Information of test product

- Requestor: Nexus Pharma Co., Ltd.
- Test product: GLUTANEX Sun stick
- Product code: KIDS-CSCR02-035
- Formulation: Solid stick
- Color: Ivory
- Main ingredients

**Table 2. Main ingredients and content**

| Main ingredients | Contents (%) |
|---|---|
| Titanium Dioxide (35%)*<br>C12-15 Alkyl Benzoate*<br>Aluminum Stearate*<br>Polyhydroxystearic Acid*<br>Alumina<br>(As Titanium Dioxide) | 20.00<br>(7.00) |
| Titanium Dioxide (49.5%)*<br>Caprylic/Capric Triglyceride*<br>Polyhydroxystearic Acid*<br>Alumina*<br>Stearic Acid<br>(As Titanium Dioxide) | 2.00<br>(0.99) |

* Main ingredients are described based on the data provided by requestor.

### 2.2 Management and storage of evaluation product

Upon the receipt of test product, the information such as the product code, receipt date, storage date shall be listed and the product shall be stored in the standard product storage room for 6 months after the completion of test, and disposed.

## 3. Standard reference sunscreen

For the standard reference sunscreen, P2, P5 or P8 was used according to the expected SPF of the test product according to the standards of ISO24444:2019.

**Table 3. SPF reference sunscreen**

| Expected SPF | Standard reference sunscreen | Mean SPF | Acceptance limits | | Note |
|---|---|---|---|---|---|
| | | | Lower limit | Upper limit | |
| SPF≤24 | P2 | 16.1 | 13.7 | 18.5 | P2, P5 or P8 |
| 25≤SPF<50 | P5 | 30.6 | 23.7 | 37.4 | P5 (minimum 5 subjects) and P2 on the remaining subjects |
| SPF≥50 | P8 | 63.1 | 43.9 | 82.3 | P8 (minimum 5 subjects) and P2 on the remaining subjects |

## 4. Main Steps

- Day 1: Initial unprotected MED (MEDu1) irradiation
- Day 2
    - Determination of the initial MEDu1
    - UV radiation for the final unprotected MED (MEDu2)
    - UV radiation for the standard reference sunscreen and test product (MEDs, MEDp)
- Day 3: Determination of the MEDu2, MEDs, MEDp

## 5. UV irradiation area

The test area on the back was restricted between the scapula line and the waist. Skeletal protrusions and extreme areas of curvature should be avoided. The test sites were randomly placed with no variation in ITA° greater than 5° from each other test area.

- Distance between test site: 1 cm
- Distance between subsites: 0.8 cm
- UV radiation area of each port: 0.64 $cm^2$

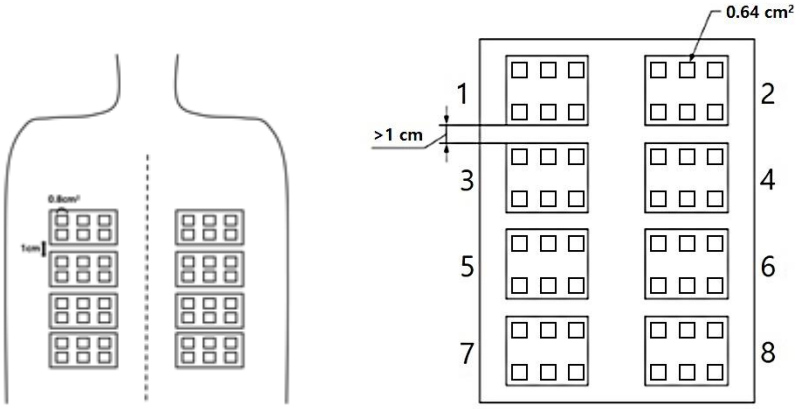


**Figure 1. UV irradiation area**

## 6. Light source

Multi-port Solar Simulator 601-300W (Solar Light, USA) equipped with 300W xenon arc lamps was used in this test. The filter used the Dichroic mirror and UG11 filter to selectively take light from 290 to 400nm wavelengths, blocking most of the wavelengths other than ultraviolet light, and using the WG320 filter to remove the wavelengths in UVC areas. Ultraviolet light is a square with a side length of 0.8 cm, and is radiated through six light guides, and the light intensity is individually adjusted using the aperture at the top of the light. The subjects were taken in a stable position and taken care not to move while investigating UV rays.

## 7. Light intensity meter

Model name: PMA2100, UVB detector (Solar Light, USA)

## 8. Product application

- Application area: 35 cm² (7 x 5 cm)
- Application amount per application area: 2.00 ± 0.05 mg/cm²
- Application method:
  The product equivalent to 70 mg are deposited using an electronic scale, then spread over the whole test site, first with circular movements to gather the droplets and second in horizontal and vertical directions using light pressure. During the application process, the finger with a finger coat was stayed in contact with the skin. After drying it for 15 to 30 minutes, the ultraviolet rays are irradiated.

## 9. Determination of minimal erythemal dose (MED)

### 9.1 Initial unprotected MED (MEDu1) irradiation

To determine the initial minimal erythemal dose (MEDu1), the provisional MEDiu was calculated according to Formula 2 based on the ITA° of each subject, and this value was set between ports 3 and 4 (3.5 port), which are the center of the 6 ports of the multi-port solar simulator. The UV intensity of each port was increased or decreased by 15% from the first 4.96 W/m$^2$ to the sixth 10.02 W/m$^2$ based on the 3.5 port.

The irradiated UV intensity is shown in the example below.

**Provisional MED (J/m$^2$) = (0.051 x (ITA°^2)) - 10.718 x ITA° + 629.32** (Formula 2)

(Example) When the subject's ITA° is 40, the provisional MED according to formula 2 is 282 J/m$^2$, and the UV intensity for each port is shown in Figure 2.

| | | |
|---|---|---|
| **1port**<br>**4.96 W/m² x 40s**<br>**= 198 J/m²** | **2port**<br>**5.70 W/m² x 40s**<br>**= 228 J/m²** | **3port**<br>**6.56 W/m² x 40s**<br>**= 262 J/m²** |
| **6port**<br>**10.02 W/m² x 40s**<br>**= 401 J/m²** | **5port**<br>**8.72 W/m² x 40s**<br>**= 349 J/m²** | **4port**<br>**7.58 W/m² x 40s**<br>**= 303 J/m²** |

**Figure 2. The UV intensity of initial minimal erythemal dose site based on ITA° 40**

### 9.2 Final unprotected MED (MEDu2) irradiation

To determine the final minimal erythemal dose (MEDu2), the initial unprotected MED (MEDu1) was set at port 4. The UV intensity of each of the 6 ports was increased or decreased by 15% from the first 4.96 W/m$^2$ to the sixth 10.02 W/m$^2$ based on the 3.5 port.

