

STATISTICAL ANALYSIS OF SKIN CARE FORMULATIONS

*A Major Project Report submitted in partial fulfillment of the
requirement for the degree of*

M.Sc. Statistics

(with specialization in Industrial Statistics)

by

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May 2024

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Kavayitri Bahinabai Chaudhari North Maharashtra University Jalgaon, Maharashtra

2023 - 24



CERTIFICATE

This is to certify that the report entitled **STATISTICAL ANALYSIS OF SKIN CARE FORMULATIONS** submitted by **Rohit Ashok Chaware** (379351), **Bhushan Sahebrao Patil** (379362), **Prachi Vinod Badgujar** (379345) to Department of Statistics in partial fulfillment of the M.Sc. Statistics with specialization in Industrial Statistics, at Kavayitri Bahinabai Chaudhari, North Maharashtra University, Jalgaon have successfully completed their project work under my guidance and supervision during the academic year 2023-2024.

Prof. R. D. Koshti
Project Guide
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Abstract

The demand for effective skincare products continues to rise as individuals seek solutions to maintain healthy and radiant skin. However, the efficacy and safety of these formulations often remain uncertain, necessitating rigorous comparative evaluation through scientific investigation. The aim of this project is to conduct a comprehensive comparative evaluation of three skincare formulations to assess their efficacy, safety, and suitability for diverse skin types. Through a series of controlled clinical trials, we systematically analyze the performance of various formulations in improving skin health, addressing specific concerns such as hydration, elasticity, and various other parameters.

Statistical analysis are employed to compare the efficacy of the formulations and identify any significant differences in outcomes. Safety assessments will also be conducted to evaluate potential adverse effects and ensure product suitability for widespread use. Ultimately, our objective is to contribute to the advancement of evidence-based skincare practices and promote consumer confidence in the products they use.

Acknowledgement

We would like to start by expressing our sincerest gratitude to our project guide, **Dr. Rohan Koshti**, Assistant Professor in the Department of Statistics at Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon for his expertise, guidance, and enthusiastic involvement during our coursework.

We would like to acknowledge the support and guidance provided by **Mr. Vishal Pardeshi, Mr. Prashant Patil, Miss. Pratibha Shelar** whose expertise and mentorship have been instrumental throughout the project. Their invaluable insights and encouragement have greatly enriched our work.

We express our special thanks to our parents for their encouragement and constant moral support, and to our friends and colleagues for being supportive during the course of this project.

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List of Medical Terms

- **In vivo** : Research done on a living organism.
- **Efficacy** : It indicates how well a treatment works.
- **Formulations** : Formulations refer to the specific composition or mixture of ingredients used to create a pharmaceutical or cosmetic product.
- **Test product reference** : Standardized sample or control used as a reference point for comparison in experiments or studies.
- **Subject Self Evaluation** : Assessment or evaluation of a participant's own condition, symptoms, or experiences in a study or clinical trial.
- **Cosmetic Acceptability** : refers to the degree to which a cosmetic product is tolerated or deemed suitable by users .
- **Dermatological evaluation** : Refers to the assessment of the skin's health, condition, and response to treatments or interventions by a dermatologist
- **Chromametry** : This technique measures skin color using specialized instruments.
- **Corneometry** : Corneometry measures the hydration levels of the stratum corneum, the outermost layer of the skin.
- **Sebumetry** : This technique measures skin color using specialized instruments.
- **Mexametry** : Measures skin melanin and erythema levels using a device called a mexameter.
- **Tewametry** : Tewametry measures transepidermal water loss (TEWL), which is the loss of water through the skin's surface.
- **Cutometry** : Elasticity measurement or biomechanical analysis, assesses the mechanical properties of the skin, including its elasticity, firmness.
- **Subjects** : Refer to the individuals who participate in the study by undergoing interventions, treatments, or assessments.
- **Protocol** : A protocol is a detailed plan or set of guidelines that outlines the objectives, design, methodology, procedures, and analysis plan for a clinical trial or research study.

- **Inclusion Criteria** : These are specific characteristics or conditions that individuals must have to be eligible for participation in the study.
- **Exclusion Criteria** : These are specific characteristics or conditions that would disqualify individuals from participating in the study.
- **Innocuousness** : Innocuousness refers to the quality of being harmless or not causing harm.
- **Tolerance Assessment** : This subsection outlines the methods or tools used to assess participants' tolerance to the intervention.
- **Adverse Effects Monitoring** : This subsection describes the procedures for monitoring participants for adverse effects or side effects related to the intervention.
- **CRA** : CRA stands for Clinical Research Associate. A CRA is a healthcare professional responsible for monitoring clinical trials .
- **Erythema** : Erythema refers to redness or inflammation of the skin, often caused by dilation of blood vessels in response to injury, irritation, or infection..
- **Itching** : Is a sensation that triggers the desire to scratch the skin.
- **Oedema** : is the abnormal accumulation of fluid in the body's tissues, leading to swelling or puffiness. .
- **Scaling** : Scaling, also known as desquamation, is the shedding or flaking of the outermost layer of the skin.
- **Acclimatization** : Acclimatization refers to the process by which an individual gradually adapts to a new environment or climate over time.
- **L*** : In colorimetry, L* represents the lightness or brightness of a color on a scale from total black ($L^*=0$) to total white ($L^*=100$). .
- **ITA°** : ITA° helps describe the perceived color of an object in relation to a reference point, typically in applications such as color matching, quality control, or color analysis.
- **ΔE^*94** : Used to quantify the difference or distance between two colors in the CIELAB color space.
- **Adverse Event Reporting** : This subsection details the process for documenting, reporting, and managing adverse events encountered during the study.
- **Safety Monitoring** : Includes provisions for ongoing safety monitoring throughout the study, including interim analyses of safety data, protocol amendments to address safety concerns, and procedures for suspending or terminating the study in the event of significant safety issues.

Chapter 1

INTRODUCTION

In the vibrant world of skincare, where countless products promise radiant and healthy skin, our study takes a closer look at three fairness creams—Product A, Product B, and Product C. As we navigate through the complexities of skincare, our focus is not just on the promises these creams make, but on understanding how well they actually work, especially after exposure to the sun.

Skin, the largest organ of the human body, is subjected to various environmental stressors, including sunlight, pollution, and aging. These stressors can lead to skin damage, uneven pigmentation, and premature aging. Fairness creams, often marketed as solutions to these concerns, claim to offer moisturization, radiance, and an even skin tone.

Our study employs rigorous statistical tests and methods to assess the efficacy and safety of these fairness creams. By conducting controlled experiments and objective measurements, we aim to provide reliable data on their performance. Specifically, we will measure parameters such as hydration levels, melanin production, and skin texture before and after application, using established dermatological assessment tools.

As we delve into our investigation, it's essential to recognize that skincare is not merely about enhancing beauty—it's about promoting skin health and overall well-being. Therefore, our study extends beyond cosmetic effects to evaluate the potential health implications of using these products. We seek to determine whether these creams are safe for long-term use and whether they offer tangible benefits beyond cosmetic improvement.

This study isn't just about beauty; it's about health and well-being. By the end, we hope to unravel the mysteries of skincare, providing insights that help dermatologists and skincare enthusiasts make informed decisions about the products chosen for skin.

Chapter 2

SUMMARY OF STUDY

In this exploration, we delved into the world of skincare, specifically focusing on the efficacy and safety of three fairness creams—Product A, Product B, and Product C. Our primary goal was to understand how these creams perform after routine sun exposure, addressing key factors like moisturization, skin radiance, brightening, and even skin tone.

2.1 Objective

To evaluate and compare the in-vivo safety and efficacy of three skincare formulations post-routine sun exposure, focusing on factors such as moisturization, skin radiance, skin brightening, improvement in even skin tone, skin firmness, reduction in dark spots (acne PIH), reduction in under-eye dark circles, and skin oiliness/sebum on healthy female subjects.

Primary objective To assess the efficacy of three skincare formulations post-routine sun exposure in terms of moisturization, skin radiance, skin brightening, and improvement in even skin tone.

Secondary objective is to assess the efficacy of three skin care formulations, post routine sun exposure in terms of skin firmness, reduction in dark spots (acne PIH), reduction in under eye dark circles, skin oiliness/ sebum.

The evaluation is performed using:

Fairness Cream		
Product A	Product B	Product C

- Subject Self Evaluation
- Dermatological Evaluation: Cosmetic Acceptability
- Dermatological Evaluation: Efficacy
- Chromametry
- Corneometry
- Sebumetry
- Mexametry
- Tewametry
- Cutometry

The study lasts 21 days following first application of the test product on the whole face.

2.2 Population

108 Female subjects are selected for the study. The study is conducted in 3 groups.

Group A (36 female subjects)	Product A
Group B (36 female subjects)	Product B
Group C (36 female subjects)	Product C

The subjects selected for this study are healthy females, aged between 18 to 35 yrs old, age having dull skin with dark spots (acne PIH), under eye dark circle, oily to mixed oily skin type & dark to wheatish skin (L^* between 45 to 55), with their daily routine involving atleast 2 hours of sun exposure.

2.3 Study Design

- Study is carried out as a “double blind test”. Neither the participating subjects nor the investigator are aware of the type of product being applied throughout the study; only the sponsor is aware of the nature of the products.
- Comparative & Randomized study

2.4 Study Duration

Duration: 21 days following the first application of the test product.

Table 2.1: Screening Schedule

Activity	Visit				
	Screening	T0	T+7Days	T+14Days	T+21Days
Registration	✓				
Protocol Briefing	✓				
Consent	✓				
ICF		✓			
Demographics	✓				
Inclusion and Non-Inclusion criteria by the Dermatologist	✓	✓			
Habits Questionnaire	✓				
Concomitant Medication	✓	✓	✓	✓	✓
History Questionnaire	✓				
Routine checkup	✓				
Prescriptions and Restrictions			✓	✓	✓
Subject Self Evaluation			✓	✓	✓
Dermatological Evaluation: Cosmetic acceptability			✓	✓	✓
Dermatological Evaluation: Efficacy			✓	✓	✓
Chromametry	✓	✓	✓	✓	✓
Corneometry			✓	✓	✓
Sebumetry			✓	✓	✓
Mexametry			✓	✓	✓
Cutometry			✓	✓	✓
Tewametry			✓	✓	✓
Distribution of Products, Products Instruction & Diary Sheet					✓
Products application with instructions and recording in information and in diary sheet					✓
Retrieval of Product & Diary Sheet					✓
AE/SAE Monitoring			✓	✓	✓

Chapter 3

STUDY PROTOCOL

Organisation selects subjects based on a questionnaire filled in by the investigator prior to the study. The questionnaire provides details of their medical history, possible allergies, skincare and makeup habits, as well as a certain amount of administrative information.

3.1 Subject Selection

The selection procedure includes:

- A preliminary interview, during which the following points are explained to the subjects: the study's modalities, its practical considerations, possible payment, as well as any possible cosmetic benefits, inconveniences or potential risks.
- All essential information is then provided to the subject to read.
- The consent form is read, approved, and signed by the subject to indicate their free acceptance of the study conditions as described to them.
- In the event of any claims for damages, subjects can benefit from the terms of the insurance policies taken out by the Clinical Research Organisation once accepted into the study by the study manager.

The subject must respect the following conditions:

- Available for the entire duration of the study.
- Motivated to freely participate in the study.
- Willing to follow the full product application procedure.
- Able to justify a permanent address.

- Able to understand Hindi, Marathi and/or English language: i.e. only Hindi, Marathi and/or English-speaking subjects capable of reading the consent documents and able to accept the participation conditions.
- No individual sentenced to imprisonment by a court decision or by an administrative decision, or hospitalized without consent, or admitted in a medical or social establishment.
- No minor as well as individual of age benefiting from a legal protection measure or enable to express his/her consent.

The subjects selected for the study are chosen under the supervision of the investigator and study incharge, on the basis of the inclusion/non inclusion criteria listed below.

3.1.1 Inclusion criteria

Standard criteria

- Indian female subjects
- Healthy subjects (no infectious and evolutive pathology which could make the subject vulnerable and stop the study, no pathology which could interfere with the study, no symptom in the process of an exploratory checkup)
- Between 18 and 35 years of age.
- Skin is healthy on the studied anatomic unit (free of eczema, wounds, inflammatory scar...)

Specific criteria

- Having dull skin with dark spots (acne PIH)
- Having under eye dark circle
- Having dark to wheatish skin (L^* between 45 to 55)
- Having oily to mixed oily skin type.
- Having daily routine involving atleast 2 hours sun exposure

3.1.2 Exclusion criteria

Specific criteria

- Being pregnant or breastfeeding or having stopped to breastfeed in the past three months
- Having refused to give her assent by not signing the consent form
- Taking part in another study liable to interfere with this study

- Being insulin-dependent diabetic or non-insulin-dependent diabetic with a recent therapy (less than 6 months)
- Having non stabilized thyroid problems (requirement of a stabilized treatment for at least 6 months)
- Following a chronic medicinal treatment comprising any of the following products: aspirin-based products, anti-inflammatories, anti-histamines, corticotherapy, taken by general or local routes (the only medication permitted is paracetamol).
- Having cutaneous hypersensitivity.
- Having undergone a surgery requiring a general anaesthetic of more than one hour in the past 6 months.
- Having changed her cosmetic habits in the 14 days preceding the start of the study on the studied anatomic unit.
- Having applied a cosmetic product (included make-up) on the studied areas the first day of the study (only face cleaned with water is accepted)

3.2 The Product

3.2.1 Presentation of the product

The test product is supplied free of charge by the study sponsor. For product identification, purity determination, composition, innocuousness, and any other characteristics of each product to be tested prior to the beginning of the study.

The study sponsor must supply a safety assessment certificate for the tested product.

3.2.2 Product application

Products	Application area	Frequency	Duration	Conservation
Fairness cream: Product A	Whole Face	Twice a day	21 days	Ambient temperature
Fairness cream: Product B	Whole Face	Twice a day	21 days	Ambient temperature
Fairness cream: Product C	Whole Face	Twice a day	21 days	Ambient temperature

Modalities of application: Cleanse your face with water. Take approximately 0.5gm of Product on tip of index finger. Apply dot wise on face message with upward strokes until the product is absorbed (avoid eyes). Ensure that you don't rub the product into your skin. Apply test product once in a day at morning on whole face for the period of 21 days.

Note: The usual cleanser/ soap can be kept during the study. Wash the face only with water on study visits i.e., T+7, T+14 days and T+21 days in morning

3.2.3 Tolerance - Adverse Effects

Any adverse event occurring during the study is followed by the Investigator / Co-Investigator. For each adverse event, the investigator will inform the study sponsor as per regulatory norms. The investigator will evaluate the severity of the adverse event, considering the chronology of appearance of the signs, the antecedents, and will initiate the appropriate supervision (medical examination). The Study Sponsor is informed about the evolution of the signs. Each case is followed until the complete disappearance, in order to determine the possible link with the tested product or the method. In function with the signs observed, an allergologic exploration could be instaured. All the medical data are recorded in a confidential file.

The study sponsor is responsible to declare the adverse events to the authorities following the laws in effect and assumes the indemnification, as well as all the damages caused to the volunteer, since it is proved the Study Sponsor responsibility. It is the reason why the Investigator required to the Study Sponsor an insurance to cover their civil liability with regards to the subjects.

3.3 Study Procedure

3.3.1 Subject Self Evaluation

- **Principle :** The subjects are asked to answer self-evaluation questionnaire at Day 1 (T_0) , Day 7 ($T_0 + 7$), Day 14 ($T_0 + 14$) & Day 21 ($T_0 + 14$) to evaluate the overall opinion and their attitude towards the safety and efficacy of the product.
- **Studied area :** Whole face
- **Procedure :** The questionnaires is filled in the organisation office. The subjects fills the questionnaire individually without any extrinsic influences (other volunteers and results of technical measurements). The filling of the questionnaires will be performed under control of the CRA who checks the acquisition according to standard procedure.

The detailed questionnaires are presented in appendix 4.