The irradiated UV intensity is shown in Figure 3.

| | | |
|---|---|---|
| **1port**<br>**4.96 W/m² x 46s**<br>**= 228 J/m²** | **2port**<br>**5.70 W/m² x 46s**<br>**= 262 J/m²** | **3port**<br>**6.56 W/m² x 46s**<br>**= 302 J/m²** |
| **6port**<br>**10.02 W/m² x 46s**<br>**= 461 J/m²** | **5port**<br>**8.72 W/m² x 46s**<br>**= 401 J/m²** | **4port**<br>**7.58 W/m² x 46s**<br>**= 349 J/m²** |

**Figure 3. The UV intensity of final minimal erythemal dose site**
**(When ITA° is 40 and MEDu1 is port 5)**

### 9.3 UV radiation for the standard reference sunscreen and test product (MEDs, MEDp)

To determine the MED of standard reference sunscreen and test product (MEDs, MEDp), the UV dose multiplied by the initial unprotected MED (MEDu1) and the expected SPF of the sample was set in port 4. The UV intensity of each of the 6 ports was increased or decreased by 15% from the first 4.96 W/m$^2$ to the sixth 10.02 W/m$^2$ based on the 3.5 port.

(Example) When ITA° is 40, MEDu1 is port 5, and the expected SPF of the sample is 16.1, the UV irradiation time is calculated as follows, and the UV intensity for each port is shown in Figure 4.

$$\text{UV irradiation time(s)} = \frac{\text{MEDu1} \times \text{expected SPF}}{\text{UV intensity of port 4}} = \frac{349 \times 16.1}{7.58} = 741\text{(s)}$$

| | | |
|---|---|---|
| **1port**<br>**4.96 W/m² x 741s**<br>**= 3675 J/m²** | **2port**<br>**5.70 W/m² x 741s**<br>**= 4224 J/m²** | **3port**<br>**6.56 W/m² x 741s**<br>**= 4861 J/m²** |
| **6port**<br>**10.02 W/m² x 741s**<br>**= 7425 J/m²** | **5port**<br>**8.72 W/m² x 741s**<br>**= 6462 J/m²** | **4port**<br>**7.58 W/m² x 741s**<br>**= 5617 J/m²** |

**Figure 4. The UV intensity of sample application site with expected SPF 16.1**
**(When ITA° is 40 and MEDu1 is port 5)**

### 9.4 Determination of minimal erythemal dose (MED)

The minimum erythema dose (MED) was determined by visual assessment of the erythema responses within the range of 20 ± 4 hours (16 to 24 hours). The observers of erythemal responses shall not be the same persons as the ones who performed product application and exposure. MED is expressed as an integer in $J/m^2$.

**Table 4. Criteria for minimal erythemal dose (MED) determination**

| Response | Description | Note |
|---|---|---|
| 0 | No response | |
| 0.5 | Erythema response less than 50% on irradiated area or is not defined borders appearing over most of the field of UV exposure | |
| 1 | Erythema response more than 50% on irradiated area with defined borders | Minimal erythemal dose (MED) |
| 2 | Moderate to intense erythema | |

## 10. Calculation of SPF value

A SPF value for each test subject (SPFi) was calculated according to Formula 3 and expressed to one decimal place by truncation.

$$SPFi = \frac{\text{Protected minimal erythemal dose (MEDip)}}{\text{Final unprotected minimal erythemal dose (MEDiu2)}} \quad \text{(Formula 3)}$$

## 11. Statistical criterion

The 95% confidence interval (CI) of the mean SPF should be within a range of ± 17% of the mean SPF. If the 95% confidence interval does not exist within ± 17% of the mean SPF, the number of subjects should be increased until the statistical criterion is met up to maximum of twenty valid results.

$$95\%\ \text{confidence interval}\ (\text{CI}) = (\text{SPF} - \text{c})\ \text{to}\ (\text{SPF} + \text{c}) \quad \text{(Formula 4)}$$

$$\text{c} = \text{t} \times \text{S}/\sqrt{\text{n}} \quad \text{(Formula 5)}$$

$$\text{CI}[\%] = \frac{100 \times \text{c}}{\text{SPF}} \quad \text{(Formula 6)}$$

t value: t value from the 'two-sided' Student-*t* distribution table under at a probability level p=0.05 and with (n-1) degrees of freedom
n: total numbers of subjects
S: standard deviation

**Table 5. Student-*t* distribution**

| N | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **t value** | 2.262 | 2.228 | 2.201 | 2.179 | 2.160 | 2.145 | 2.131 | 2.120 | 2.110 | 2.101 | 2.093 |

## 12. Skin adverse reaction evaluation

When the subject has a skin adverse reaction, the researcher graded it according to the severity. The adverse reaction evaluation includes the judgment of the existence of erythema, edema, scaling, itching, stinging, burning, tightness and prickling, and takes the actions in accordance with the regulation for skin abnormality treatment. The research organization is conducted with the safety of the subject as the top priority during the test period. If adverse reactions and side effects occur, the medical treatment or decision was made by dermatologist. The cost of medical treatment is paid by the requestor. The investigation will proceed until the skin adverse reaction is resolved or stable, or it is no longer possible to follow up. However, if damage is not caused by participation in the test, compensation is excluded.

# VII. Test results

## 1. Results of SPF

The SPF of the test product was provided as **[SPF 50+]** from the requestor "**Nexus Pharma Co., Ltd.**", and the expected SPF of the sample was set to [SPF 50] according to the Standard Operating Procedures (SOP) of Korea Institute of Dermatological Sciences. A total of 10 subjects participated in the test (Table 6, 7).

As a result of the test, the SPF of the standard reference sunscreens P2 and P8 was 15.2 ± 1.1 and 74.9 ± 8.8, respectively, and the mean SPF of the test product was 56.0 ± 5.1.

**Table 6. Subjects information**

| No | Subject ID | Age | Sex | ITA° |
|---|---|---|---|---|
| 1 | KIDS-FS0213-317 | 24 | F | 32 |
| 2 | KIDS-FS0213-441 | 29 | F | 44 |
| 3 | KIDS-FS0214-537 | 24 | F | 54 |
| 4 | KIDS-FS0214-474 | 28 | F | 47 |
| 5 | KIDS-MS0221-391 | 29 | M | 39 |
| 6 | KIDS-FS0222-425 | 24 | F | 42 |
| 7 | KIDS-MS0222-511 | 26 | M | 51 |
| 8 | KIDS-MS0227-463 | 21 | M | 46 |
| 9 | KIDS-FS0227-435 | 24 | F | 44 |
| 10 | KIDS-FS0301-403 | 26 | F | 40 |

| | | | | |
|---|---|---|---|---|
| **Total 10 subjects** | **Mean 25.5** | **Female 7** | **Mean ITA°** | **43.9** |
| | | | **28° ~ 40°** | **3** |
| | | **Male 3** | **41° ~ 55°** | **7** |
| | | | **≥56°** | **0** |

**Table 7. Results of SPF test**

| No | Initial unprotected MEDu1 (J/m²) | Final unprotected MEDu2 (J/m²) | Standard reference sunscreen | Reference sunscreen MED (J/m²) | Reference sunscreen SPF | Test product MED (J/m²) | Test product SPF |
|---|---|---|---|---|---|---|---|
| 1 | 274 | 314 | P8 | 22856 | 72.7 | 18106 | 57.6 |
| 2 | 236 | 235 | P2 | 3798 | 16.1 | 15601 | 66.3 |
| 3 | 212 | 244 | P8 | 17685 | 72.4 | 12191 | 49.9 |
| 4 | 296 | 340 | P2 | 4768 | 14.0 | 19569 | 57.5 |
| 5 | 234 | 235 | P2 | 3767 | 16.0 | 13464 | 57.2 |
| 6 | 249 | 288 | P8 | 18077 | 62.7 | 14318 | 49.7 |
| 7 | 227 | 262 | P2 | 3654 | 13.9 | 13054 | 49.8 |
| 8 | 265 | 230 | P2 | 3693 | 16.0 | 13250 | 57.6 |
| 9 | 273 | 273 | P8 | 22775 | 83.4 | 15705 | 57.5 |
| 10 | 228 | 227 | P8 | 19018 | 83.7 | 13115 | 57.7 |
| **Mean** | **249** | **265** | **P2** | **3936** | **15.2** | **14837** | **56.0** |
| | | | **P8** | **20082** | **74.9** | | |
| **Standard Dev.** | **27** | **39** | **P2** | **469** | **1.1** | **2409** | **5.1** |
| | | | **P8** | **2542** | **8.8** | | |

## 2. Statistical criterion

The SPF of standard reference sunscreens P2 and P8 is within the range suggested by ISO24444:2019, and the SPF result of the test product has a 95% confidence interval within ±17% of the mean SPF (Table 8). Therefore, this test has the suitability and reliability.