3.3.2 Dermatological Evaluation (Cosmetic Acceptability)

- **Principle** : Safety of the product is assessed by the dermatologist, through the grading on the face of defined clinical signs (observed by the dermatologist) and functional signs (felt by the subjects and reported to the dermatologist), at Day 1 T_0 , Day 7($T_0 + 7$), Day 14 ($T_0 + 14$), Day 21 ($T_0 + 21$) Day visit, as follows:

Table 3.1: Clinical Signs and Functional Signs (Transposed)

Clinical Signs	Erythema	Oedema	Dryness	Scaling	Peeling
Functional Signs	Itching	Tingling	-	-	-

- **Environmental conditions** : The evaluation is carried out under a controlled temperature and relative humidity (temperature: 20°C to 25°C, hygrometry: 50 ±10%). The lighting is ensured by a ceiling lamp.
- **Subject** : A 20-minute period of acclimatization in the air-conditioned room is respected for the subject prior the measurements (temperature: 20°C to 25°C, hygrometry: 50 ±10%).The subject is sitting on a chair facing the test site towards dermatologist.The subject is positioned just below a lamp of ceiling. All the shutters of the room are closed and the only light is provided by the lamp of the ceiling.
- **Studied areas** : Whole Face
- **Measures** : The dermatologist assesses each descriptor using the dedicated scale and reports the grade in the CRF.
- The result is given in terms of a score from 0 to 3 for each studied descriptor.The evaluation of the cosmetic acceptability is not submitted to a statistical analysis (descriptive analysis only).

3.3.3 Dermatological Evaluation by a Dermatologist (Efficacy)

- **Principle** : The overall product efficacy, is assessed by the dermatologist, through the grading at Day 1 T_0 , Day 7($T_0 + 7$), Day 14 ($T_0 + 14$), Day 21 ($T_0 + 21$) Day visit of the following parameters:
 - Density of dark spots (acne PIH) (Scale: 0 to 7)
 - Skin Even Tone (Scale: 1 to 10; where 1 = Poor, 5 = Good & 10 = Excellent)
 - Reduction in under eye dark circle (Scale: 1 to 10; where 1 = No dark Circle, 5 = Moderate dark circle with smaller area & 10 = severe dark circle with larger area)
 - Skin Brightening using shade card. (Scale: 1 to 10; 1 = Dark Skin & 10 = Fair Skin)

- **Environmental conditions** : The evaluation is carried out under a controlled temperature and relative humidity (temperature: 20°C to 25°C, hygrometry: 50 ±10%).
- **Subject** : A 20-minute period of acclimatization in the air-conditioned room is respected for the subject prior the measurements (temperature: 20°C to 25°C, hygrometry: 50 ±10%). The subject is sitting on a chair facing the test site towards the dermatologist. The subject is positioned just below a lamp of ceiling. All the shutters of the room are closed and the only light is provided by the lamp of the ceiling.
- **Studied areas** : Whole Face
- **Measures** : The dermatologist assesses each descriptor using the dedicated scale and reports the grade in the CRF.

Treatment of raw data

- **For dark spot reduction** : The result is given in terms of a score from 0 to 7 for density of dark spots. The decrease in the score shows an effect of the product in terms of reduction in density of dark spots.
- **For Skin even tone** : The result is given in terms of a score from 1 to 10 for even skin tone. The significant increase in the score for skin tone evenness shows an effect of the product in terms of Skin Even tone.
- **For Under Eye Dark Circles** : The result is given in terms of a score from 1 to 10 for under eye dark circle. The significant decrease in the score for under eye dark circle parameter shows an effect of the product in terms reduction in under eye dark circle.
- **For Skin Brightening** : The result is given in terms of a score from 1 to 10 for Skin Brightening. The significant increase in the score for parameter shows an effect of the product in terms of Skin Brightening.

3.3.4 Chromametry

- **Principle** : Tristimulus colorimeters are made of a control unit and a measurement head line associated. The measurement head line takes the measurements from a zone of 8mm in diameter and uses a diffuse lighting as well as an angle of 0° (including specular component). The headline measurement has a light with a pulsed xenon arch lamp. A double beam system measures the incident light and the reflected light by means of six photocells. The used material is a Chromameter CR-400 (Minolta).

- **Environmental conditions** : The evaluation is carried out under a controlled temperature and relative humidity (temperature: 20°C - 25°C, hygrometry: 50±10 %).
- **Subject** : A 20-minute period of acclimatization in the air-conditioned room is respected for the subjects prior to the measurements (temperature: 20°C - 25°C, hygrometry: 50±10 %). For the measurement on cheeks, the subject is seated on a chair.
- **Checking of the calibration** : A calibration is made for each supply of electricity to the device according to the recommendations of the manufacturer, by means of a white ceramic plate CR-A44, supplied with the device.
- **Studied areas and marking** : The measurements are performed on 3 sites (for skin even tone) Forehead & Both Cheekbone (for skin brightening) as shown in the below image. The site of the instrumental measurements and their location at the different points of the kinetics should be strictly the most reproducible. The location are determined by a cutaneous marking on the instrumental measurement sites at T0. In order to reposition this marking accurately while the measurements are taken, a mapping of the skin's surface, for the measurement site and for each subject, is made on a transparent film.



- **Measurements** Three measurements are carried out on the study area, for each subject and at each examination time on Day 1 T_0 , Day 7 ($T_0 + 7$), Day 14 ($T_0 + 14$), Day 21 ($T_0 + 21$) Day .
- **Parameters** L^* represents the relative brightness from total black ($L^*=0$) to total white ($L^*=100$).

$$ITA^\circ = \arctan\left(\frac{L^* - 50}{b^*}\right) \times \left(\frac{180}{\pi}\right)$$

individual typological angle

E*94 represents the relative difference in color between two given areas.

$$\Delta E_{94}^* = \sqrt{\left(\frac{\Delta L^*}{k_L S_L}\right)^2 + \left(\frac{\Delta C_{ab}^*}{k_C S_C}\right)^2 + \left(\frac{\Delta H_{ab}^*}{k_H S_H}\right)^2}$$

$$\Delta L^* = L_1^* - L_2^*$$

$$C_1^* = \sqrt{a_1^{*2} + b_1^{*2}}$$

$$C_2^* = \sqrt{a_2^{*2} + b_2^{*2}}$$

$$\Delta C_{ab}^* = C_1^* - C_2^*$$

$$\Delta H_{ab}^* = \sqrt{\Delta E_{ab}^{*2} - \Delta L^{*2} - \Delta C_{ab}^{*2}} = \sqrt{\Delta a^{*2} + \Delta b^{*2} - \Delta C_{ab}^{*2}}$$

$$\Delta a^* = a_1^* - a_2^*$$

$$\Delta b^* = b_1^* - b_2^*$$

$$S_L = 1$$

$$S_C = 1 + K_1 C_1^*$$

$$S_H = 1 + K_2 C_1^*$$

Where, kC and kH are usually both unity and the weighting factors kL, K1 and K2 depend on the application. It includes a commercial factor that weights the formula for Graphic Arts.

All the captured data was entered in excel manually from CRFs & was calculated subsequently, on Microsoft Excel file. As the data was captured manually the mean of the three measurements were performed for each site.

- A significant decrease in the E*94 parameter corresponds to an improvement of the skin tone evenness (skin homogeneity).
- A significant increase in L* parameter and ITA° parameter corresponds to an improvement in skin Brightening/ improvement in skin tone.

3.3.5 Corneometry

- **Principle** Corneometry is a technique used to determine the level of moisture in the outer layers of the stratum corneum. This method is based on the relationship between the electrical properties of skin tissues and their moisture content. The principle of corneometry consists in passing a high frequency electric current through the skin between two electrodes. The electric field produced in the epidermis is function to the geometry and the dielectric constant of the electrodes and of the capacitance of the skin in contact with the probe. A moisturizing variation of the skin is traduced by a modification of the total capacitance of the system. The apparatus used is a CM 825 (Courage and Khazaka, Germany).
- **Environmental conditions** The evaluation is carried out under a controlled temperature and relative humidity (temperature: 20°C to 25°C, hygrometry: 50±10%).
- **Checking the calibration** Prior to each series of measurements, the calibration of the device is checked according to the procedure supplied by the manufacturer.
- **Subject** A 20-minute period of acclimatization in the air-conditioned room is respected for the subjects prior to the measurements (temperature: 20°C to 25°C, hygrometry: 50±10%). The subject is sitting on a chair facing towards technician
- **Studied areas and marking** The measurements are performed on both Cheek bone. The site to be measured at each kinetics should be reproducible. The site is determined by a cutaneous marking at T0 with the help of transparency.

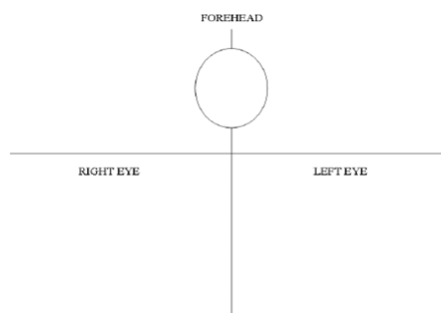


- **Measurements** At Day 1 T_0 , Day 7 ($T_0 + 7$), Day 14 ($T_0 + 14$), Day 21 ($T_0 + 21$) Day the measurements are carried out on both the cheek bones, after wiping delicately the skin with an absorbent paper. Three measurements are performed on the study areas for each subject and each examination time.
- **Influence of the operator behaviour on the technique** This technique is considered operator-dependent: for a given subject, the measurements are performed by the same technician at all the kinetics time points.

All the captured data are entered in excel manually from CRFs & are calculated subsequently, on Microsoft Excel file. The studied parameter is the capacitance, expressed in arbitrary units. An increase in the value of the parameter shows a moisturizing effect of the product.

3.3.6 Sebumetry

- **Principle** The sebum measurement on the skin as well as on the hair and scalp is based on the internationally recognized SEBUMETER® 815 method. It is a direct measurement of the sebum secretion on skin, hair and scalp. The measurement principle is the photometric method, the grease spot photometer. This method is not sensitive to moisture. For the determination of the sebum, the measuring head of the cassette is inserted into the aperture of the device, where a photocell measures the transparency. The light transmission represents the sebum content on the surface of the measuring area. A microprocessor calculates the result, which is shown on the display in $\mu\text{g sebum}/\text{cm}^2$ of the skin.
- **Environmental conditions** The evaluation is carried out under a controlled temperature and relative humidity (temperature: $20^{\circ}\text{C} - 25^{\circ}\text{C}$, hygrometry: $50 \pm 10\%$). The measurements are imperatively made at the same time on each day of measurements (1hour).
- **Subject** A 20-minute period of acclimatization in the air-conditioned room is respected for the subjects prior to the measurements (temperature: $20^{\circ}\text{C} - 25^{\circ}\text{C}$, hygrometry: $50 \pm 10\%$). For the measurement on forehead, the subject is seated on a chair.
- **Studied areas and marking** The studied area is the forehead (close to the hair line). This analysis requires repeated measurements to be performed in exactly the same area. The procedure for relocating the site of the sebum collection will be the most importance. A transparent film is used to indicate the position of the tapes at each time.



- **Measurements** A single measurement is taken. The forehead skin is previously dabbed with an absorbent paper to absorb the sweat if any. Sebutapes will be placed perpendicular to the test site while taking the measurement at Day 1 T_0 , Day 7 ($T_0 + 7$), Day 14 ($T_0 + 14$), Day 21 ($T_0 + 21$) Day .

All the captured data are entered in excel manually from CRFs & are calculated subsequently, on Microsoft Excel file. The studied parameter is the capacitance, expressed in arbitrary units. An increase in the value of the parameter shows a moisturizing effect of the product.

3.3.7 Mexametry

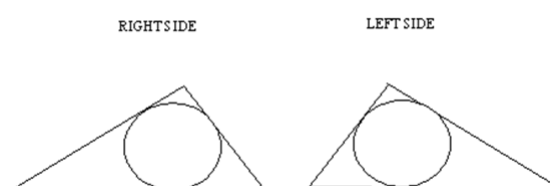
- **Principle** Mexametry is the technique used to determine the melanin content of the skin. This method is based on absorption/reflection. The probe of the Mexameter® MX 18 emits 3 specific light wavelengths. A receiver measures the light reflected by the skin. The positions of emitter and receiver guarantee that only diffuse and scattered light is measured. As the quantity of emitted light is defined, the quantity of light absorbed by the skin can be calculated. The apparatus used is a MX 18 (Courage and Khazaka, Germany).
- **Environmental conditions** The evaluation is carried out under a controlled temperature (20°C to 25°C) and relative hygrometry (50± 10%).
- **Parameters** The results obtained for melanin are expressed in arbitrary units.
- **Subject** A 20-minute period of acclimatization in the air-conditioned room is respected for the subject prior the measurements (temperature: 20°C to 25°C, hygrometry: 50±10 %). The subject is seated on a chair
- **Checking the calibration** Prior to each series of measurements, the calibration of the device is checked according to the procedure supplied by the manufacturer.
- **Studied areas and marking** The measurements are performed on both Cheek bone. The site to be measured at each kinetics should be reproducible. The site is determined by a cutaneous marking at T_0 with the help of transparency.
- **Measurements** At Day 1 T_0 , Day 7 ($T_0 + 7$), Day 14 ($T_0 + 14$), Day 21 ($T_0 + 21$) Day the measurements are carried out on both the cheek bones, after wiping delicately the skin with an absorbent paper. Three measurements are performed on the study areas for each subject and each examination time.

All the captured data are entered in excel manually from CRFs & are calculated subsequently, on Microsoft Excel file. The studied parameter is the capacitance, expressed in arbitrary units.

An increase in the value of the parameter shows a moisturizing effect of the product.

3.3.8 Cutometry

- **Principle** Measurements are taken using the Cutometer®MPA 580 (Courage & Khazaka). The principle of this technique is based on the creation of negative pressure on the skin's surface and on the measurement of vertical movement on the induced skin. This movement is determined by an optical system (composed of an infra-red diode, two prisms and a light sensor). The quantity of light detected by the sensor is proportional to the movement of the skin's surface.
- **Environmental conditions** The evaluation was carried out under a controlled temperature and relative humidity (temperature: 20°C to 25°C, hygrometry: 50±10%).
- **Parameters** The studied parameters are R0 & which R2 which are for skin firmness & skin elasticity respectively.
- **Subject** A 20-minute period of acclimatization in the air-conditioned room was respected for the subjects prior to the measurements (temperature: 20°C to 25°C, hygrometry: 50±10%). The subject sat on a chair facing towards technician.
- **Studied areas and marking** The measurements were performed on both cheekbones. The site of the instrumental measurements and their location at the different points of the kinetics was strictly the most reproducible. The location was determined by a cutaneous marking on the instrumental measurement sites at T0. In order to reposition this marking accurately while the measurements were taken, a mapping of the skin's surface, for the measurement site and for each subject, was made on a transparent film.



- **Measurements** At Day 1 T_0 , Day 7 ($T_0 + 7$), Day 14 ($T_0 + 14$), Day 21 ($T_0 + 21$) Day visit three measurements were performed on the study areas for each subject and each examination time. The experimental conditions were: Diameter probe: 2 mm Pressure: 450 mbar On-time: 2s Off-time: 2s Repetition: 3

All the captured data were entered in excel manually from CRFs & were calculated subsequently, on Microsoft Excel file.

The significant decrease in the R0 Parameter showed an effect of the product in terms of Skin firmness.

The significant increase in the R2 parameter shows an effect of the product in terms of improvement of Skin Elasticity.

3.3.9 Tewametry

- **Principle** Measurement is based on the Diffusion Law. The Tewameter® probe measures the density gradient of the water evaporation from the skin indirectly by the two pairs of sensors (temperature and relative humidity) inside the hollow cylinder. This is an open chamber measurement. The open chamber measurement method is the only method to assess the TEWL continuously without influencing its micro environment. By the use of a microprocessor and two pairs of sensors in the probe it is possible to receive the information of corresponding temperature and moisture values of each TEWL-value during the complete measurement.
- **Environmental conditions** The evaluation was carried out under a controlled temperature and relative humidity (temperature: 20°C to 25°C, hygrometry: 50±10 %).
- **Parameters** The studied parameter was the Trans epidermal water loss. The obtained results were expressed in g/h/m² unit.
- **Subject** A 20-minute period of acclimatization in the air-conditioned room was respected for the subjects prior to the measurements (temperature: 20°C to 25°C, hygrometry: 50±10 %). The subject was seated on a chair.
- **Studied areas and marking** The measurements were performed on three sites of cheek bone. The site to be measured at each kinetics was reproducible. The site was determined by a cutaneous marking at T_0 with the help of gauge.



- **Measurements** At Day 1 T_0 , Day 7($T_0 + 7$), Day 14 ($T_0 + 14$), Day 21 ($T_0 + 21$) Day visit the measurements were carried out on cheek bone after wiping delicately the skin with an absorbent paper. One measurement was performed on the study area for each subject and each examination time.

All the captured data were entered in excel manually from CRFs & were calculated subsequently on Microsoft Excel file. The significant decrease in the parameter showed a prevention of the water loss from skin.

3.4 Examination Schedule

Activity/Day	Screening	Day 1 (T0)	Day 7	Day 14	Day 21
Registration	✓	-	-	-	-
Protocol Briefing	✓	-	-	-	-
Consent for screening	✓	-	-	-	-
Concomitant Medication	✓	✓	✓	✓	✓
Demographics	✓	-	-	-	-
Habits Questionnaire	✓	-	-	-	-
History Questionnaire	✓	-	-	-	-
Routine Check-up	✓	-	-	-	-
Acclimatization	✓	✓	✓	✓	✓
Checking of criteria	✓	✓	✓	✓	✓
Acknowledgement, reading and signature of the ICF	-	✓	-	-	-
Dermatological Evaluation: Cosmetic Acceptability	-	✓	✓	✓	✓
Dermatological Evaluation: Efficacy	-	✓	✓	✓	✓
Subject Self Evaluation	-	✓	✓	✓	✓
Chromametry	-	✓	✓	✓	✓
Corneometry	-	✓	✓	✓	✓
Sebumeter	-	✓	✓	✓	✓
Mexametry	-	✓	✓	✓	✓
Cutometry	-	✓	✓	✓	✓
Tewametry	-	✓	✓	✓	✓
Weighing of the products	-	✓	-	-	-
Distribution of the products, products instruction and diary sheet	-	✓	-	-	-
Products application with instructions and recording	-	✓	-	-	-
Adverse Event/ Serious Adverse Event Monitoring	-	✓	✓	✓	✓
Proscriptions and Restrictions	-	-	✓	✓	✓

Table 3.2: Summary of Activities and Procedures

3.5 Withdrawal from study

A subject accepted into the study may be withdrawn or considered to have “dropped-out” if:

- a side effect attributable to the product is judged severe by the Dermatologist
- the subject develops an illness (without being related to the products used in the study but occurring during the study) and has to take contra-indicated medication which is likely to influence the test measurements and evaluations.
- The subject does not respect the protocol.

The subjects are entitled to drop out of the study at any time if they so desire (should this occur, the study manager determines the reasons in order to know if it is linked to the study or not).

3.6 Discontinuation of study

The study sponsor may stop the study at any time for one of the following reasons:

- Impossibility of selecting enough subjects;
- Protocol violations;
- Incomplete or imprecise data;
- Intolerances or adverse reactions due to the test product

In case of URGENT need to halt the study, the sponsor must contact the management to inform him of his decision.

The investigator may also interrupt the study at any time in case of serious adverse event that involve risks to the subjects, after having informed the study sponsor.

3.7 Technical Equipment

If technical incidents involving the equipment occur, the study will be postponed rather than cancelled until the equipment is functioning again, with the consent of the study sponsor.

Chapter 4

DATA ANALYSIS AND STATISTICS

4.1 Methodology

- **Data Collection** : 108 Female subjects are selected for the study. The study is conducted in 3 groups . Study is carried out as a “double blind test”. The questionnaires is filled in the organisation office. reading are noted for corresponding parameter of particular equipment.
- **Software / Tools** : The analysis was conducted using MINITAB 17
- **Statistical Techniques**
 - **Descriptive Statistics** : Measures of central tendency (mean, median) and variability (standard deviation) were calculated.
 - **Visualization Tools** : Box Plots is used to display the distribution of data based on a five-number summary (minimum, first quartile, median, third quartile, and maximum).
- **Assumptions for Tests** :
 - **Normality** Testing for normality is an essential step in determining whether parametric tests are appropriate for your data. There are several statistical tests available to assess normality. Here we have used Kolmogorov-Smirnov Test at 1% los.
 - **Homogeneity of Variances (Homoscedasticity)** The variances within each group being compared should be similar. This is particularly relevant for tests like the

independent samples t-test and ANOVA using Levene's Test.

- **Inferential Statistics (parametric) :** Inferential statistics are used to make inferences and predictions about a population based on a sample of data. These techniques help to test hypotheses and make decisions.
 - **T-test** is used to determine if there is a significant difference between the means of two groups. Types include:
Independent Samples t-test: Compares means from two different groups. Paired Samples t-test: Compares means from the same group at different times.
 - **Chi-Square Test** is used to determine if there is a significant association between two categorical variables.
- **Inferential Statistics (non parametric)**
 - **Mann-Whitney U Test** is used to compare the differences between two independent groups. It is a non-parametric alternative to the independent samples t-test.
 - **Wilcoxon Signed-Rank Test** is used to compare two related samples. It is a non-parametric alternative to the paired samples t-test.

4.2 Data analysis of Technical data (not for dermatological evaluation of safety)

- Raw values for each subject at each examination.
- Differences, in relation to T0 for each subject during the study ($T_n - T_0$).
- Means, medians, maximum, minimum and standard deviations of the raw values and of the differences in relation to T0 obtained by the entire panel.
- Variations, in relation to T0 expressed as a percentage calculated from the mean values.
- Numbers and percentages of subjects presenting an improvement .

Data View

- **Comparison in time for product :** The normality of the distributions is checked using Shapiro-Wilk test, threshold at 1%. The statistical analysis for each product of the

	Parameter	T_0				T_0+7 days				T_0+14 days				T_0+21 days			
		1	2	3	Average	1	2	3	Average	1	2	3	Average	1	2	3	Average
PRODUCT A		Corresponding Readings															
PRODUCT B																	
PRODUCT C																	

Table 4.1: Table with Corresponding Readings Over Time for Different Products

evolution of the measured parameters during the study at each time point is performed using the Student T test (normality of distributions checked) or the Wilcoxon test (normality of the distributions rejected). The significance threshold is fixed at 5%.

- **Comparison between products** : Comparison analysis between the products is performed using the ANOVA or with the Kruskal–Wallis test, post hoc test analysis done accordingly. The significance threshold is fixed at 5%.

4.3 Data analysis of Subject Self-evaluation

The analysis involves establishing frequency tables that take into account the number of responses and calculate the frequency of the different possible answers (given as percentage) to each qualitative question. For each question, results are shown in tabular form (number of individuals and frequency).

To evaluate the efficacy and the appreciation of the products for each item, two percentages Z1 and Z2 are calculated as follows:

Z1 = favourable opinion (Ex: “Completely agree” + “Somewhat agree”)

Z2 = unfavourable opinion (Ex: “Completely disagree” + “Somewhat disagree”)

The statistical difference in frequencies (%) between favourable and unfavourable opinions is evaluated using the Chi-squared test at 5%.

The table below summarises the agreement percentages recorded for each suggested item for Product A, Product B & Product C after Day 1 T_0 , Day 7, Day 14, Day 21 of product application, as well as their statistical significance evaluated using Chi-squared test at 5%.

	Product A	T7	T14	T21
		% agreement	% agreement	% agreement
1	Makes my skin look visibly brighter/ Fairer	90%	90%	90%
2	Makes skin look even toned	90%	90%	90%
3	Skin appears soft, smooth and bright	87%	88%	89%
4	Does not leave white patches on skin	88%	89%	87%
5	Does not make my skin feel stretchy/dry	83%	89%	87%
6	It hides spots / Marks / blemishes on my skin	84%	78%	86%
7	Makes skin look even toned (uniform colour, free of patches)	80%	89%	84%
8	It hides my dark circles/ lightens the appearance of dark circles	81%	88%	88%
9	It makes my skin look flawless and Radiant	79%	86%	81%
10	Makes my skin look visibly brighter/ Fairer all day long	82%	91%	86%
11	It helps to control sweat through the day/ Keeps skin sweat free all day long	86%	87%	84%
12	It helps to my skin oil-free all day	83%	84%	88%
13	It keeps skin non-oily, non-sticky through the day	81%	89%	87%
14	Keeps my face looking fresh all day long	81%	90%	88%
15	Keeps my skin soft & smooth all day long	77%	90%	91%
16	Keeps my skin soft & smooth all day long	88%	84%	91%
17	Protects my skin from tired & dull look all day long	82%	78%	86%
18	It makes my skin lighter/ fairer over time	81%	88%	89%
19	It improves my overall complexion	80%	88%	83%
20	Helps my skin protect from Sun Darkening / Tanning	84%	88%	87%
21	Visibly reduces spots / Marks / blemishes on my skin	78%	84%	81%
22	It reduces skin patchiness/ uneven skin tone	81%	83%	85%
23	Reduces dark circles under my eyes	73%	82%	81%
24	Makes my skin visibly fairer in last 7 days / 2 week/ 3 weeks	81%	85%	86%
25	Make my skin more even toned after 7 days / 2 week/ 3 weeks	84%	86%	88%
26	Protects from harmful sun rays	88%	88%	93%
27	Makes my skin feel soft and smooth immediately after application	92%	87%	92%
28	Moisturises my skin	96%	91%	94%
29	Makes me feel fresh after application	92%	91%	96%
30	Keeps my skin moisturised all day long	86%	92%	97%
31	Does not cause any irritation /redness/ itching	100%	100%	100%
32	Doesn't cause pimples / Acne	100%	100%	99%
33	It is suitable for my skin type	94%	100%	98%
34	It is safe for everyday use	94%	100%	98%
35	It is mild and gentle on my skin	97%	96%	98%

Table 4.2: Survey Results on Skin Care Product Effectiveness

	Product B	T7	T14	T21
		% agreement	% agreement	% agreement
1	Makes my skin look visibly brighter/ Fairer	88%	91%	88%
2	Makes skin look even toned	86%	92%	87%
3	Skin appears soft, smooth and bright	86%	89%	87%
4	Does not leave white patches on skin	81%	87%	87%
5	Does not make my skin feel stretchy/dry	88%	90%	87%
6	It hides spots / Marks / blemishes on my skin	83%	83%	84%
7	Makes skin look even toned (uniform colour, free of patches)	74%	81%	81%
8	It hides my dark circles/ lightens the appearance of dark circles	76%	83%	79%
9	It makes my skin look flawless and Radiant	87%	86%	81%
10	Makes my skin look visibly brighter/ Fairer all day long	84%	86%	89%
11	It helps to control sweat through the day/ Keeps skin sweat free all day long	72%	86%	89%
12	It helps to my skin oil-free all day	79%	85%	88%
13	It keeps skin non-oily, non-sticky through the day	79%	83%	87%
14	Keeps my face looking fresh all day long	82%	82%	85%
15	Keeps my skin soft & smooth all day long	89%	83%	84%
16	Keeps my skin soft & smooth all day long	87%	89%	85%
17	Protects my skin from tired & dull look all day long	88%	84%	87%
18	It makes my skin lighter/ fairer over time	86%	87%	83%
19	It improves my overall complexion	73%	82%	82%
20	Helps my skin protect from Sun Darkening / Tanning	80%	84%	87%
21	Visibly reduces spots / Marks / blemishes on my skin	76%	85%	87%
22	It reduces skin patchiness/ uneven skin tone	84%	86%	84%
23	Reduces dark circles under my eyes	82%	84%	82%
24	Makes my skin visibly fairer in last 7 days / 2 week/ 3 weeks	82%	81%	86%
25	Make my skin more even toned after 7 days / 2 week/ 3 weeks	79%	87%	82%
26	Protects from harmful sun rays	86%	90%	90%
27	Makes my skin feel soft and smooth immediately after application	84%	86%	91%
28	Moisturisers my skin	87%	92%	91%
29	Makes me feel fresh after application	89%	85%	92%
30	Keeps my skin moisturised all day long	90%	88%	92%
31	Does not cause any irritation /redness/ itching	96%	94%	96%
32	Doesn't cause pimples / Acne	96%	91%	91%
33	It is suitable for my skin type	93%	92%	94%
34	It is safe for everyday use	91%	89%	92%
35	It is mild and gentle on my skin	89%	91%	91%

Table 4.3: Survey Results on Skin Care Product Effectiveness

	Product C	T7	T14	T21
		% agreement	% agreement	% agreement
1	Makes my skin look visibly brighter/ Fairer	90%	87%	89%
2	Makes skin look even toned	84%	89%	88%
3	Skin appears soft, smooth and bright	86%	87%	86%
4	Does not leave white patches on skin	82%	87%	86%
5	Does not make my skin feel stretchy/dry	91%	84%	88%
6	It hides spots / Marks / blemishes on my skin	86%	87%	85%
7	Makes skin look even toned (uniform colour, free of patches)	69%	81%	79%
8	It hides my dark circles/ lightens the appearance of dark circles	78%	86%	84%
9	It makes my skin look flawless and Radiant	72%	87%	82%
10	Makes my skin look visibly brighter/ Fairer all day long	84%	89%	91%
11	It helps to control sweat through the day/ Keeps skin sweat free all day long	80%	88%	80%
12	It helps to my skin oil-free all day	85%	89%	84%
13	It keeps skin non-oily, non-sticky through the day	83%	90%	90%
14	Keeps my face looking fresh all day long	83%	91%	87%
15	Keeps my skin soft & smooth all day long	87%	91%	90%
16	Keeps my skin soft & smooth all day long	86%	90%	88%
17	Protects my skin from tired & dull look all day long	79%	87%	88%
18	It makes my skin lighter/ fairer over time	83%	91%	86%
19	It improves my overall complexion	82%	85%	88%
20	Helps my skin protect from Sun Darkening / Tanning	76%	83%	81%
21	Visibly reduces spots / Marks / blemishes on my skin	73%	80%	77%
22	It reduces skin patchiness/ uneven skin tone	77%	83%	84%
23	Reduces dark circles under my eyes	78%	81%	79%
24	Makes my skin visibly fairer in last 7 days / 2 week/ 3 weeks	79%	92%	89%
25	Make my skin more even toned after 7 days / 2 week/ 3 weeks	81%	92%	90%
26	Protects from harmful sun rays	85%	90%	89%
27	Makes my skin feel soft and smooth immediately after application	93%	92%	96%
28	Moisturisers my skin	95%	92%	97%
29	Makes me feel fresh after application	94%	97%	96%
30	Keeps my skin moisturised all day long	92%	93%	95%
31	Does not cause any irritation /redness/ itching	95%	100%	97%
32	Doesn't cause pimples / Acne	97%	100%	97%
33	It is suitable for my skin type	93%	99%	96%
34	It is safe for everyday use	91%	100%	97%
35	It is mild and gentle on my skin	91%	99%	97%

Table 4.4: Survey Results on Skin Care Product Effectiveness

For Product A, all the suggested items are significantly and highly recognized by the panel, after 21 days with 73% to 100% of agreement.

Analysis

For Product A

- **Instant whitening/ Brightening** : Concerning the product efficacy, test product A is well appreciated For making skin look visibly brighter/fairer with 90% of agreement, for making skin look even toned with 90% of agreement, smooth and bright skin appearance with 90% of agreement, for not leaving white patches on skin with 88% of agreement, for not making skin feel stretchy/dry with 83% to 87% of agreement, for hiding spots / Marks / blemishes on skin with 84% to 86% of agreement from , for making skin look even toned (uniform colour, free of patches) with 80% to 84% of agreement, for hiding dark circles/ lightens the appearance of dark circles with 81% to 88% of agreement & for making skin look flawless and Radiant with 79% to 86% of agreement after 14 days of application.
- **All day effect** : Concerning the product efficacy, test product A is well appreciated for making skin look visibly brighter/ Fairer all day long with 82% to 91% of agreement, for helping to control sweat through the day/ Keeps skin sweat free all day long with 86% of agreement, for helping to make skin oil-free all day with 83% to 88% of agreement, for keeping skin non-oily, non-sticky through the day with 81% to 87% of agreement, for keeping the face looking fresh all day long with 81% to 88% of agreement, for keeping the skin soft & smooth all day long with 77% to 191% of agreement after 21 days of application and for protecting the skin from tired & dull look all day long with 82% to 86% of agreement.
- **Long term efficacy** : Concerning the product efficacy, test product A is well appreciated for making the skin lighter/ fairer over time with 81% to 89% of agreement, for improving overall complexion with 80% to 88% of agreement, for helping the skin to protect from Sun Darkening / Tanning with 84% to 88% of agreement, for Visibly reducing spots / Marks / blemishes on skin with 78% to 84% of agreement, for reducing skin patchiness/ uneven skin tone with 81% to 85% of agreement,for reducing dark circles under the eyes with 73% to 82% of agreement, for making skin visibly fairer in last 7 days / 2 week/ 3 weeks with 81% to 86% of agreement, for making skin more even toned after 7 days / 2 week/ 3 weeks with 84% to 88% of agreement and for Protecting from harmful sun rays

with 88% to 93% of agreement after 21 days of application.