**Table 8. Statistical criterion of SPF test**

| | Mean SPF | s | n | t | 17% of mean SPF | c (t × s/√n) | CI[%] | 95% CI |
|---|---|---|---|---|---|---|---|---|
| Test Product | 56.0 | 5.1 | 10 | 2.262 | 9.5 | 3.7 | 6.5 | 52.3 to 59.7 (n=10) |
| P2 | 15.2 | 1.1 | 5 | 2.776 | 2.6 | 1.4 | 9.3 | 13.8 to 16.6 (n=5) |
| P8 | 74.9 | 8.8 | 5 | 2.776 | 12.7 | 10.9 | 14.6 | 64.0 to 85.8 (n=5) |

## 3. Skin adverse event

The skin adverse reaction was not observed during the entire test processes.

## VIII. Conclusion

This test shows the result that determining Sun Protection Factor (SPF) of "**GLUTANEX Sun stick**" requested by "**Nexus Pharma Co., Ltd.**"

The test was conducted on 10 subjects in total that satisfied the selection criteria.

The SPF of standard reference sunscreens P2 and P8 is within the range suggested by the SPF Test Method of Cosmetics Europe (ISO 24444:2019) and the Standard Operating Procedures (SOP) of Korea Institute of Dermatological Sciences.

Since the 95% confidence interval (CI) was within a range of ± 17% of the mean SPF, this test has the suitability and reliability.

The skin adverse reaction was not observed during the entire test processes.

The Sun Protection Factor (SPF) of "**GLUTANEX Sun stick**" was confirmed to be **56.0 ± 5.1.**

## IX. References

No. 2019-47 regulations on functional cosmetic inspection by Ministry of food and drug safety

COLIPA Guideline International Sun Protection (SPF) test method

China Food and Drug Administration (CFDA)

[ISO24444:2019] Cosmetics-Sun Protection test methods -in vivo determination of SPF (Sun Protection Factor)

[ISO24442:2011] Cosmetics-Sun Protection test methods -in vivo determination of sunscreen UVA protection

[FDA final rule 2011] Federal Register-Rules and Regulations

[JCIA 2011] The revisions to japan cosmetic industry association SPF measurement standards

[JCIA 2012] The revisions to japan cosmetic industry association measurement standards for UVA protection efficacy

Chardon A, Cretois I, Hourseau C., "Skin colour typology and suntanning pathways.", Int J Cosmet Sci. 1991 Aug;13(4):191-208.

Marcus Wilkes, BS; Caradee Y. Wright, PhD; Johan L. du Plessis, PhD; et al, "Fitzpatrick Skin Type, Individual Typology Angle, and Melanin Index in an African Population", JAMA Dermatol. 2015;151(8):902-903.

Del Bino S, Sok J, Bessac E, Bernerd F., "Relationship between skin response to ultraviolet exposure and skin color type.", Pigment Cell Res. 2006 Dec;19(6):606-14.

A. Pérez Ferriols, J. Aguilera, P. Aguilera, el al, "Determination of Minimal Erythema Dose and Anomalous Reactions to UVA Radiation by Skin Phototype", Actas Dermosifiliogr. 2014 Oct;105(8):780-8.

# Appendixes

**[Appendix 1] Research members of the organization**

**[Appendix 2] Facilities of the organization**

**[Appendix 3] Details of test results**

**[Appendix 4] Case Report Form**

# [Appendix 1] Research members of the organization

## ■ In Sook An (director of research center, Adjunct Professor, Doctor of Science)

**Educational background and careers**

2005.09-2008.02 Master's degree of Department of Cosmetic & beauty at Konkuk University Graduate School of Industry

2010.03 - 2013.02 Ph.D. of Department of Cosmetic & beauty at Konkuk University

2011.12 - 2015.07 CEO of B&Jin Co., Ltd.

2015.10 - 2017.10 Korea - China Cosmetics Industry International Joint Forum [Korea Institute of Skin Science/GENECELLPHARM International Joint Forum] Organisers

2015.07 - Currently CEO of GENECELLPHARM Co., Ltd.

2015.07 - Currently Director of the Korea Institute of Derma Science

2017.01 - Currently member of the Korea Food and Drug Administration's Research Council on Cosmetic Non-medical Products

2017.01 - Currently member of the Consumer Hazard Prevention and Assessment Committee of the Ministry of Food and Drug Safety

2017.01 - Currently Editorial Writer of the current Asian Beauty Cosmetics Journal (KI Research Foundation, Registry)

2017.01 - Currently Editorial Writer of Biomedical Dermatology (International Names, English Literature)

2017.01 - Currently Special Experts (Representative of Korea) - China Personal Care Products Cosmetic Industry Innovation Alliance

2017.01 - Currently CJ On Style TV Channel Beauty Program Fixed Panel (Cosmetics Specialist)

2017.03 - Currently industry-academic professor of cosmetics engineering at Konkuk University

2019.01. - Currently please. Goddess (Taiwan Beauty Program) Fixed Panel (Cosmetics Specialist)

**Award details**

2007 Excellent thesis award by Korean Society of Skin and Beauty

2008 Konkuk University Graduate School of Industry Award

2009 Citation by Korean Society of Skin and Beauty

2016 Seoul Korea-China FTA 1st Anniversary Partnership Reward

**Research performance**

-Internationally known SCI level academic thesis

• Heo MJ, Choi SY, Lee C, et al. (2020) Perphenazine Attenuates the Pro-Inflammatory Responses in Mouse Models of Th2-Type Allergic Dermatitis. Int. J. Mol. Sci., 21: E3241.

• Choi M, Choi YM, Choi SY, et al. (2020) Glucose Metabolism Regulates Expression of Hair-Inductive Genes of Dermal Papilla Spheres via Histone Acetylation. Sci. Rep., 10: 4887.

• Heo MJ, Lee C, Choi SY, et al. (2020) Nintedanib ameliorates animal model of dermatitis. Sci. Rep., 10: 4493. Cha HJ, He C, Zhao H, et al . Intercellular and intracellular functions of ceramides and their metabolites in skin (Review). Int. J. Mol. Med. , 38: 16-22, 2016.

• Choi SY, Heo MJ, Lee C, et al. (2020) 2-deoxy-d-glucose Ameliorates Animal Models of Dermatitis. Biomedicines., 8: 20.