- **Skin Moisturization** Concerning the product efficacy, test product A is well appreciated for making skin feel soft and smooth immediately after application with 92% of agreement, for moisturizing the skin with 96% of agreement, for making feel fresh after application with 92% to 96% of agreement and for keeping skin moisturised all day long with 86% to 97% of agreement after 21 days of application.
- **Safe to use** : Concerning the product acceptability, test product A is well appreciated for not causing any irritation /redness/ itching with 100% of agreement, for not causing pimples / Acne with 100% of agreement, for being suitable for the skin type with 94% to 100% of agreement and for being safe for everyday use with 94% to 100% of agreement, for being mild and gentle with 97% to 98% of agreement after 21 days of application.

For Product B

For Product B, all the suggested items are significantly and highly recognized by the panel, after 21 days with 72% to 96% of agreement.

- **Instant whitening/ Brightening** Concerning the product efficacy, test product B is well appreciated For making skin look visibly brighter/fairer with 88% of agreement, for making skin look even toned with 86% to 92% of agreement, smooth and bright skin appearance with 86% to 89% of agreement, for not leaving white patches on skin with 81% to 87% of agreement, for not making skin feel stretchy/dry with 88% to 90% of agreement, for hiding spots / Marks / blemishes on skin with 84% of agreement , for making skin look even toned (uniform colour, free of patches) with 74% to 81% of agreement, for hiding dark circles/ lightens the appearance of dark circles with 76% to 83% of agreement & for making skin look flawless and Radiant with 87% of agreement after 21 days of application.
- **All day effect** Concerning the product efficacy, test product A is well appreciated for making skin look visibly brighter/ Fairer all day long with 84% to 89% of agreement, for helping to control sweat through the day/ Keeps skin sweat free all day long with 72% to 89% of agreement, for helping to make skin oil-free all day with 79% to 88% of agreement, for keeping skin non-oily, non-sticky through the day with 79% to 87% of agreement, for keeping the face looking fresh all day long with 82% to 85% of agreement, for keeping the skin soft & smooth all day long with 89% of agreement after 21 days of application and for protecting the skin from tired & dull look all day long with 88% of agreement.

- **Long term efficacy** Concerning the product efficacy, test product B is well appreciated for making the skin lighter/ fairer over time with 86% of agreement, for improving overall complexion with 73% to 82% of agreement, for helping the skin to protect from Sun Darkening / Tanning with 80% to 87% of agreement, for Visibly reducing spots / Marks / blemishes on skin with 76% to 87% of agreement, for reducing skin patchiness/ uneven skin tone with 84% to 86% of agreement, for reducing dark circles under the eyes with 82% of agreement, for making skin visibly fairer in last 7 days / 2 week/ 3 weeks with 82% to 86% of agreement, for making skin more even toned after 7 days / 2 week/ 3 weeks with 79% to 87% of agreement and for Protecting from harmful sun rays with 86% to 90% of agreement after 21 days of application.
- **Skin Moisturization** Concerning the product efficacy, test product B is well appreciated for making skin feel soft and smooth immediately after application with 84% to 91% of agreement, for moisturizing the skin with 87% to 92% of agreement, for making feel fresh after application with 89% to 92% of agreement and for keeping skin moisturised all day long with 92% of agreement after 21 days of application.
- **Safe to use** Concerning the product acceptability, test product B is well appreciated for not causing any irritation /redness/ itching with 96% of agreement, for not causing pimples / Acne with 96% of agreement, for being suitable for the skin type with 94% of agreement and for being safe for everyday use with 92% of agreement, for being mild and gentle with 91% of agreement after 21 days of application.

For Product C, all the suggested items are significantly and highly recognized by the panel, after 21 days with 72% to 97% of agreement.

For Product C

- **Instant whitening/ Brightening** : Concerning the product efficacy, test product C is well appreciated For making skin look visibly brighter/fairer with 90% of agreement, for making skin look even toned with 84% to 89% of agreement, smooth and bright skin appearance with 86% of agreement, for not leaving white patches on skin with 82% to 87% of agreement, for not making skin feel stretchy/dry with 91% of agreement, for hiding spots / Marks / blemishes on skin with 87% of agreement , for making skin look even toned (uniform colour, free of patches) with 69% to 81% of agreement, for hiding dark circles/ lightens the appearance of dark circles with 78% to 86% of agreement & for making skin look flawless and Radiant with 72% to 87% of agreement after 21 days of

application.

- **All day effect** : Concerning the product efficacy, test product C is well appreciated for making skin look visibly brighter/ Fairer all day long with 84% to 91% of agreement, for helping to control sweat through the day/ Keeps skin sweat free all day long with 88% of agreement, for helping to make skin oil-free all day with 85% to 89% of agreement, for keeping skin non-oily, non-sticky through the day with 83% to 90% of agreement, for keeping the face looking fresh all day long with 83% to 91% of agreement, for keeping the skin soft & smooth all day long with 87% to 91% of agreement after 21 days of application and for protecting the skin from tired & dull look all day long with 88% of agreement.
- **Long term efficacy** : Concerning the product efficacy, test product C is well appreciated for making the skin lighter/ fairer over time with 86% to 90% of agreement, for improving overall complexion with 79% to 87% of agreement, for helping the skin to protect from Sun Darkening / Tanning with 83% to 91% of agreement, for Visibly reducing spots / Marks / blemishes on skin with 82% to 88% of agreement, for reducing skin patchiness/ uneven skin tone with 76% to 83% of agreement, for reducing dark circles under the eyes with 73% to 80% of agreement, for making skin visibly fairer in last 7 days / 2 week/ 3 weeks with 77% to 84% of agreement, for making skin more even toned after 7 days / 2 week/ 3 weeks with 78% to 81% of agreement and for Protecting from harmful sun rays with 79% to 92% of agreement after 21 days of application.
- **Skin Moisturization** : Concerning the product efficacy, test product C is well appreciated for making skin feel soft and smooth immediately after application with 81% to 92% of agreement, for moisturizing the skin with 85% to 90% of agreement, for making feel fresh after application with 93% to 96% of agreement and for keeping skin moisturised all day long with 97% of agreement after 21 days of application.
- **Safe to use** : Concerning the product acceptability, test product B is well appreciated for not causing any irritation /redness/ itching with 97% of agreement, for not causing pimples / Acne with 95% of agreement, for being suitable for the skin type with 100% of agreement and for being safe for everyday use with 100% of agreement, for being mild and gentle with 99% of agreement after 21 days of application.

		Product A			Product B			Product C		
		T7	T14	T21	T7	T14	T21	T7	T14	T21
		Sig.?(5%)	Sig.?(5%)	Sig.?(5%)	Sig.?(5%)	Sig.?(5%)	Sig.?(5%)	Sig.?(5%)	Sig.?(5%)	Sig.?(5%)
1	Makes my skin look visibly brighter/ Fairer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	Makes skin look even toned	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	Skin appears soft, smooth and bright	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	Does not leave white patches on skin	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	Does not make my skin feel stretchy/dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	It hides spots / Marks / blemishes on my skin	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7	Makes skin look even toned (uniform colour, free of patches)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	It hides my dark circles/ lightens the appearance of dark circles	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	It makes my skin look flawless and Radiant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10	Makes my skin look visibly brighter/ Fairer all day long	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	It helps to control sweat through the day/ Keeps skin sweat free all day long	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12	It helps to my skin oil-free all day	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
13	It keeps skin non-oily, non-sticky through the day	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
14	Keeps my face looking fresh all day long	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
15	Keeps my skin soft & smooth all day long	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
16	Keeps my skin soft & smooth all day long	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
17	Protects my skin from tired & dull look all day long	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
18	It makes my skin lighter/ fairer over time	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
19	It improves my overall complexion	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
20	Helps my skin protect from Sun Darkening / Tanning	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
21	Visibly reduces spots / Marks / blemishes on my skin	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
22	It reduces skin patchiness/ uneven skin tone	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
23	Reduces dark circles under my eyes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
24	Makes my skin visibly fairer in last 7 days / 2 week/ 3 weeks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
25	Make my skin more even toned after 7 days / 2 week/ 3 weeks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
26	Protects from harmful sun rays	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
27	Makes my skin feel soft and smooth immediately after application	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
28	Moisturisers my skin	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
29	Makes me feel fresh after application	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
30	Keeps my skin moisturised all day long	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
31	Does not cause any irritation /redness/ itching	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
32	Doesn't cause pimples / Acne	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
33	It is suitable for my skin type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
34	It is safe for everyday use	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
35	It is mild and gentle on my skin	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4.5: However, for all the parameter there is significant difference observed at all time visit.

4.4 Chromametry

4.4.1 L* parameter

The study parameters is the L* parameter. A significant increase in the L* parameter shows an effect of the product in terms of skin brightening.

Descriptive Statistics

Var	N	Mean	StDev	Min	Max
T ₀ _A	36	53.193	4.406	45.658	60.652
T7_A	36	53.623	4.518	45.85	60.745
T14_A	36	54.138	4.51	45.942	61.698
T21_A	36	54.301	4.455	46.042	61.798
T ₀ _B	35	53.2	5.346	41.77	60.107
T7_B	35	53.669	5.359	42.2	60.303
T14_B	35	54.21	5.402	41.955	60.887
T21_B	35	54.313	5.39	42.055	60.987
T ₀ _C	36	53.227	4.561	42.307	60.613
T7_C	36	53.626	4.47	42.382	60.925
T14_C	36	54.113	4.402	42.622	61.467
T21_C	35	54.309	4.413	42.722	61.567

Table 4.6: Five-number summary

This graph provides a visual summary of how products for L* measurements vary over time. It provides a visual summary of the central tendency, spread, and skewness of the data, as well as identifying outliers. No outlier present.

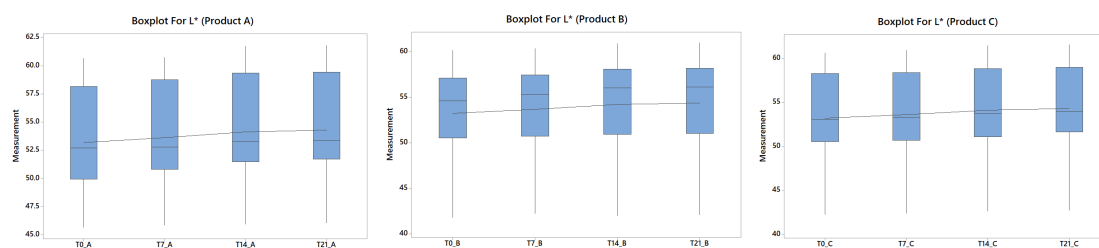


Figure 4.1: Boxplot for L* Measurements

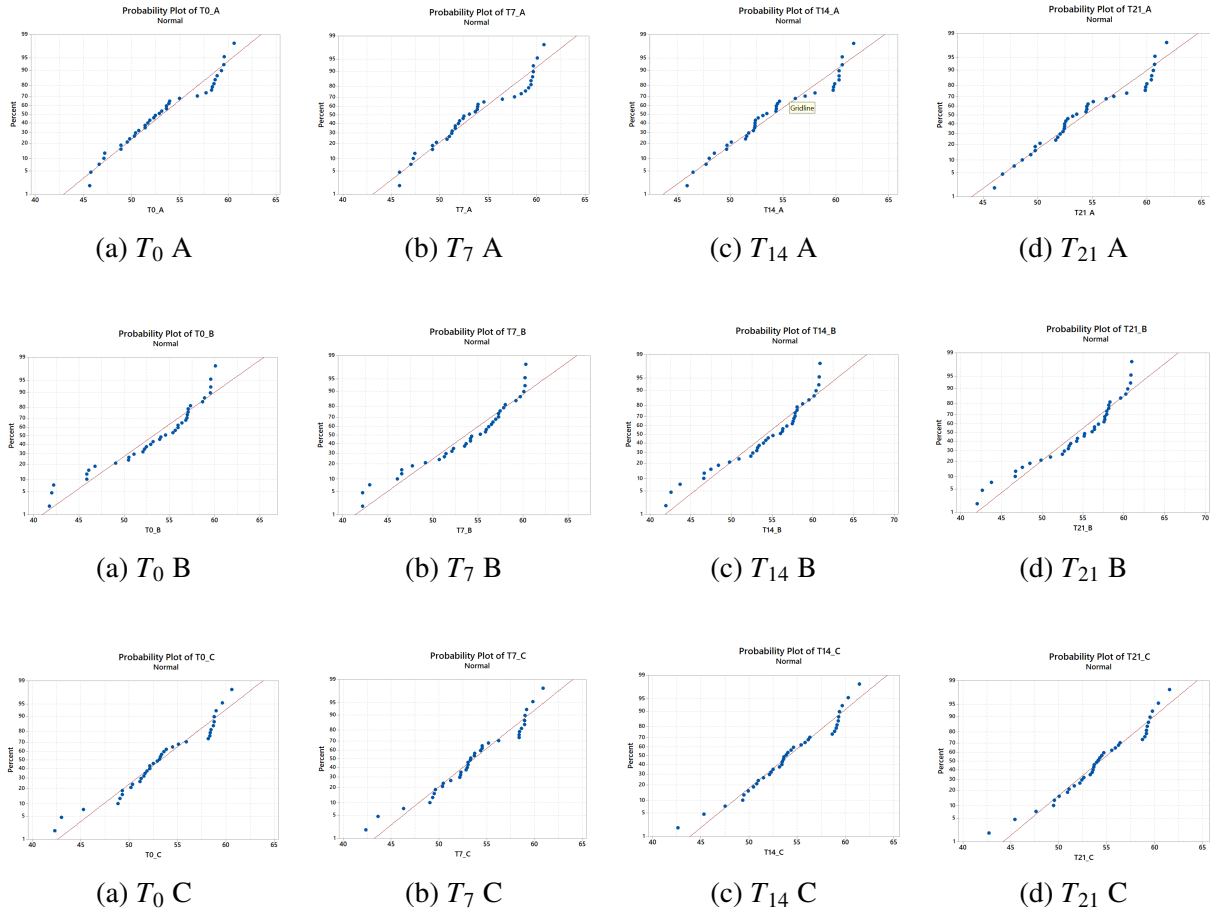
Normality Check

Checking the normality of the L* measurement reading by a Shapiro-Wilk test at 1%.

H_0 : The L^* measurement reading is normally distributed.

H_1 : The L^* measurement reading is not normally distributed.

If the p-value is less than the chosen significance level (e.g., 0.01 for a 1% significance level), we reject the null hypothesis in favor of the alternative hypothesis, indicating that the data significantly deviates from a normal distribution.



Time Point	Product	Statistic	p-value	Result
T_0	A	<0.01	0.100	Accept
	B	<0.01	0.023	Accept
	C	<0.01	0.096	Accept
T_7	A	<0.01	0.095	Accept
	B	<0.01	0.029	Accept
	C	<0.01	0.100	Accept
T_{14}	A	<0.01	0.123	Accept
	B	<0.01	0.025	Accept
	C	<0.01	0.100	Accept
T_{21}	A	<0.01	0.100	Accept
	B	<0.01	0.029	Accept
	C	<0.01	0.100	Accept

Table 4.7: Shapiro-Wilk Test Results at 1% Significance Level

For all products (A, B, and C) at all time points (T_0 , $T_0+7\text{Days}$, $T_0+14\text{Days}$, and $T_0+21\text{Days}$), the p-values are greater than the significance level of 0.01. Therefore, we accept the null hypothesis for all cases, concluding that the data for each product at each time point is normally distributed according to the Shapiro-Wilk test at a 1% significance level.

Homogeneity of Variances

Checking the Homoscedasticity of the distributions by a Levene's Test test at 1%.

H_0 : The variances across all products are equal.

H_1 : At least one product has a different variance compared to the others.

If the test statistic does not fall in the rejection region (i.e., it is less than or equal to the critical value or the p-value is greater than 0.01), fail to reject the null hypothesis. This suggests that there is not enough evidence to conclude that the variances are different across the Product.

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T_0	P value	0.389	0.345	0.882
	Significance	No	No	No
$T_0 + 7 \text{ Days}$	P value	0.5	0.284	0.615
	Significance	No	No	No
$T_0 + 14 \text{ Days}$	P value	0.45	0.292	0.711
	Significance	No	No	No
$T_0 + 21 \text{ Days}$	P value	0.445	0.319	0.762
	Significance	No	No	No

Table 4.8: Levene's Test Results at 1% Significance Level

At each time point for each pair of products (A vs B, B vs C, A vs C), the p-values are all greater than 0.01 (1% significance level).

Therefore, we fail to reject the null hypothesis for all comparisons at all time points.

This means that there is no statistically significant difference in variances between the groups being compared (Product A vs B, Product B vs C, and Product A vs C) at any of the time points.

Raw Values

The following table summarizes the means and standard deviations of the raw values, evolution & percent variation of L^* parameter observed on the Forehead & Both Cheekbone treated with test Product A, Product B & Product C at T_0 , T_0+7 , T_0+14 & T_0+21 Days visit as well as the

corresponding statistical results for the evolution in time (Student T test or Wilcoxon test, two-tailed for paired groups at 5%, after checking the normality of the distributions by a Shapiro-Wilk test at 1%).

Paired T test is used to compare the means of two related groups or conditions.

H_0 : There is no significant difference between the means of two dependent groups (time point) on the variable of interest (L^* parameter).

H_1 : There is a significant difference between the means of the two dependent groups (time point) on the variable of interest.

If the p-value is less than the chosen significance level (0.05), it indicates that there is sufficient evidence to reject the null hypothesis.

Conclusion: There is a statistically significant difference between the means of the two dependent groups.

Product	Time Interval	Mean	Standard Dev.	Sig 5% ($T_n - T_0$)	p values	Test
A	T_0	53.1934	4.406	Yes		
	T_0+7 days	53.6228	4.518	Yes	<0.001	Paired T test
	T_0+14 days	54.138	4.51	Yes	<0.001	Paired T test
	T_0+21 days	54.3008	4.455	Yes	<0.001	Paired T test
B	T_0	53.1999	5.346	Yes		
	T_0+7 days	53.6687	5.359	Yes	<0.001	Paired T test
	T_0+14 days	54.2097	5.402	Yes	<0.001	Paired T test
	T_0+21 days	54.3133	5.39	Yes	<0.001	Paired T test
C	T_0	53.2269	4.561	Yes	<0.001	Paired T test
	T_0+7 days	53.6261	4.47	Yes	<0.001	Paired T test
	T_0+14 days	54.1127	4.402	Yes	<0.001	Paired T test
	T_0+21 days	54.3094	4.412	Yes	<0.001	Paired T test

Table 4.9: Summary of L^* Measurements

Evolution ($T_n - T_0$)

The following table presents the means and the standard deviations of the evolutions ($T_n - T_0$) of L^* parameter, observed on the Forehead & Both Cheekbone treated with test Product A, Product B & Product C.

Variations ($(T_n - T_0)/T_0$ (%))

Variation in Percentage of L^* Parameter.

Product	$(T_0 + 7days - T_0)$	$(T_0 + 14days - T_0)$	$(T_0 + 21days - T_0)$
A	0.4294	0.9446	1.1074
B	0.4688	1.0098	1.1134
C	0.3993	0.8859	0.9639

Table 4.10: Evolution of L* Parameter

Product	$(T_0 + 7days - T_0)/T_0$	$(T_0 + 14days - T_0)/T_0$	$(T_0 + 21days - T_0)/T_0$
A	0.81%	1.78%	2.08%
B	0.88%	1.90%	2.09%
C	0.75%	1.66%	1.81%

Table 4.11: Variation in Percentage of L* Parameter

Analysis

For Product A

- The statistical analysis shows a significant increase in L* parameter by 0.81%, 1.78% & 2.08% with test Product A on average on whole panel respectively at Day1 T_0 , Day 7 T_0+7 , Day 14 T_0+14 , Day 21 T_0+21 day show effect of product in skin brightening.
- 51% and 67% of the panel presented an improvement in the studied parameter at Day 14 T_0+14 , Day 21 T_0+21 respectively.

For Product B

- The statistical analysis shows a significant increase in L* parameter by 0.88%, 1.90% & 2.09% with test Product B on average on whole panel respectively at Day1 T_0 , Day 7 T_0+7 , Day 14 T_0+14 , Day 21 T_0+21 day show effect of product in skin brightening.
- 54% and 64% of the panel presented an improvement in the studied parameter at Day 14 T_0+14 , Day 21 T_0+21 respectively.

For Product C

- The statistical analysis shows a significant increase in L* parameter by 0.75%, 1.66% & 1.81% on the whole face with test Product C on average on whole panel respectively at Day1 T_0 , Day 7 T_0+7 , Day 14 T_0+14 , Day 21 T_0+21 day show effect of product in skin brightening.
- 48% and 56% of the panel presented an improvement in the studied parameter at Day 14 T_0+14 , Day 21 T_0+21 respectively.

L*		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T₀	P value	0.996	0.975	0.982
	Significance at 5%	No	No	No
T₀ + 7 Days	P value	0.969	0.998	0.971
	Significance at 5%	No	No	No
T₀ + 14Days	P value	0.952	0.981	0.934
	Significance at 5%	No	No	No
T₀ + 21Days	P value	0.992	0.993	0.997
	Significance at 5%	No	No	No

Comparison in L* Parameter Between Products

H_0 : there is no significant difference between the means of the two product.

H_1 : there is a significant difference between the means of the two product.

If the p-value is greater than the significance level, we fail to reject the null hypothesis. This would mean that there is not enough evidence to conclude that there are any differences in means between the products.

- Based on the results of the independent t-test, there is no evidence to reject the null hypothesis for any of the comparisons. Therefore, we conclude that there are no significant differences between the products in terms of L* values at any of the time points.

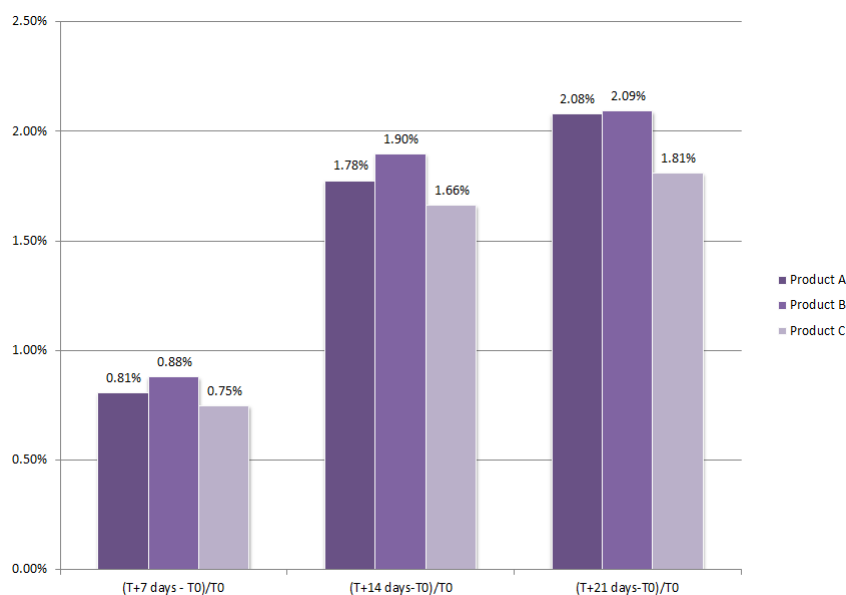


Figure 4.5: Graphical representation for variation

4.4.2 ITA°

The study parameters is the ITA° parameter. A significant increase in the ITA° parameter shows an effect of the product in terms of skin tone.

Descriptive Statistics

Variable	N	Mean	StDev	Minimum	Maximum
T_0_A	36	9.09	12.48	-12.86	27.11
T_7_A	36	10.29	12.8	-13.23	28.28
T_{14}_A	36	11.22	11.91	-11.26	27.91
T_{21}_A	36	11.39	11.48	-10.74	27.58
T_0_B	35	9.13	15.17	-22.95	30.18
T_7_B	35	10.42	15.24	-22.54	32.1
T_{14}_B	35	11.53	14.54	-21.15	31.99
T_{21}_B	35	11.6	14.22	-20.46	31.46
T_0_C	36	9.05	12.44	-20.93	28.61
T_7_C	36	10.32	12.6	-22.79	30.23
T_{14}_C	36	11.2	11.85	-20.21	29.82
T_{21}_C	35	11.72	11.87	-19.96	30.03

Table 4.12: Five-number summary

No outlier detected.

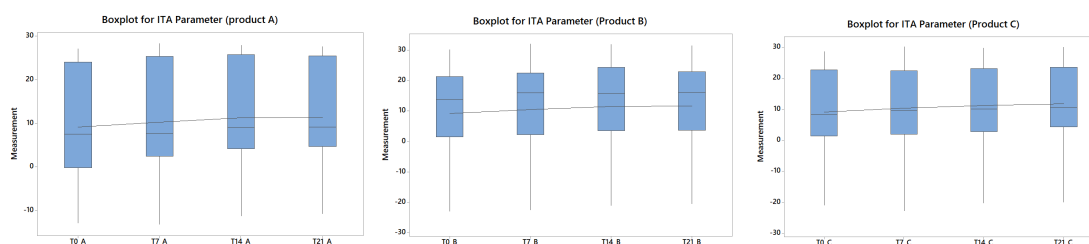


Figure 4.6: Boxplot of ITA° parameter reading

Normality Check

Time Point	Product	Statistic	p-value	Result
T_0	A	<0.01	0.096	Accept
	B	<0.01	0.026	Accept
	C	<0.01	0.100	Accept
T_7	A	<0.01	0.075	Accept
	B	<0.01	0.028	Accept
	C	<0.01	0.100	Accept
T_{14}	A	<0.01	0.062	Accept
	B	<0.01	0.032	Accept
	C	<0.01	0.123	Accept
T_{21}	A	<0.01	0.066	Accept
	B	<0.01	0.029	Accept
	C	<0.01	0.100	Accept

Table 4.13: Shapiro-Wilk Test Results at 1% Significance Level

Homogeneity of Variances

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T_0	P value	0.12	0.516	0.066
	Significance	No	No	No
$T_0 + 7$ Days	P value	0.344	0.642	0.603
	Significance	No	No	No
$T_0 + 14$ Days	P value	0.01	0.281	0.171
	Significance	No	No	No
$T_0 + 21$ Days	P value	0.041	0.215	0.479
	Significance	No	No	No

Table 4.14: Levene's Test Results at 1% Significance Level

Raw Values

The following table summarizes the means and standard deviations of the raw values, evolution & percent variation of ITA° parameter observed.

Evolutions ($T_n - T_0$)

The following table presents the means of the evolutions ($T_n - T_0$) of ITA° parameter with test Product A, Product B & Product C.

Product	Time Interval	Mean	Standard Dev.	Sig 5% ($T_n - T_0$)	p values	Test
A	T_0	9.087	12.48	Yes	< 0.001	Paired T-test
	T_0+7 days	10.285	12.8	Yes	< 0.001	Paired T-test
	T_0+14 days	11.223	11.91	Yes	< 0.001	Paired T-test
	T_0+21 days	11.392	11.48	Yes		
B	T_0	9.132	14.95	Yes	< 0.001	Paired T-test
	T_0+7 days	10.417	15.02	Yes	< 0.001	Paired T-test
	T_0+14 days	11.534	14.33	Yes	< 0.001	Paired T-test
	T_0+21 days	11.597	14.01	Yes		
C	T_0	9.053	12.44	Yes	< 0.001	Paired T-test
	T_0+7 days	10.323	12.6	Yes	< 0.001	Paired T-test
	T_0+14 days	11.195	11.85	Yes	< 0.001	Paired T-test
	T_0+21 days	11.715	11.7	Yes		

Table 4.15: Summary of ITA° Measurements

Product	T_0+7 days - T_0	T_0+14 days - T_0	T_0+21 days - T_0
Product A	1.198	2.136	2.305
Product B	1.285	2.402	2.466
Product C	1.269	2.142	2.33

Table 4.16: Evolution of ITA° Parameter

Variations ($(T_n - T_0)/T_0$ (%))

Product	$(T_0+7$ days - $T_0)/T_0$	$(T_0+14$ days - $T_0)/T_0$	$(T_0+21$ days - $T_0)/T_0$
Product A	13.18%	23.50%	25.36%
Product B	14.07%	26.31%	27.01%
Product C	14.02%	23.67%	25.75%

Table 4.17: Variation in Percentage of ITA° Parameter

Analysis

For Product A

- The statistical analysis shows a significant increase in ITA° parameter by 13.18%, 23.50% & 25.36% with test Product A on average on whole panel respectively at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in skin tone.
- 93% and 100% of the panel presented an improvement in the studied parameter at Day 14 (T_0+14), Day 21 (T_0+21) respectively.

For Product B

- The statistical analysis shows a significant increase in ITA° parameter by 14.07%, 26.31% & 27.01% with test Product B on average on whole panel respectively at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in skin tone.
- 100% of the panel presented an improvement in the studied parameter at Day 14 (T_0+14) & Day 21 (T_0+21) respectively.

For Product C

- The statistical analysis shows a significant increase in ITA° parameter by 14.02%, 26.31% & 25.75% on the whole face with test Product C on average on whole panel respectively at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in skin tone.
- 87% and 100% of the panel presented an improvement in the studied parameter at Day 14 (T_0+14), Day 21 (T_0+21) respectively.

ITA°		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T0	P value	0.989	0.991	0.981
	Significance at 5%	No	No	No
T0 + 7 Days	P value	0.969	0.99	0.977
	Significance at 5%	No	No	No
T0 + 14Days	P value	0.922	0.992	0.915
	Significance at 5%	No	No	No
T0 + 21Days	P value	0.947	0.908	0.97
	Significance at 5%	No	No	No

- No significant difference in the studied parameter between Products A, B, and C at T_0 , T_0+7 , T_0+14 , and T_0+21 , indicating comparability at baseline across all time points.