• Choi M, Choi YM, An IS, et al. (2020) E3 ligase RCHY1 negatively regulates HDAC2. Biochem. Biophys. Res. Commun., 521: 37-41.

• Lee YR, Bae S, Kim JY, et al. (2019) Monoterpenoid Loliolide Regulates Hair Follicle Inductivity of Human Dermal Papilla Cells by Activating the Akt/β-Catenin Signaling Pathway. J. Microbiol. Bio-technol., 29: 1830-1840.

• Lee J, An S, Jung JH, et al. (2019) MUL1 E3 ligase regulates the antitumor effects of metformin in chemoresistant ovarian cancer cells via AKT degradation. Int. J. Oncol., 54: 1833-1842.

• Kim HM, Jung JH, Kim JY, et al. (2019) The Protective Effect of Violaxanthin from Nannochloropsis oceanica against Ultraviolet B-Induced Damage in Normal Human Dermal Fibroblasts. Photochem. Photobiol., 95: 595-604.

• Lee A, Kim JY, Heo J, et al. (2018) The Inhibition of Melanogenesis via the PKA and ERK Signaling Pathways by Chlamydomonas reinhardtii Extract in B16F10 Melanoma Cells and Artificial Human Skin Equivalents. J. Microbiol. Biotechnol., 28: 2121-2132.

• Hahn HJ, Kim KB, An IS, et al. (2017) Protective effects of rosmarinic acid against hydrogen peroxide-induced cellular senescence and the inflammatory response in normal human dermal fibroblasts. Mol. Med. Rep., 16: 9763-9769.

• Choi YM, An S, Lee J, et al. (2017) Titrated extract of Centella asiatica increases hair inductive prop-erty through inhibition of STAT signaling pathway in three-dimensional spheroid cultured human dermal papilla cells. Biosci. Biotechnol. Biochem., 81: 2323-2329.

• Kim K, An S, Choi BG, et al. (2017) Arctiin regulates collagen type 1α chain 1 mRNA expression in human dermal fibroblasts via the miR-378b-SIRT6 axis. Mol. Med. Rep., 16:

9120-9124.

• Joo D, An S, Choi BG, et al. (2017) MicroRNA-378b regulates α-1-type 1 collagen expression via sirtuin 6 interference. Mol. Med. Rep., 16: 8520-8524.

• Lee JJ, Kim KB, Heo J, et al. (2017) Protective effect of Arthrospira platensis extracts against ultravio-let B-induced cellular senescence through inhibition of DNA damage and matrix metalloproteinase-1 expression in human dermal fibroblasts. J. Photochem. Photobiol. B., 173: 196-203.

• An S, Cha HJ, Ko JM, et al. (2017) Kinetin Improves Barrier Function of the Skin by Modulating Keratinocyte Differentiation Markers. Ann. Dermatol., 29: 6-12.

Kwon SB, An S, Kim MJ, et al. (2017) Phytosphingosine-1-phosphate and epidermal growth factor synergistically restore extracellular matrix in human dermal fibroblasts in vitro and in vivo. Int. J. Mol. Med., 39: 741-748.

• Youn HJ, Kim KB, Han HS, et al. (2017) 23-Hydroxytormentic Acid Protects Human Dermal Fibroblasts by Attenuating UVA-induced Oxidative Stress. Photoimmunol. Photomed., 33: 92-100.

• Lee J, An S, Choi YM, et al. (2017) TRIAD1 Is a Novel Transcriptional Target of p53 and Regulates Nutlin-3a-Induced Cell Death. J. Cell. Biochem., 118: 1733-1740.

• Lee J, An S, Choi YM, et al. (2016) Musashi-2 is a novel regulator of paclitaxel sensitivity in ovarian cancer cells. Int. J. Oncol., 49: 1945-1952.

• Hahn HJ, Jung HJ, Schrammek-Drusios MC, et al. (2016) Instrumental evaluation of anti-aging effects of cosmetic formulations containing palmitoyl peptides, Silybum marianum seed oil, vitamin E and other functional ingredients on aged human skin. Exp. Ther. Med., 12: 1171-1176.

• Choi S, Youn J, Kim K, et al. (2016) Apigenin inhibits UVA-induced cytotoxicity in vitro and prevents signs of skin aging in vivo. Int. J. Mol. Med., 38: 627-634.

• Lee JJ, An S, Kim KB, et al. (2016) Extract of Ettlia sp. YC001 Exerts Photoprotective Effects against UVB Irradiation in Normal Human Dermal Fibroblasts. J. Microbiol. Biotechnol., 28: 775-783.

• Shin S, Kim K, Lee MJ, et al. (2016) Epigallocatechin Gallate-Mediated Alteration of the MicroRNA Expression Profile in 5α-Dihydrotestosterone-Treated Human Dermal Papilla Cells. Ann. Dermatol., 28: 327-334.

• Cha HJ, He C, Zhao H, et al. (2016) Intercellular and intracellular functions of ceramides and their metabolites in skin (Review). Int. J. Mol. Med., 38: 16-22.

• Choi SJ, Lee SN, Kim K, et al. (2016) Biological effects of rutin on skin aging. Int. J. Mol. Med., 38: 357-363.

• Joo DH, Cha HJ, Kim K, et al. (2015) Benzo(a)pyrene represses melanogenesis in B16F10 mouse mel-anoma cells. Mol. Cell. Toxicol., 11: 349-355.

• Bae S, An IS and An S. (2015) Development of a high-throughput screening system for identifica-tion of novel reagents regulating DNA damage in human dermal fibroblasts. Acta. Pharm., 65: 331-341.

• Lee KM, An S, Lee OK, et al. (2015) Analysis of changes in microRNA expression profiles in response to the troxerutin-mediated antioxidant effect in human dermal papilla cells. Mol. Med. Rep., 12: 2650-2660.

Lee BM, An S, Kim SY, et al. (2015) Topical application of a cleanser containing extracts of Diospy-ros kaki folium, Polygonum cuspidatum and Castanea crenata var. dulcis reduces skin oil content and pore size in human skin. Biomed. Rep., 3: 343-346.

• Lee MJ, Cha HJ, Lim KM, et al. (2015) Analysis of the microRNA expression profile of normal human dermal papilla cells treated with 5α-dihydrotestosterone. Mol. Med. Rep., 12: 1205-1212.

• Lee OK, Cha HJ, Lee MJ, et al. (2015) Implication of microRNA regulation in paraphenylenediamine-induced cell death and senescence in normal human hair dermal papilla cells. Mol. Med. Rep., 12: 921-936.

• Cha HJ, Lee OK, Kim SY, et al. (2015) MicroRNA expression profiling of p-phenylenediamine treat-ment in human keratinocyte cell line. Mol. Cell. Toxicol., 11: 19-28.

• Cha HJ, Bae S, Kim K, et al. (2015) Overdosage of methylparaben induces cellular senescence in vitro and in vivo. J. Invest. Dermatol., 135: 609-612.

• Bae S, Kim K, Cha HJ, et al. (2015) Low-dose γ-irradiation induces dual radio-adaptive responses depending on the post-irradiation time by altering microRNA expression profiles in normal human dermal fibroblasts. Int. J. Mol. Med., 35: 227-237.