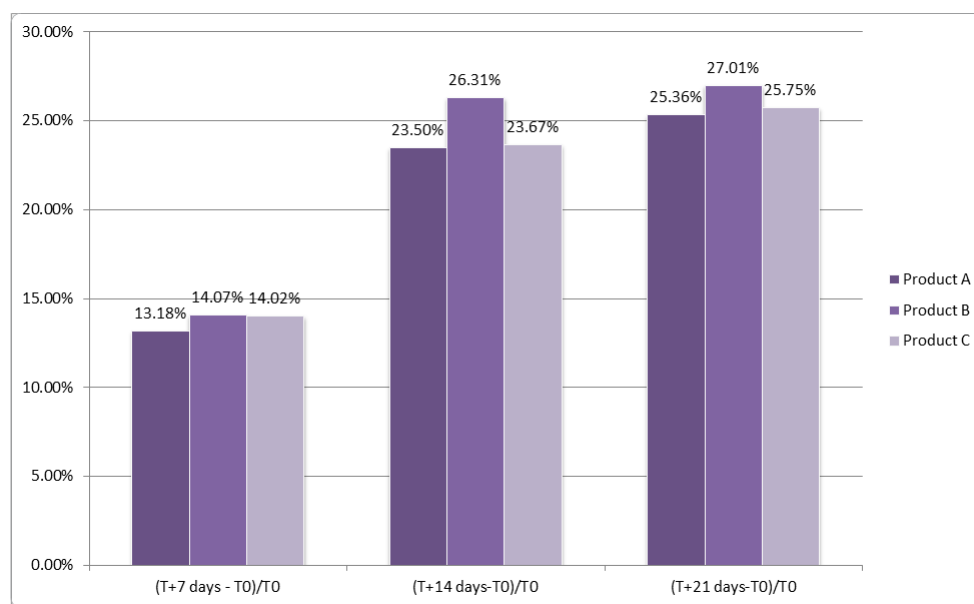


Figure 4.7: Graphical representation for variation

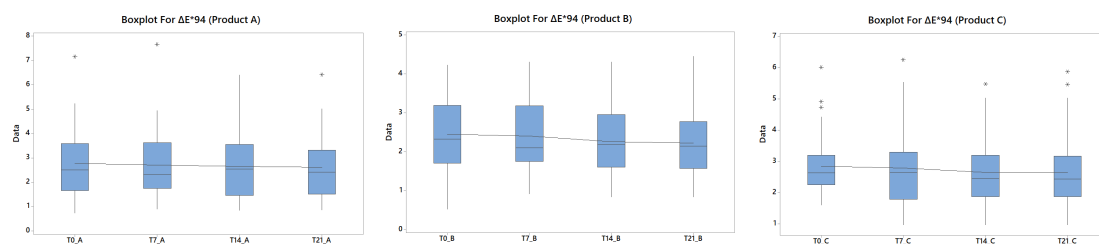
4.4.3 ΔE^*94

The studied parameters is the ΔE^*94 parameter. A significant decrease in the ΔE^*94 parameter corresponds to an improvement of the skin tone evenness (skin homogeneity).

Descriptive Statistics

Variable	N	Mean	StDev	Minimum	Maximum
T_0_A	36	2.764	1.341	0.733	7.169
$T7_A$	36	2.694	1.381	0.9	7.67
$T14_A$	36	2.653	1.321	0.84	6.395
$T21_A$	36	2.616	1.331	0.848	6.415
T_0_B	35	2.449	0.888	0.52	4.218
$T7_B$	35	2.399	1.018	0.914	4.306
$T14_B$	35	2.251	0.853	0.834	4.3
$T21_B$	35	2.22	0.863	0.832	4.447
T_0_C	36	2.835	0.978	1.599	6.02
$T7_C$	36	2.78	1.207	0.959	6.257
$T14_C$	36	2.642	1.104	0.97	5.489
$T21_C$	35	2.646	1.206	0.957	5.883

Table 4.18: Descriptive Statistics

Figure 4.8: Boxplot of ΔE^*94 parameter reading

Normality Check

Time Point	Product	Statistic	p-value	Result
T_0	A	<0.01	0.78	Accept
	B	<0.01	0.056	Accept
	C	<0.01	< 0.01	Reject
T_7	A	<0.01	< 0.01	Reject
	B	<0.01	0.78	Accept
	C	<0.01	0.78	Accept
T_{14}	A	<0.01	0.062	Accept
	B	<0.01	0.054	Accept
	C	<0.01	0.123	Accept
T_{21}	A	<0.01	0.066	Accept
	B	<0.01	0.029	Accept
	C	<0.01	0.100	Accept

Table 4.19: Shapiro-Wilk Test Results at 1% Significance Level

Homogeneity of Variances

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T_0	P value	0.364	0.239	0.714
	Significance at 5%	No	No	No
$T_0 + 7$ Days	P value	0.48	0.268	0.605
	Significance at 5%	No	No	No
$T_0 + 14$ Days	P value	0.363	0.258	0.774
	Significance at 5%	No	No	No
$T_0 + 21$ Days	P value	0.351	0.333	0.932
	Significance at 5%	No	No	No

Table 4.20: Levene's Test Results at 5% Significance Level

Raw Values

The following table summarizes the means and standard deviations of the raw values, evolution & percent variation of ΔE^*94 parameter corresponds to an improvement of the skin tone

Product	Time Interval	Mean	Standard Dev.	Sig 5%($T_n - T_0$)	p values	Test
A	T_0	2.764	1.341	No	0.242	Wilcoxon test
	T_0+7 days	2.694	1.381	No	0.112	Paired T-test
	T_0+14 days	2.653	1.321	No	0.054	Paired T-test
	T_0+21 days	2.616	1.331	No		
B	T_0	2.449	0.888	No	0.699	Paired T-test
	T_0+7 days	2.399	1.018	No	0.161	Paired T-test
	T_0+14 days	2.251	0.853	No	0.105	Paired T-test
	T_0+21 days	2.220	0.863	No		
C	T_0	2.835	0.978	No	0.654	Wilcoxon test
	T_0+7 days	2.780	1.207	No	0.075	Wilcoxon test
	T_0+14 days	2.642	1.104	No	0.045	Wilcoxon test
	T_0+21 days	2.646	1.206	Yes		

Table 4.21: Summary of ΔE^*94 Measurements

evenness with test Product A, Product B & Product C at T_0 , T_0+7 , T_0+14 & T_0+21 Days visit as well as the corresponding statistical results for the evolution in time (Student test or Wilcoxon test, two-tailed for paired groups at 5%, after checking the normality of the distributions by a Shapiro-Wilk test at 1%).

Evolutions (T_n-T_0)

The following table presents the means and the standard deviations of the evolutions (T_n-T_0) of ΔE^*94 parameter corresponds to an improvement of the skin tone evenness with test Product A, Product B & Product C.

Product	T_0+7 days - T_0	T_0+14 days - T_0	T_0+21 days - T_0
Product A	1.198	2.136	2.305
Product B	1.285	2.402	2.466
Product C	1.269	2.142	2.33

Table 4.22: Evolution of ΔE^*94 Parameter

Variations ($(T_n-T_0)/T_0$ (%))

ΔE^*94	($T+7$ days - T_0)/ T_0	($T+14$ days - T_0)/ T_0	($T+21$ days - T_0)/ T_0
Product A	-2.55%	-4.04%	-5.38%
Product B	-2.04%	-8.13%	-9.35%
Product C	-1.94%	-6.81%	-7.23%

Table 4.23: Variation in Percentage of ΔE^*94 Parameter

Analysis

For Product A

- The statistical analysis shows a significant increase in ΔE^*94 parameter corresponds to an improvement of the skin tone evenness by -2.55%, -4.04% & -5.38% with test Product A on average on whole panel respectively at Day1 T0, Day 7 T0+7, Day 14 T0+14, Day 21 T0+21 day show effect of product in skin tone.
- 100% of the panel presented an decrement in the studied parameter at Day 14 T0+14, Day 21 T0+21 respectively.

For Product B

- The statistical analysis shows a significant decrease in ΔE^*94 parameter corresponds to an improvement of the skin tone evenness by -2.04%, -8.13% & -9.35% with test Product B on average on whole panel respectively at Day1 T0, Day 7 T0+7, Day 14 T0+14, Day 21 T0+21 day show effect of product in skin tone.
- 100% of the panel presented an decrement in the studied parameter at Day 14 T0+14, Day 21 T0+21 respectively.

For Product C

- The statistical analysis shows a significant increase in ΔE^*94 parameter corresponds to an improvement of the skin tone evenness by -1.94%, -6.81% & -7.23% on the whole face with test Product C on average on whole panel respectively at Day1 T0, Day 7 T0+7, Day 14 T0+14, Day 21 T0+21 day show effect of product in skin tone.
- 100% of the panel presented an decrement in the studied parameter at Day 14 T0+14, Day 21 T0+21 respectively.

ΔE^*94		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T0	P value	0.247	0.991	0.981
	Significance at 5%	No	No	No
T0 + 7 Days	P value	0.969	0.99	0.977
	Significance at 5%	No	No	No
T0 + 14Days	P value	0.132	0.971	0.915
	Significance at 5%	No	No	No
T0 + 21Days	P value	0.142	0.92	0.97
	Significance at 5%	No	No	No

- No significant difference in the studied parameter was noted between test Products A , B and C at (T_0) , (T_0+7) , (T_0+14) , or (T_0+21) , indicating that the sites are comparable at these baseline points.

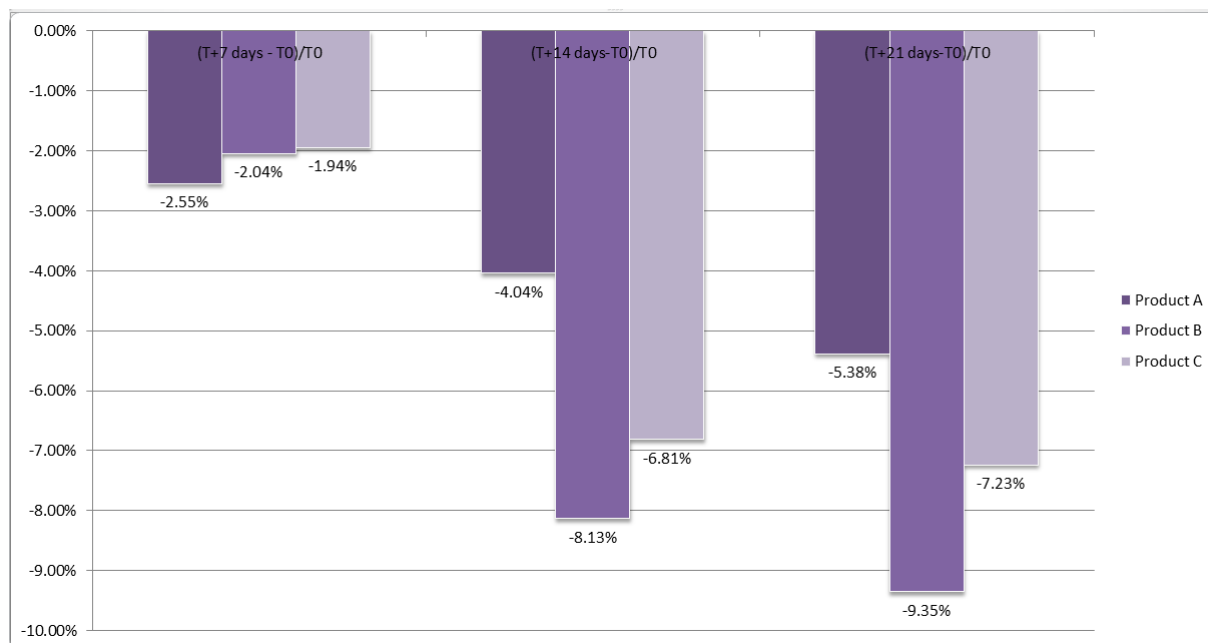


Figure 4.9: Graphical representation for variation

4.5 Corneometry

An significant increase in the value of the Corneometry parameter shows a moisturizing effect of the product.

Descriptive Statistics

Variable	N	Mean	StDev	Minimum	Maximum
T0_A	36	34.966	5.988	23.683	46.367
T7_A	36	44.6	6.23	31.72	61.15
T14_A	36	51.05	5.407	43.317	64.017
T21_A	36	52.542	5.226	40.833	63.233
T0_B	35	35.9	6.73	24.89	56.68
T7_B	35	47.16	9.48	30.78	67.12
T14_B	35	53.3	6.68	39.05	67.48
T21_B	35	56.28	6.46	43.1	70.93
T0_C	36	35.08	6.46	22.6	54.7
T7_C	36	45.97	7.47	31.63	66.48
T14_C	36	51.41	7.67	34.68	63
T21_C	35	52.48	6.55	37.52	65

Table 4.24: Five number summary

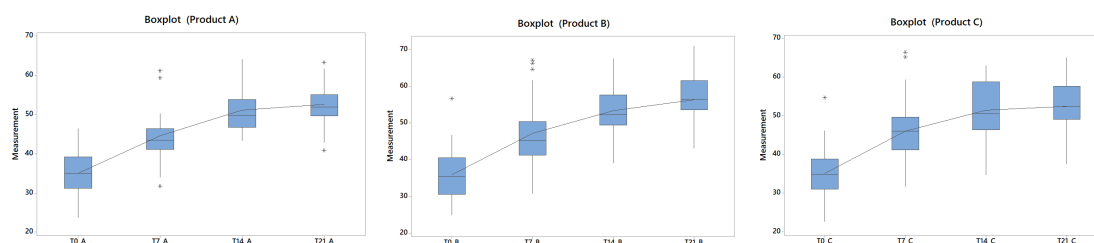


Figure 4.10: Boxplot of measurement

Outliers detected were replaced by mean respectively.

Normality Check

Time Point	Product	Statistic	p-value	Result
T_0	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept
T7	A	<0.01	< 0.010	Reject
	B	<0.01	0.041	Accept
	C	<0.01	0.033	Accept
T14	A	<0.01	0.073	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept
T21	A	<0.01	0.097	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept

Table 4.25: Shapiro-Wilk Test Results at 1% Significance Level

Homogeneity of Variances

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T_0	P value Significance	0.556 No	0.663 No	0.907 No
$T_0 + 7$ Days	P value Significance	0.035 No	0.357 No	0.199 No
$T_0 + 14$ Days	P value Significance	0.301 No	0.012 No	0.178 No
$T_0 + 21$ Days	P value Significance	0.28 No	0.132 No	0.723 No

Table 4.26: Levene's Test Results at 1% Significance Level

Raw Values

The following table summarizes the means and standard deviations of the raw values of moisturizing effect observed on both Cheek bone treated with test Product A, Product B & Product C at Day1 T_0 , Day 7 T_0+7 , Day 14 T_0+14 , Day 21 T_0+21 day visit as well as the corresponding statistical results for the evolution in time (Student test or Wilcoxon test, two-tailed for paired groups at 5%, after checking the normality of the distributions by a Shapiro-Wilk test at 1%).

Product	Time Interval	Mean	Standard Dev.	Sig 5%($T_n - T_0$)	p values	Test
A	T_0	34.966	5.988	Yes	<0.001	Wilcoxon test
	T_0+7 days	44.6	6.23	Yes	<0.001	Paired T test
	T_0+14 days	51.05	5.407	Yes	<0.001	Paired T test
	T_0+21 days	52.542	5.226	Yes	<0.001	Paired T test
B	T_0	35.9	6.73	Yes	<0.001	Paired T test
	T_0+7 days	47.16	9.48	Yes	<0.001	Paired T test
	T_0+14 days	53.3	6.68	Yes	<0.001	Paired T test
	T_0+21 days	56.28	6.46	Yes	<0.001	Paired T test
C	T_0	35.08	6.46	Yes	<0.001	Paired T test
	T_0+7 days	45.97	7.47	Yes	<0.001	Paired T test
	T_0+14 days	51.41	7.67	Yes	<0.001	Paired T test
	T_0+21 days	52.48	6.55	Yes	<0.001	Paired T test

Table 4.27: Summary of Corneometry Measurements

Evolutions ($T_n - T_0$)

The following table presents the means and the standard deviations of the evolutions ($T_n - T_0$) of moisturizing effect observed on both Cheek bone with test Product A, Product B & Product C.

Product	$(T_0 + 7days - T_0)$	$(T_0 + 14days - T_0)$	$(T_0 + 21days - T_0)$
A	9.64	16.084	17.58
B	11.26	17.402	20.38
C	10.89	16.33	17.04

Table 4.28: Evolution of Corneometry Parameter

Variations $(T_n - T_0)/T_0$ (%)

The following table summarises the average percentages of the variation $(T_n - T_0)/T_0$ of moisturizing effect observed on both Cheek bone with test Product A, Product B & Product C.

Product	$(T_0 + 7 \text{ days} - T_0)/T_0$	$(T_0 + 14 \text{ days} - T_0)/T_0$	$(T_0 + 21 \text{ days} - T_0)/T_0$
A	28%	46%	50%
B	31%	48%	49%
C	31%	47%	49%

Table 4.29: Variation in Percentage of Corneometry Parameter

Analysis

For Product A

- The statistical analysis shows a significant increase in moisturizing effect parameter by 28%, 46% & 50% with test Product A on average for the whole panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in skin tone.
- 100% of the panel presented an decrease in the studied parameter at Day 14 (T_0+14), Day 21 (T_0+21) respectively.

For Product B

- The statistical analysis shows a significant increase in moisturizing effect parameter by 31%, 48% & 49% with test Product B on average for the whole panel respectively at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in skin tone.
- 100% of the panel presented an decrease in the studied parameter at Day 14 (T_0+14), Day 21 (T_0+21) respectively.