• Bae S, Lim K, Cha H, et al. (2014) Arctiin blocks hydrogen peroxide-induced senescence and cell death though microRNA expression changes in human dermal papilla cells. Biol. Res., 47: 50.

• Cha HJ, Kim OY, Lee GT, et al. (2014) Identification of ultraviolet B radiation-induced microRNAs in normal human dermal papilla cells. Mol. Med. Rep., 10: 1663-1670.

• Kim KB, Kim K, Bae S, et al. (2014) MicroRNA-1290 promotes asiatic acid-induced apoptosis by de-creasing BCL2 protein level in A549 non-small cell lung carcinoma cells. Oncol. Rep., 32: 1029-1036.

• Bae S, Kim K, Cha HJ, et al. (2014) Altered microRNA expression profiles are involved in resistance to low-dose ionizing radiation in the absence of BMI1 in human dermal fibroblasts. Int. J. Oncol., 45: 1618-1628.

• Cha HJ, Lee GT, Lee KS, et al. (2014) Photoprotective effect of arctiin against ultraviolet B-induced damage in HaCaT keratinocytes is mediated by microRNA expression changes. Mol. Med. Rep., 10: 1363-1370.

• Kwon KJ, Bae S, Kim K, et al. (2014) Asiaticoside, a component of Centella asiatica, inhibits melano-genesis in B16F10 mouse melanoma. Mol. Med. Rep., 10: 503-507.

• Kim OY, Cha HJ, Ahn KJ, et al. (2014) Identification of microRNAs involved in growth arrest and cell death in hydrogen peroxide-treated human dermal papilla cells. Mol. Med. Rep., 10: 145-154.

Cha HJ, Lee KS, Lee GT, et al. (2014) Altered miRNA expression profiles are involved in the protec-tive effects of troxerutin against ultraviolet B radiation in normal human dermal fibroblasts. Int. J. Mol. Med., 33: 957-963.

• Lee KS, Cha HJ, Lee GT, et al. (2014) Troxerutin induces protective effects against ultraviolet B radia-tion through the alteration of microRNA expression in human HaCaT keratinocyte cells. Int. J. Mol. Med., 33: 934-942.

• Lee GT, Cha HJ, Lee KS, et al. (2014) Arctiin induces an UVB protective effect in human dermal fi-broblast cells through microRNA expression changes. Int. J. Mol. Med., 33: 640-648.

• Bae S, Lee EJ, Lee JH, et al. (2014) Oridonin protects HaCaT keratinocytes against hydrogen perox-ide-induced oxidative stress by altering microRNA expression. Int. J. Mol. Med., 33: 185-193.

• Lee EJ, Cha HJ, Ahn KJ, et al. (2013) Oridonin exerts protective effects against hydrogen peroxide-induced damage by altering microRNA expression profiles in human dermal fibroblasts. Int. J. Mol. Med., 32: 1345-1354.

• An IS, An S, Park S, et al. (2013) Involvement of microRNAs in epigallocatechin gallate-mediated UVB protection in human dermal fibroblasts. Oncol. Rep., 29: 253-259.

• An IS, An S, Kwon KJ, et al. (2013) Ginsenoside Rh2 mediates changes in the microRNA expression profile of human non-small cell lung cancer A549 cells. Oncol. Rep., 29: 523-528.

• Kim K, An S, Cha HJ, et al. (2012) Lenalidomide induces apoptosis and alters gene expression in non-small cell lung cancer cells. Oncol. Left., 5: 588-592.

• An IS, An S, Choe TO, et al. (2012) Centella asiatica protects against UVB-induced HaCaT keratino-cyte damage through microRNA expression changes. Int. J. Mol. Med., 30: 1349-1356.

• An IS, An S, Kang SM, et al. (2012) Titrated extract of Centella asiatica provides a UVB protective effect by altering microRNA expression profiles in human dermal fibroblasts. Int. J. Mol. Med., 30: 1194-1202.

• Bae S, Kim SY, Jung JH, et al. (2012) Akt is negatively regulated by the MULAN E3 ligase. Cell Res., 22: 873-885.

• Bae S, Jeong HJ, Cha HJ, et al. (2012) The hypoxia-mimetic agent cobalt chloride induces cell cycle arrest and alters gene expression in U266 multiple myeloma cells. Int. J. Mol. Med., 30: 1180-1186.

• Bae S, Jung JH, Kim K, et al. (2012) TRIAD1 inhibits MDM2-mediated p53 ubiquitination and degra-dation. FEBS Lett., 586: 3057-3063.

• Choi YM, An S, Lee EM, et al. (2012) CYP1A1 is a target of miR-892a-mediated posttranscriptional repression. Int. J. Oncol., 41: 331-336.

## ■ Il Hong (Headquarter director, Master of engineering)

**Educational background and career**

2005.03 ~ 2008.08 Researcher of Seoul National University School of Pharmacy

2008.09 ~ 2013.02 Leader of research and development team of Care Gen

2013.06 ~ 2016.03 Leader of research and development team of Ami Cosmetics

2016.03 ~ Currently Headquarter director of Korea Institute of Dermatological Sciences

**Research performance**

-Internationally known SCI level academic thesis

• Hong I, Rho HS, Kim DH, Lee MO. (2010) Activation of LXRα induces lipogenesis in HaCaT cells. Arch Pharm Res. 33(9):1443-9.

• Na TY, Shin YK, Roh KJ, Kang SA, Hong I, Oh SJ, Seong JK, Park CK, Choi YL, Lee MO. (2009) Liver X receptor mediates hepatitis B virus X protein-induced lipogenesis in hepatitis B virus-associated hepatocellular carcinoma. Hepatology. 49(4):1122-31.

• Lee MH, Hong I, Kim M, Lee BH, Kim JH, Kang KS, Kim HL, Yoon BI, Chung H, Kong G, Lee MO. (2008) Gene expression profiles of murine fatty liver induced by the administration of methotrexate. Toxicology. 10;249(1):75-84.

• Kang BY, Kim S, Lee KH, Lee YS, Hong I, Lee MO, Min D, Chang I, Hwang JS, Park JS, Kim DH, Kim BG. (2008) Transcriptional profiling in human HaCaT keratinocytes in response to kaempferol and identification of potential transcription factors for regulating differential gene expression. Exp Mol Med. 30;40(2):208-19.

• Hong I, Lee MH, Na TY, Zouboulis CC, Lee MO. (2007) LXRalpha enhances lipid synthesis in SZ95 sebocytes. J Invest Dermatol. 128(5):1266-72.

• Gene expression profiles of murine fatty liver induced by the administration of valproic acid. Lee MH, Hong I, Kim M, Lee BH, Kim JH, Kang KS, Kim HL, Yoon BI, Chung H, Kong G, Lee MO. Toxicol Appl Pharmacol. 1;220(1):45-59.

• Kim S, Hong I, Hwang JS, Choi JK, Rho HS, Kim DH, Chang I, Lee SH, Lee MO, Hwang JS. (2006) Phytosphingosine stimulates the differentiation of human keratinocytes and inhibits TPA-induced inflammatory epidermal hyperplasia in hairless mouse skin. Mol Med.12(1-3):17-24.

## ■ Woncheol Kim (Senior researcher, Master of Engineering)

**Educational background**

2011.03 ~ 2013.02 Master of Engineering, Department of Biotechnology, Inha University

**Career**

2012.12 ~ 2016.06 Researcher of Miwon Commercial Co., Ltd.

2016.07 ~ 2021.06 Senior Researcher of DERMAPRO Ltd.

2021.07 ~ Currently Senior Researcher of Korea Institute of Dermatological Sciences

## ■ Tae Yeop Kim (Chief researcher, Bachelor of Science)

**Educational background**

2011.03 ~ 2019.08 Bachelor of Science , Department of Life Sciences, Hanyang University

**Career**

2019.10 ~ Currently Chief researcher of Korea Institute of Dermatological Sciences

## ■ Ye Bin Jung (Researcher, Bachelor of Engineering)

**Educational background**

2017.03 ~ 2021.02 Bachelor of Engineering, Bachelor of Cosmetic Science and Technology, Mokwon University

**Career**

2021.06 ~ Currently Researcher of Korea Institute of Dermatological Sciences

## ■ Eun Min Park (Researcher, Bachelor of Engineering)

**Educational background**

2017.03 ~ 2021.02 Bachelor of Engineering, Bachelor of Cosmetic Science and Technology, Daegu Haany University

**Career**

2022.02 ~ Currently Researcher of Korea Institute of Dermatological Sciences

## ■ Won Ung Shin (Dermatologist)

**Educational background and career**

2002.03 ~ 2008.02 Korea University College of Medicine

2010.03 ~ 2012.02 Korea University Graduate School of Medicine, Dermatology

2009.03 ~ 2013.02 Korea University Guro Hospital, Dermatologist

2016.03 ~ 2018.02 Director of Renewme Skin Clinic, Jamsil Branch

2018.02 ~ Currently Adjunct Professor at Korea University College of Medicine

2018.02 ~ Currently Director of Timeless Dermatology, Dogok Branch

**Research performance**

-Internationally known SCI level academic thesis


- Baek YS, Shin WU, Song HJ, Oh CH, Son S. (2013) Plantar leukocytoclastic vasculitis with detection of herpes simplex virus type 2 by PCR assay. *Int J Dermatol*. Nov;52(11):1434-5.
- Lee O, Jeong SH, Shin WU, Lee G, Oh C, Son SW. (2013) Influence of surface charge of gold nanorods on skin penetration. *Skin Res Technol*. Feb;19(1):e390-6.
- Kim JH, Baek YS, Shin WU, Oh CH, Kim JH. (2015) Acquired dyskeratotic leukoplakia of the lip and conjunctiva. *Int J Dermatol*. Mar;54(3):332-3.
- Shin WU, Baek YS, Kim TJ, Oh CH, Kim J. (2013) Laboratory tests and compliance of dermatologic outpatients. *F1000Res*. Oct 7;2:206.
- Wong TW, Liao SZ, Ko WC, Wu CJ, Wu SB, Chuang YC, Huang IH. (2019) Indocyanine Green-Mediated Photodynamic Therapy Reduces Methicillin-Resistant Staphylococcus aureus Drug Resistance. *J Clin Med*. Mar 25;8(3):411.
- Shin WU, Baek YS, Oh TS, Heo YS, Son SB, Oh CH, Song HJ. (2011) Birt-hogg-dube syndrome, a rare case in Korea confirmed by genetic analysis. *Ann Dermatol*. Oct;23(Suppl 2):S193-6.

## ■ Kyung Goo Lee (Dermatologist)

**Educational background and career**

2002.03 ~ 2008.02 Korea University College of Medicine

2010.03 ~ 2012.02 Korea University Graduate School of Medicine, Dermatology

2009.03 ~ 2013.02 Korea University Ansan Hospital, Dermatologist

2013.03 ~ 2014.02 Public health doctor at Gimcheon Juvenile Prison

2014.03 ~ 2016.02 Director of Dermatology, Cheongju Hansen Welfare Association

2016.03 ~ 2017.02 Director of Renewme Skin Clinic, Jamsil Branch

2016.03 ~ 2017.02 Director of Jayjun Dermatology

2018.02 ~ Currently Adjunct Professor at Korea University College of Medicine

2018.02 ~ Currently Director of Timeless Dermatology, Dogok Branch

**Research performance**

-Internationally known SCI level academic thesis

- Lee KG, Son SW. (2011) Efficacy of korean red ginseng in the treatment of atopic dermatitis. *J Ginseng Res*. Jun;35(2):149-54.
- Jung SK, Jang HW, Kim HJ, Lee SG, Lee KG, Kim SY, Yi SM, Kim JH, Kim IH. (2014) A Prospective, Long-Term Follow-Up Study of 1,444 nm Nd:YAG Laser: A New Modality for Treating Axillary Bromhidrosis. *Ann Dermatol*. Apr;26(2):184-8.
- Kim JH, Yi SM, Kim S, Lee KG, Kim IH. (2011) Barbed suture suspension technique for prevention of lower eyelid ectropion after Mohs micrographic surgery. *Ophthalmic Plast Reconstr Surg*. May-Jun;27(3):e79-81.
- Yi SM, Lee KG, Kim JH, Choi JE, Ro KW, Kim IH. (2011) Single-stage reconstruction of nasal ala and perialar defect with island pedicle flap and Burow's graft. *Dermatol Surg*. Jun;37(6):851-4.
- Lee KG, Kim SA, Yi SM, Kim JH, Kim IH. (2014) Subdermal Coagulation Treatment of Axillary Bromhidrosis by 1,444 nm Nd:YAG Laser: A Comparison with Surgical Treatment. *Ann Dermatol*. Feb;26(1):99-102.

## ■ Ga Ram Kim (Director of Quality Assurance · Doctor of Engineering)

**Educational background and career**

2010. 03 ~ 2012.02 Master's degree in Biotechnology, Graduate School of General Studies, Konkuk University

2012.03 ~ 2016.08 Ph.D. in Biotechnology, Graduate School of General Studies, Konkuk University

2012.03 ~ 2020. 04 Senior Researcher at the Korea Institute of Skin Science

2018.03 ~ Currently Industry-academic professor of cosmetics engineering at Konkuk University

2020. 05 ~ Currently Director of Quality Assurance at the Korea Institute of Skin Science

**Research performances**

- Internationally known SCI level academic thesis

• Lee J, An S, Jung JH, *et al.* (2019) MUL1 E3 ligase regulates the antitumor effects of metformin in chemoresistant ovarian cancer cells via AKT degradation. *Int. J. Oncol.,* 54: 1833-1842.

• Kim K, An S, Choi BG, *et al*. (2017) Arctiin regulates collagen type 1α chain 1 mRNA expression in human dermal fibroblasts via the miR-378b-SIRT6 axis. *Mol. Med. Rep.,* 16: 9120-9124.

• Joo DH, An S, Choi BG, *et al.* (2017) MicroRNA-378b regulates α-1-type 1 collagen expression via sirtuin 6 interference. *Mol. Med. Rep.,* 16: 8520-8524.

• Shin S, Kim K, Lee MJ, *et al*. (2016) Epigallocatechin Gallate-Mediated Alteration of the MicroRNA Expression Profile in 5α-Dihydrotestosterone-Treated Human Dermal Papilla Cells. *Ann. Dermatol.,* 28: 327-334.