For Product C

- The statistical analysis shows a significant increase in moisturizing effect parameter by 31%, 47% & 49% on the whole face with test Product C on average for the whole panel respectively at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in skin tone.
- 100% of the panel presented an decrease in the studied parameter at Day 14 (T_0+14), Day 21 (T_0+21) respectively.

CORNEOMETRY		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T0	P value	0.54	0.94	0.602
	Significance at 5%	No	No	No
T0 + 7 Days	P value	0.3427	0.2303	0.559
	Significance at 5%	No	No	No
T0 + 14Days	P value	0.124	0.821	0.27
	Significance at 5%	No	No	No
T0 + 21Days	P value	0.009	0.963	0.017
	Significance at 5%	Yes	No	Yes

Table 4.30: Corneometry parameter Comparison in Product

- No significant difference in the studied parameter was noted between test Products A and C at (T_0) , (T_0+7) , (T_0+14) , or (T_0+21) , indicating that the sites are comparable at these baseline points. However, a significant difference between test Products A and B, and between Products B and C, was noted at (T_0+21) .

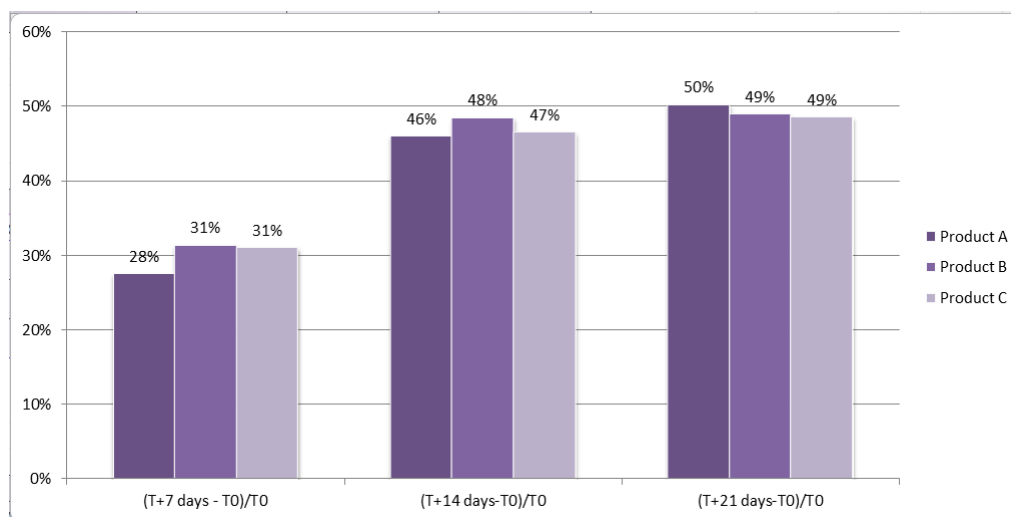


Figure 4.11: Graphical representation for variation

4.6 Sebumetry

The significant decrease in the sebum level showed an effect of the product in terms of anti-sebum effect.

Descriptive Statistics

Variable	N	Mean	StDev	Minimum	Maximum
T0_A	36	238.81	28.29	183	313
T7_A	36	155.22	17	119	190
T14_A	36	149.69	21.64	116	208
T21_A	36	144.64	25.03	101	211
T0_B	35	230.06	30.48	174	298
T7_B	35	146.03	27.66	109	201
T14_B	35	134.66	30.47	71	199
T21_B	35	128.8	30.25	69	189
T0_C	36	232.47	31.01	152	311
T7_C	36	156.75	31.35	79	233
T14_C	36	152.25	27.66	90	212
T21_C	35	149.23	28.94	79	205

Table 4.31: Five number summary

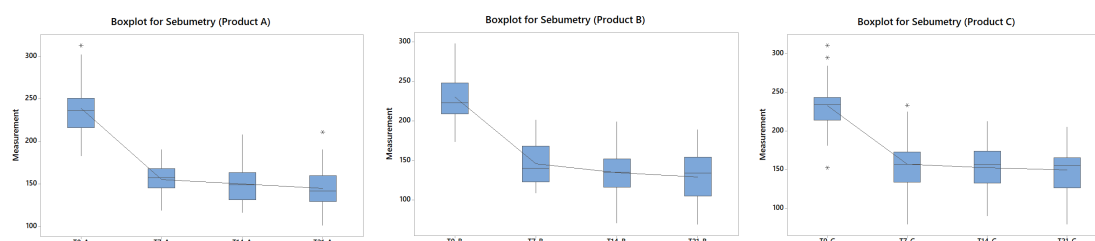


Figure 4.12: Boxplot for sebumetry parameter reading

Outliers were detected and replaced.

Normality Check

Time Point	Product	Statistic	p-value	Result
T0	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept
T7	A	<0.01	> 0.100	Accept
	B	<0.01	0.073	Accept
	C	<0.01	> 0.100	Accept
T14	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept
T21	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept

Table 4.32: Shapiro-Wilk Test Results at 1% Significance Level

Homogeneity of Variances

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T_0	P value	0.627	0.772	0.864
	Significance at 5%	No	No	No
$T_0 + 7$ Days	P value	0.015	0.838	0.019
	Significance at 5%	No	No	No
$T_0 + 14$ Days	P value	0.114	0.989	0.068
	Significance at 5%	No	No	No
$T_0 + 21$ Days	P value	0.262	0.694	0.495
	Significance at 5%	No	No	No

Table 4.33: Levene's Test Results at 5% Significance Level

Raw Values

The following table summarizes the means and standard deviations of the raw values of sebum content observed on the forehead treated with test Product A, Product B & Product C at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day visit as well as the corresponding statistical results for the evolution in time (Student test or Wilcoxon test, two-tailed for paired groups at 5%, after checking the normality of the distributions by a Shapiro-Wilk test at 1%).

Product	Time Interval	Mean	Standard Dev.	Sig 5% ($T_n - T_0$)	p values	Test
A	T_0	238.81	28.29	Yes	<0.001	Paired T test
	T_0+7 days	155.22	17	Yes	<0.001	Paired T test
	T_0+14 days	149.69	21.64	Yes	<0.001	Paired T test
	T_0+21 days	144.64	25.03	Yes	<0.001	Paired T test
B	T_0	230.06	30.48	Yes	<0.001	Paired T test
	T_0+7 days	146.03	27.66	Yes	<0.001	Paired T test
	T_0+14 days	134.66	30.47	Yes	<0.001	Paired T test
	T_0+21 days	128.8	30.25	Yes	<0.001	Paired T test
C	T_0	232.47	31.01	Yes	<0.001	Paired T test
	T_0+7 days	156.75	31.35	Yes	<0.001	Paired T test
	T_0+14 days	152.25	27.66	Yes	<0.001	Paired T test
	T_0+21 days	149.23	28.94	Yes	<0.001	Paired T test

Table 4.34: Summary of Sebumetry Measurements

Evolutions ($T_n - T_0$)

The following table presents the means and the standard deviations of the evolutions ($T_n - T_0$) of sebum content observed on the forehead with test Product A, Product B & Product C.

Product	$(T_0 + 7days - T_0)$	$(T_0 + 14days - T_0)$	$(T_0 + 21days - T_0)$
A	-83.58	-89.11	-94.17
Std dev	19.39	24.19	25.97
B	-84.03	-95.4	-101.26
Std dev	13.35	25.91	27.33
C	-75.72	-80.22	-84.03
Std dev	18.8	21.81	26.65

Table 4.35: Evolution of Sebumetry Parameter

Variations $(T_n - T_0)/T_0$ (%)

The following table summarises the average percentages of the variation $(T_n - T_0)/T_0$ of the sebum content observed on the forehead with test Product A, Product B & Product C.

Product	$(T_0 + 7 \text{ days} - T_0)/T_0$	$(T_0 + 14 \text{ days} - T_0)/T_0$	$(T_0 + 21 \text{ days} - T_0)/T_0$
A	-35.00%	-37.31%	-39.43%
B	-36.53%	-41.47%	-44.01%
C	-32.57%	-34.51%	-36.15%

Table 4.36: Variation in Percentage of Sebum

Analysis

For Product A

- The statistical analysis shows a significant decrease in sebum content parameter by - 35.00%, -37.31% & -39.41% on the forehead with test Product A on average for the whole panel respectively at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in terms of anti-sebum effect.
- 55% and 100% of the panel presented an decrease in the studied parameter at Day 14 (T_0+14), Day 21 (T_0+21) respectively.

For Product B

- The statistical analysis shows a significant decrease in sebum content parameter by - 36.53%, -41.47% & -44.01% on the forehead with test Product B on average for the whole panel respectively at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in terms of anti-sebum effect.
- 100% of the panel presented an decrease in the studied parameter at Day 14 (T_0+14), Day 21 (T_0+21) respectively.

For Product C

- The statistical analysis shows a significant decrease in sebum content parameter by - 32.57%, -34.51% & -36.15% on the forehead with test Product C on average for the whole panel respectively at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in terms of anti-sebum effect.
- 100% of the panel presented an decrease in the studied parameter at Day 14 (T_0+14), Day 21 (T_0+21) respectively.

Comparison of Test Products

The following table presents the statistical results comparing the studied parameter observed between Product A, Product B, and Product C at T_n . The analysis was conducted using a Student's t-test (two-tailed, for independent samples) or a Mann-Whitney test at 5%), after checking the normality of the distributions with a Shapiro-Wilk test at 1

- No significant difference in the studied parameter was noted between test Products A , B and C at (T_0), (T_0+7) indicating that the sites are comparable at these baseline points.

Sebumetry		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T₀	P value	0.54	0.94	0.602
	Significance at 5%	No	No	No
T₀ + 7 Days	P value	0.3427	0.2303	0.559
	Significance at 5%	No	No	No
T₀ + 14Days	P value	0.124	0.821	0.27
	Significance at 5%	No	No	No
T₀ + 21Days	P value	0.009	0.963	0.017
	Significance at 5%	Yes	No	Yes

Table 4.37: Sebumentry Comparison in Product

- However, a significant difference between test Products A and B, and between Products B and C, was noted at (T_0+14) and (T_0+21).
- Significant difference between test Product A, Product B & Product C is noted at ($T_0 + 21$ days) for the studied parameter.

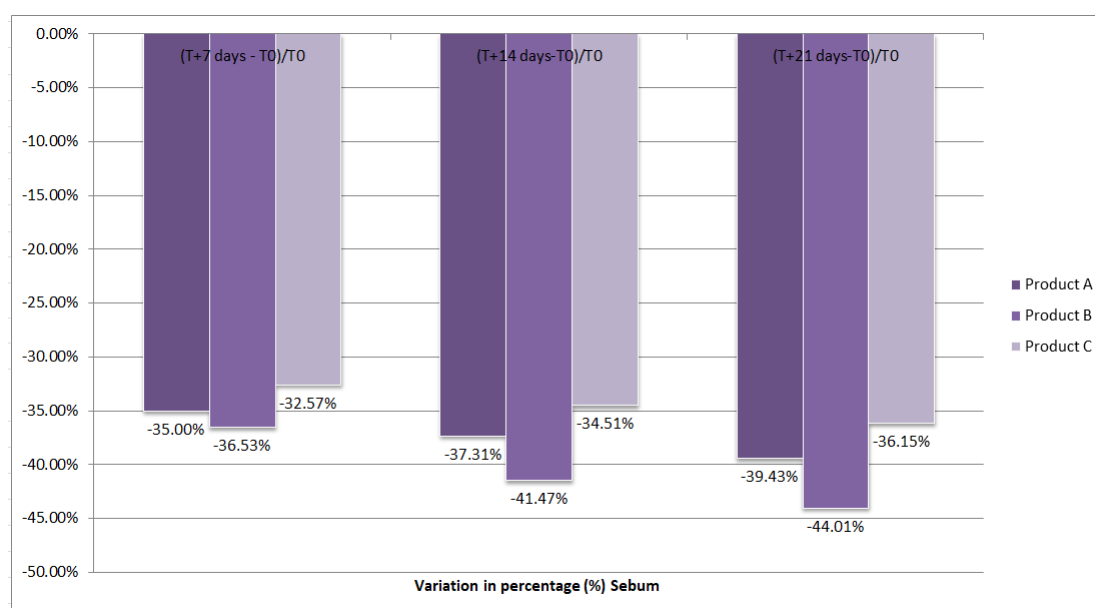


Figure 4.13: Graphical representation for variation

4.7 Mexametry

The significant decrease in the melanin readings shows an effect of the product in terms of reduction in melanin content of the spot.

Descriptive Statistics

Variable	N	Mean	StDev	Minimum	Maximum
T0_A	36	421.5	80.6	198.3	584.3
T7_A	36	419.3	80.6	197.7	581.7
T14_A	36	417.2	81.1	196	579.7
T21_A	36	416.1	81.1	194	579.7
T0_B	35	443.4	95.9	287.3	648
T7_B	35	441	95.4	285.7	640.3
T14_B	35	438.8	95.9	283	639.7
T21_B	35	437.6	95.8	282.3	638.3
T0_C	36	418.7	87.5	288.3	644
T7_C	36	416.8	87.4	285.7	637.7
T14_C	36	415	87	285.7	634.7
T21_C	35	414.1	88.1	283.7	635.3

Table 4.38: Five number summary

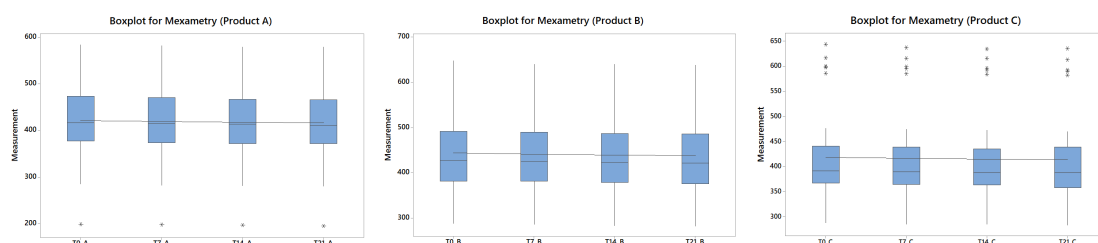


Figure 4.14: Boxplot for Mexametry Parameter measurement

Normality Check

Time Point	Product	Statistic	p-value	Result
T_0	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	< 0.10	Reject
T7	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	< 0.10	Reject
T14	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	< 0.10	Reject
T21	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	< 0.10	Reject

Table 4.39: Shapiro-Wilk Test Results at 1% Significance Level

Homogeneity of Variances

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T_0	P value Significance	0.249 No	0.223 No	0.795 No
$T_0 + 7$ Days	P value Significance	0.252 No	0.226 No	0.795 No
$T_0 + 14$ Days	P value Significance	0.266 No	0.212 No	0.746 No
$T_0 + 21$ Days	P value Significance	0.268 No	0.247 No	0.812 No

Table 4.40: Levene's Test Results at 1% Significance Level

Raw Values

The following table summarizes the means and standard deviations of melanin content for spots treated with test Products A, B, and C at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21). It also includes the corresponding statistical results for changes over time, using a Student's t-test or Wilcoxon test (two-tailed for paired groups at 5%), after verifying normality with a Shapiro-Wilk test at 1

Product	Time Interval	Mean	Standard Dev.	Sig 5%($T_n - T_0$)	p values	Test
A	T_0	421.5	80.6	Yes	<0.001	Paired T test
	T_0+7 days	419.3	80.6	Yes	<0.001	Paired T test
	T_0+14 days	417.2	81.1	Yes	<0.001	Paired T test
	T_0+21 days	416.1	81.1	Yes	<0.001	Paired T test
B	T_0	443.4	95.9	Yes	<0.001	Paired T test
	T_0+7 days	441	95.4	Yes	<0.001	Paired T test
	T_0+14 days	438.8	95.9	Yes	<0.001	Paired T test
	T_0+21 days	437.6	95.8	Yes	<0.001	Paired T test
C	T_0	418.7	87.5	Yes	<0.001	Wilcoxon test
	T_0+7 days	416.8	87.4	Yes	<0.001	Wilcoxon test
	T_0+14 days	415	87	Yes	<0.001	Wilcoxon test
	T_0+21 days	414.1	88.1	Yes	<0.001	Wilcoxon test

Table 4.41: Summary of Mexametry Measurements

Evolutions ($T_n - T_0$)

The following table presents the means and the standard deviations of the evolutions ($T_n - T_0$) of melanin content of the spot observed with test Product A, Product B & Product C.