• Choi S, Youn J, Kim K, *et al*. (2016) Apigenin inhibits UVA-induced cytotoxicity *in vitro* and prevents signs of skin aging in vivo. *Int. J. Mol. Med.,* 38: 627-634.

• Hahn HJ, Youn HJ, Cha HJ, *et al.* (2016) Single Low-Dose Radiation Induced Regulation of Keratinocyte Differentiation in Calcium-Induced HaCaT Cells. *Ann. Dermatol.,* 28: 433-437.

• Cha HJ, Bae S, Kim K, *et al*. (2015) Overdosage of methylparaben induces cellular senescence in vitro and in vivo. *J. Invest. Dermatol*., 135: 609-612.

• Bae S, Kim K, Cha HJ, *et al*. (2015) Low-dose γ-irradiation induces dual radio-adaptive responses depending on the post-irradiation time by altering microRNA expression profiles in normal human dermal fibroblasts. *Int. J. Mol. Med.*, 35: 227-237.

• Bae S, Kim K, Cha HJ, *et al.* (2014) Altered microRNA expression profiles are involved in resistance to low-dose ionizing radiation in the absence of BMI1 in human dermal fibroblasts. *Int. J. Oncol.*, 45: 1618-1628.

• Kim K, An S, Cha HJ, *et al.* (2012) Lenalidomide induces apoptosis and alters gene expression in non-small cell lung cancer cells. *Oncol. Left.*, 5: 588-592.

• Bae S, Kim SY, Jung JH, *et al*. (2012) Akt is negatively regulated by the MULAN E3 ligase. *Cell Res*.,

22: 873-885.

• Bae S, Jeong HJ, Cha HJ, *et al*. (2012) The hypoxia-mimetic agent cobalt chloride induces cell cycle arrest and alters gene expression in U266 multiple myeloma cells. *Int. J. Mol. Med.*, 30: 1180-1186.

• Bae S, Jung JH, Kim K, *et al*. (2012) TRIAD1 inhibits MDM2-mediated p53 ubiquitination and degradation. *FEBS Lett.*, 586: 3057-3063.

• Choi YM, An S, Lee EM, *et al.* (2012) CYP1A1 is a target of miR-892a-mediated posttranscriptional repression. *Int. J. Oncol.*, 41: 331-336.

• Bae S, Lee EM, Cha HJ, *et al*. (2011) Resveratrol alters microRNA expression profiles in A549 human non-small cell lung cancer cells. *Mol. Cells*, 32: 243-249

# [Appendix 2] Facilities of the organization

- Korea Institute of Dermatological Sciences (KIDS) expertly performs the non-invasive clinical studies with human subjects for the safety and efficacy of functional cosmetics, common cosmetics, and other cosmetic products.
- KIDS is established by dermatologists, professors and researchers in Department of Dermatology, Cosmetic Biology, and Biological Sciences.
- All of studies in KIDS are conducted according to the laws and regulations of designation as the test institution for drugs, quasi-drugs, cosmetics, and medical devices; the guidelines of the management standards for clinical drug evaluations; the guidelines of *in vivo* clinical and *in vitro* evaluation studies; the guidelines of the experimental methods for cosmetic display and advertisements; and the guidelines of the validation of functional cosmetics of the Ministry of Food and Drug Safety, Republic of Korea; the laws of the bioethics and safety of the Ministry of Health and Welfare, Republic of Korea; and the standard operation procedure of the KIDS.
- Evaluation and Research Fields

| 1. Efficacy evaluation |
|---|
| Skin whitening |
| Inhibition of melanogenesis |
| Skin hydration |
| Skin sebum secretion |
| Skin desquamation and regeneration |
| Stratum corneum recovery |
| Stratum corneum turnover |
| Epidermal barrier quality |
| Anti-aging |
| Skin wrinkle |
| Skin lifting effects |
| Skin biomechanical properties and elasticity |
| Skin thickness and dermis density |
| Transepidermal water loss |
| Cleansing effects |
| Anti-microbial effects |
| Irritation prevention |
| Calming effects |
| Anti-inflammatory effects |
| Anti-acne effects |
| Protection and recovery against free radicals |
| *Demodex folliculorum* removal |
| Improvement of skin pore |

| |
|---|
| Improvement of scalp condition |
| Anti-dandruff effects |
| Prevention of hair loss and hair growth |
| Curling effects of eyelashes |
| Sliming |
| Cellulite treatment effects |
| Breast lifting and firming effects |
| Edema reducing effects |
| 2. Safety evaluation |
| Human patch test |
| Repeat insult parch test |
| Cumulative test |
| Stinging potential test |
| Modified lactic acid stinging test |
| Phototoxicity and photosensitization |
| Usage test |
| 3. Sensory evaluation |
| Subjective evaluation |
| Questionnaire on usability assurance |
| 4. Cell efficacy evaluation and mechanism studies |
| 2D and 3D cell culture based experiments (keratinocytes, melanocytes, dermal fibroblasts, sebocytes, dermal papilla cells, immune cells, fat cells, primary cells, etc.) |
| Various biochemical experiments |
| Skin cell and molecular biology |
| Anti-aging and senescence |
| Melanogenesis |
| Anti-inflammation |
| Cell growth, migration, cell cycle arrest, autophagy, and apoptosis |
| Cell differentiation |

• Major Facilities and Laboratories

| |
|---|
| Constant Temperature and Humidity Sector |
| Clinical Data Analysis Room |
| Clinical Efficacy Room |
| Efficacy Evaluation Room |
| Safety Evaluation Room |
| Functional Evaluation Room |
| UV Irradiation Room |

| |
|---|
| Waterproof Evaluation Room |
| Cellular Efficacy Room |
| 3D Skin Cell Culture Room |
| 3D Image Processing Room |
| In Vitro Experiment Equipment Room |
| Studio |
| Dark Room and Film Analysis Room |
| Data Storage Room |
| Storage Room |
| Washing Room |
| Microscope Room |
| Molecular Targeted Drug and Biomedical Research Lab |
| Cell Culture and Analysis Room |
| DNA and Gene Analysis Room |
| Protein and Enzyme Analysis Room |
| Microorganism Culture and Analysis Room |
| Highly Functional Biomaterial Screening Room |
| Bioactive Material Isolation and Purification Room |
| Super Precisional Material Analysis Room |
| Freezer and Incubator Room |
| Volunteer Waiting Room |
| Volunteer Counseling Room |
| Volunteer Locker Room |
| Conference Room |
| Office for Director |
| Office for Researchers |
| Administrative Office |

# [Appendix 3] Details of test results

| Subject | | ITA° of test site | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. | code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Mean |
| 1 | KIDS-FS0213-317 | 31.1 | 31.5 | 31.4 | 31.8 | 31.9 | 32.1 | 32.1 | 31.9 | 32 |
| 2 | KIDS-FS0213-441 | 44.2 | 44.0 | 44.1 | 44.3 | 44.2 | 44.1 | 44.1 | 44.1 | 44 |
| 3 | KIDS-FS0214-537 | 53.4 | 53.6 | 53.5 | 53.6 | 53.7 | 53.7 | 53.9 | 54.1 | 54 |
| 4 | KIDS-FS0214-474 | 47.1 | 47.4 | 47.3 | 47.2 | 47.4 | 47.4 | 47.5 | 47.5 | 47 |
| 5 | KIDS-MS0221-391 | 39.0 | 39.1 | 39.2 | 39.0 | 39.1 | 39.2 | 39.1 | 39.2 | 39 |
| 6 | KIDS-FS0222-425 | 42.3 | 42.9 | 42.5 | 42.3 | 42.4 | 42.6 | 42.6 | 42.4 | 42 |
| 7 | KIDS-MS0222-511 | 50.5 | 51.7 | 51.4 | 50.5 | 51.1 | 51.3 | 51.2 | 51.2 | 51 |
| 8 | KIDS-MS0227-463 | 46.2 | 46.1 | 46.4 | 46.5 | 46.5 | 46.3 | 46.1 | 46.0 | 46 |
| 9 | KIDS-FS0227-435 | 43.6 | 43.6 | 43.5 | 43.2 | 43.2 | 43.2 | 43.5 | 44.2 | 44 |
| 10 | KIDS-FS0301-403 | 40.8 | 40.9 | 40.2 | 39.7 | 39.5 | 40.2 | 40.3 | 41.0 | 40 |

| ISO 24444:2019 Test Method | | | | Test Code: KIDS-CSCR02-035 | | | |
|---|---|---|---|---|---|---|---|
| Laboratory: Korea Institute of Dermatological Sciences | | | | | | | |
| Start Date: 2023-02-13 | | | | End Date: 2023-03-03 | | | |
| Test Product Description: GLUTANEX Sun stick | | | | | | | |
| Expected SPF: 50 | | | | Dose Increments: 1.15x | | | |
| UV source: Multiport® Model 601-300W V2.5, Xenon Lamp (Solar Light Company, Inc.) | | | | | | | |
| | TEST | | | SIM | TEST SUBJECTS | | | |
| Subj. | Exposure | Applied | Read | SIM EE (hightes) | Subject | | | Skin |
| No. | data | by | by | W/m$^2$ eff. | code | age | gender | ITA° |
| 1 | 2023-02-13 | KTY | KWC | 11.3 | KIDS-FS0213-317 | 24 | F | 32 |
| 2 | 2023-02-13 | KTY | KWC | 11.3 | KIDS-FS0213-441 | 29 | F | 44 |
| 3 | 2023-02-14 | KTY | KWC | 11.3 | KIDS-FS0214-537 | 24 | F | 54 |
| 4 | 2023-02-14 | KTY | KWC | 11.3 | KIDS-FS0214-474 | 28 | F | 47 |
| 5 | 2023-02-21 | KTY | KWC | 11.3 | KIDS-MS0221-391 | 29 | M | 39 |
| 6 | 2023-02-22 | KTY | KWC | 11.3 | KIDS-FS0222-425 | 24 | F | 42 |
| 7 | 2023-02-22 | KTY | KWC | 11.3 | KIDS-MS0222-511 | 26 | M | 51 |
| 8 | 2023-02-27 | KTY | KWC | 11.3 | KIDS-MS0227-463 | 21 | M | 46 |
| 9 | 2023-02-27 | KTY | KWC | 11.3 | KIDS-FS0227-435 | 24 | F | 44 |
| 10 | 2023-03-01 | KTY | KWC | 11.3 | KIDS-FS0301-403 | 26 | F | 40 |
| Mean | | | | | | 25.5 | | |
| SD | | | | | | 2.6 | | |

| Subj. | Subject | MEDu1 | | MEDu2 | | MEDp | | | Reject? |
|---|---|---|---|---|---|---|---|---|---|
| No. | code | h:mm:ss | J/m$^2$ | h:mm:ss | J/m$^2$ | h:mm:ss | J/m$^2$ | SPFis | Y/N |
| 1 | KIDS-FS0213-317 | 0:00:48 | 274 | 0:00:36 | 314 | 0:30:07 | 18106 | 57.6 | N |
| 2 | KIDS-FS0213-441 | 0:00:36 | 236 | 0:00:31 | 235 | 0:25:57 | 15601 | 66.3 | N |
| 3 | KIDS-FS0214-537 | 0:00:28 | 212 | 0:00:28 | 244 | 0:23:18 | 12191 | 49.9 | N |
| 4 | KIDS-FS0214-474 | 0:00:34 | 296 | 0:00:39 | 340 | 0:32:33 | 19569 | 57.5 | N |
| 5 | KIDS-MS0221-391 | 0:00:41 | 234 | 0:00:31 | 235 | 0:25:44 | 13464 | 57.2 | N |
| 6 | KIDS-FS0222-425 | 0:00:38 | 249 | 0:00:33 | 288 | 0:27:22 | 14318 | 49.7 | N |
| 7 | KIDS-MS0222-511 | 0:00:30 | 227 | 0:00:30 | 262 | 0:24:57 | 13054 | 49.8 | N |
| 8 | KIDS-MS0227-463 | 0:00:35 | 265 | 0:00:35 | 230 | 0:29:08 | 13250 | 57.6 | N |
| 9 | KIDS-FS0227-435 | 0:00:36 | 273 | 0:00:36 | 273 | 0:30:01 | 15705 | 57.5 | N |
| 10 | KIDS-FS0301-403 | 0:00:40 | 228 | 0:00:30 | 227 | 0:25:04 | 13115 | 57.7 | N |
| Mean | | | 249 | | 265 | | 14837 | 56.0 | |
| SD | | | 27 | | 39 | | 2409 | 5.1 | |

| Subj. | Subject | Reference Standard | | | | Reference Standard | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | code | P# | h:mm:ss | J/m$^2$ | SPF | P# | h:mm:ss | J/m$^2$ | SPF |
| 1 | KIDS-FS0213-317 | | | | | 8 | 0:38:01 | 22856 | 72.7 |
| 2 | KIDS-FS0213-441 | 2 | 0:08:21 | 3798 | 16.1 | | | | |
| 3 | KIDS-FS0214-537 | | | | | 8 | 0:29:25 | 17685 | 72.4 |
| 4 | KIDS-FS0214-474 | 2 | 0:10:29 | 4768 | 14.0 | | | | |
| 5 | KIDS-MS0221-391 | 2 | 0:08:17 | 3767 | 16.0 | | | | |
| 6 | KIDS-FS0222-425 | | | | | 8 | 0:34:33 | 18077 | 62.7 |
| 7 | KIDS-MS0222-511 | 2 | 0:08:02 | 3654 | 13.9 | | | | |
| 8 | KIDS-MS0227-463 | 2 | 0:09:23 | 3693 | 16.0 | | | | |
| 9 | KIDS-FS0227-435 | | | | | 8 | 0:37:53 | 22775 | 83.4 |
| 10 | KIDS-FS0301-403 | | | | | 8 | 0:31:38 | 19018 | 83.7 |
| Mean | | | | 3936 | 15.2 | | | 20082 | 74.9 |
| SD | | | | 469 | 1.1 | | | 2542 | 8.8 |

| | Mean SPF | s | n | t | 17% of mean SPF | c (t × s/√n) | CI[%] | 95% CI |
|---|---|---|---|---|---|---|---|---|
| Test Product | 56.0 | 5.1 | 10 | 2.262 | 9.5 | 3.7 | 6.5 | 52.3 to 59.7 (n=10) |

# [Appendix 4] Case Report Form

Korea Institute of Dermatological Sciences

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