Product	$(T_0 + 7days - T_0)$	$(T_0 + 14days - T_0)$	$(T_0 + 21days - T_0)$
A	-2.148	-4.213	-5.389
B	-2.39	-4.638	-5.819
C	-1.889	-3.63	-4.952

Table 4.42: Evolution of L* Parameter

Variations $(T_n - T_0)/T_0$ (%)

The following table summarises the average percentages of the variation $(T_n - T_0)/T_0$ of the melanin content of the spot observed with test Product A, Product B & Product C.

Product	$(T_0 + 7 \text{ days} - T_0)/T_0$	$(T_0 + 14 \text{ days} - T_0)/T_0$	$(T_0 + 21 \text{ days} - T_0)/T_0$
A	-0.51%	-1.00%	-1.28%
B	-0.54%	-1.05%	-1.31%
C	-0.45%	-0.87%	-1.18%

Table 4.43: Variation in Percentage of Mexametry

Analysis

For Product A

- The statistical analysis shows a significant decrease in melanin content of the spot parameter by -0.51%, -1% & -1.28% with test Product A on average for the whole panel respectively at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in terms of anti-melanin effect.
- 100% of the panel presented an decrement in the studied parameter at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) respectively.

For Product B

- The statistical analysis shows a significant decrease in melanin content parameter by -0.54%, -1.05% & -1.38% with test Product B on average for the whole panel respectively at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in terms of anti-melanin effect.
- 100% of the panel presented an decrement in the studied parameter at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) respectively.

For Product C

- The statistical analysis shows a significant decrease in melanin content parameter by -0.45%, -0.86% & -1.18% on the whole face with test Product B for the average for the whole panel respectively at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day show effect of product in terms of anti-melanin effect.
- 100% of the panel presented an improvement in the studied parameter at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) respectively.

MEXAMETRY		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T₀	P value	0.301	0.4745	0.21
	Significance at 5%	No	No	No
T₀ + 7 Days	P value	0.305	0.485	0.2408
	Significance at 5%	No	No	No
T₀ + 14Days	P value	0.312	0.4885	0.2362
	Significance at 5%	No	No	No
T₀ + 21Days	P value	0.312	0.4938	0.2473
	Significance at 5%	No	No	No

Table 4.44: Mexametry Comparison in Product

- No significant difference in the studied parameter was noted between test Products A, B, and C at T_0 , T_0+7 , T_0+14 , or T_0+21 , indicating that the sites are comparable at all baseline points.

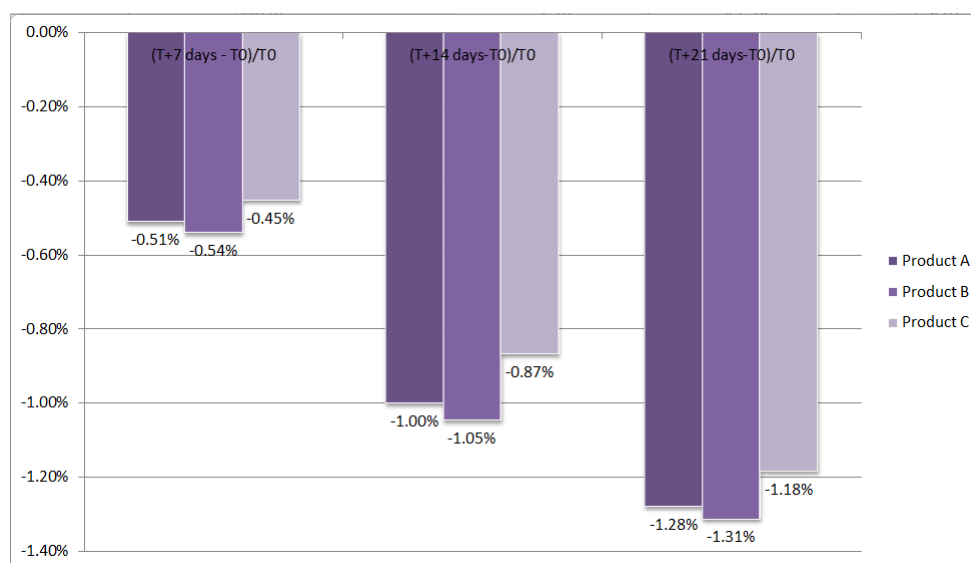


Figure 4.15: Graphical representation for variation

4.8 Tewametry

The significant decrease in the parameter showed a prevention of the water loss from skin.

Descriptive Statistics

Variable	N	Mean	StDev	Minimum	Maximum
T0_A	36	13.386	1.807	9.25	16.6
T7_A	36	12.278	1.706	8.4	16.3
T14_A	36	11.658	1.605	7.75	14.55
T21_A	36	10.84	1.875	7.55	14.35
T0_B	35	13.733	2.152	9.8	19
T7_B	35	12.556	2.056	8.4	18.65
T14_B	35	11.82	2.119	8.5	18.3
T21_B	35	11.033	2.091	7.6	17.05
T0_C	36	13.238	2.059	9.25	19.45
T7_C	36	12.34	2.044	8.45	19.25
T14_C	36	11.791	2.048	8.45	19
T21_C	35	11.067	1.941	8.35	18.3

Table 4.45: Five number summary

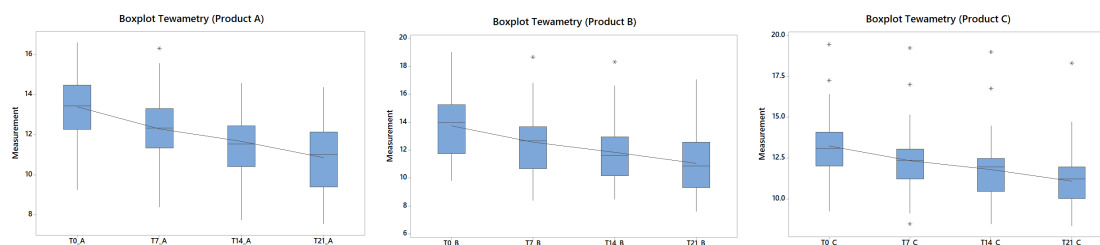


Figure 4.16: Boxplot for Tewametry parameter reading

Normality Check

Time Point	Product	Statistic	p-value	Result
T_0	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	0.074	Accept
T7	A	<0.01	> 0.100	Accept
	B	<0.01	0.096	Accept
	C	<0.01	< 0.01	Reject
T14	A	<0.01	> 0.100	Accept
	B	<0.01	0.012	Accept
	C	<0.01	< 0.01	Reject
T21	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	< 0.01	Reject

Table 4.46: Shapiro-Wilk Test Results at 1% Significance Level

Homogeneity of Variances

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T_0	P value Significance	0.232 No	0.368 No	0.88 No
$T_0 + 7$ Days	P value Significance	0.348 No	0.556 No	0.819 No
$T_0 + 14$ Days	P value Significance	0.25 No	0.666 No	0.522 No
$T_0 + 21$ Days	P value Significance at 5%	0.464 No	0.368 No	0.814 No

Table 4.47: Levene's Test Results at 1% Significance Level

Raw Values

The following table summarizes the means and standard deviations of the raw values of the density gradient of water evaporation from the skin treated with test Products A, B, and C at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21) visits. Additionally, the table includes the corresponding statistical results for the evolution over time, determined by either a Student's t-test or a Wilcoxon test (two-tailed for paired groups at 5%) after checking the normality of the distributions using a Shapiro-Wilk test at 1

Product	Time Interval	N	Mean	Standard Dev.	Sig 5%($T_n - T_0$)	p values	Test
A	T_0	36	13.386	1.807	Yes	<0.001	Paired T-test
	T_0+7 days	36	12.278	1.706	Yes	<0.001	Paired T-test
	T_0+14 days	36	11.658	1.605	Yes	<0.001	Paired T-test
	T_0+21 days	36	10.84	1.875	Yes	<0.001	Paired T-test
B	T_0	35	13.733	2.152	Yes	<0.001	Paired T-test
	T_0+7 days	35	12.556	2.056	Yes	<0.001	Paired T-test
	T_0+14 days	35	11.82	2.119	Yes	<0.001	Paired T-test
	T_0+21 days	35	11.033	2.091	Yes	<0.001	Paired T-test
C	T_0	36	13.238	2.059	Yes	<0.001	Wilcoxon test
	T_0+7 days	36	12.34	2.044	Yes	<0.001	Wilcoxon test
	T_0+14 days	36	11.791	2.048	Yes	<0.001	Wilcoxon test
	T_0+21 days	35	11.067	1.941	Yes	<0.001	Wilcoxon test

Table 4.48: Summary of Tewametry Measurements

Evolutions ($T_n - T_0$)

The following table presents the means and the standard deviations of the evolutions ($T_n - T_0$) of density gradient of the water evaporation from the skin with test Product A, Product B & Product C.

Product	T_0+7 days - T_0	T_0+14 days - T_0	T_0+21 days - T_0
A (Mean)	-1.1083	-1.728	-2.546
	0.5948	0.733	0.859
B (Mean)	-1.177	-1.913	-2.7
	0.792	1.142	1.096
C (Mean)	-0.8972	-1.447	-2.206
	0.5266	0.744	0.961

Table 4.49: Evolution of parameter

Variations ($(T_n - T_0)/T_0$ (%))

The following table summarises the average percentages of the variation $(T_n - T_0)/T_0$ of density gradient of the water evaporation from the skin with test Product A, Product B & Product C.

Product	$(T_0 + 7 \text{ days} - T_0)/T_0$	$(T_0 + 14 \text{ days} - T_0)/T_0$	$(T_0 + 21 \text{ days} - T_0)/T_0$
A	-8.28%	-12.91%	-19.02%
B	-8.57%	-13.93%	-19.66%
C	-6.78%	-10.93%	-16.66%

Table 4.50: Variation in Percentage of Tewametry

Analysis

For Product A

- The statistical analysis shows a significant decrease in density gradient of the water evaporation from the skin parameter by -8.28%, -12.91% & -19.02% with test Product A on average for the entire panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), respectively, demonstrating the effect of the product.
- 61% and 100% of the panel presented an improvement in the studied parameter at Day 14 (T_0+14), Day 21 (T_0+21) respectively.

For Product B

- The statistical analysis shows a significant decrease in density gradient of the water evaporation from the skin parameter by -8.57%, -13.93% & -19.66% with test Product B on average for the entire panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), respectively, demonstrating the effect of the product.
- 73% and 100% of the panel presented an improvement in the studied parameter at Day 14 (T_0+14), Day 21 (T_0+21) respectively.

For Product C

- The statistical analysis shows a significant decrease in density gradient of the water evaporation from the skin parameter by -6.78%, -10.98% & -16.66% on the whole face with test Product C on average for the entire panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), respectively, demonstrating the effect of the product.
- 55% and 100% of the panel presented an improvement in the studied parameter at Day 14 (T_0+14), Day 21(T_0+21) respectively.

TEWAMETRY		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T₀	P value	0.465	0.392	0.3311
	Significance at 5%	No	No	No
T₀ + 7 Days	P value	0.538	0.9148	0.4478
	Significance at 5%	No	No	No
T₀ + 14Days	P value	0.719	0.9596	0.7344
	Significance at 5%	No	No	No
T₀ + 21Days	P value	0.684	0.8857	0.9672
	Significance at 5%	No	No	No

Table 4.51: Tewametry Comparison in Product

- There were no significant differences in the studied parameter between test Products A, B, and C at T_0 , T_0+7 , T_0+14 , and T_0+21 , indicating that all sites are comparable at baseline and throughout the study period.

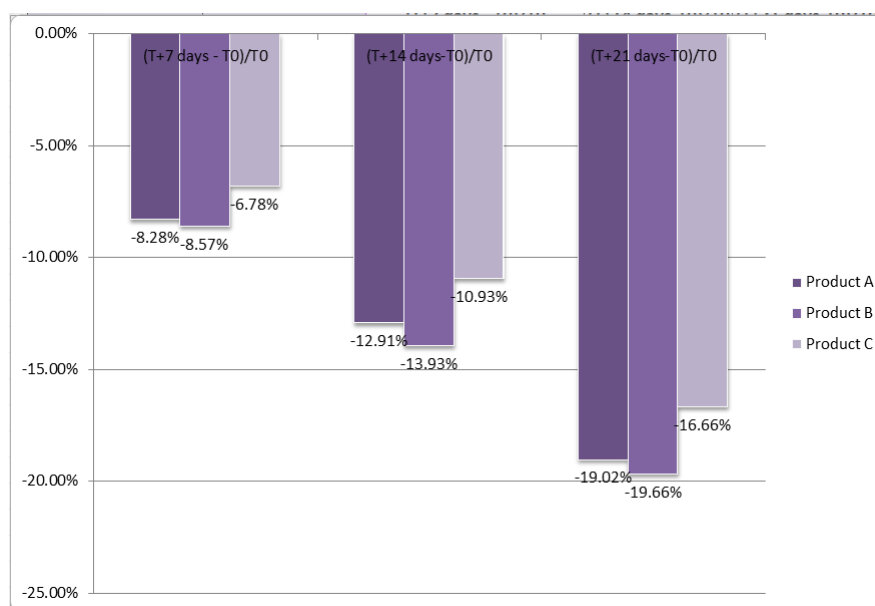


Figure 4.17: Graphical representation for variation

4.9 Cutometry

The studied parameters are R0 & which R2 which are for skin firmness & skin elasticity respectively.

The significant decrease in the R0 Parameter showed an effect of the product in terms of Skin firmness.

Descriptive Statistics

Variable	N	Mean	StDev	Minimum	Maximum
T0_A	36	0.39924	0.05674	0.3181	0.5393
T7_A	36	0.39531	0.05762	0.3117	0.5383
T14_A	36	0.39366	0.05671	0.3165	0.5354
T21_A	36	0.38596	0.05503	0.307	0.5153
T0_B	35	0.41565	0.04462	0.3256	0.4753
T7_B	35	0.4107	0.04298	0.3249	0.4695
T14_B	35	0.40845	0.04397	0.3133	0.4725
T21_B	35	0.39997	0.04677	0.304	0.4698
T0_C	36	0.387	0.0746	0.221	0.5737
T7_C	36	0.3839	0.0749	0.2205	0.5728
T14_C	36	0.3821	0.075	0.2181	0.5677
T21_C	35	0.371	0.0742	0.205	0.5607

Table 4.52: Five number summary

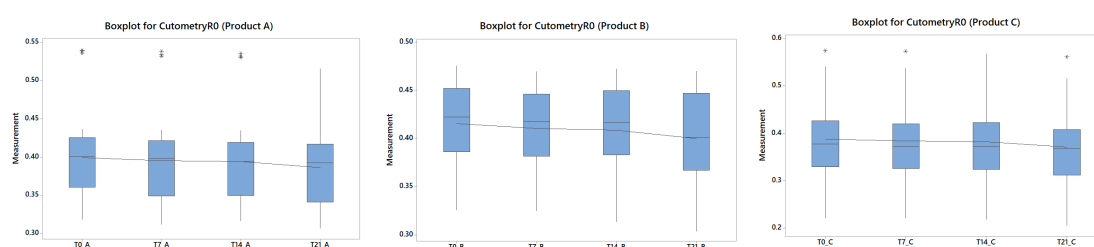


Figure 4.18: Boxplot For cutometry R0 reading

Raw Values

The following table summarizes the means and standard deviations of the raw values of R0 for skin firmness treated with test Product A, Product B & Product C at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21) day visit as well as the corresponding statistical results

for the evolution in time (Student test or Wilcoxon test, two-tailed for paired groups at 5%, after checking the normality of the distributions by a Shapiro-Wilk test at 1%).

Normality Check

Time Point	Product	Statistic	p-value	Result
T_0	A	<0.01	0.02	Accept
	B	<0.01	0.060	Accept
	C	<0.01	> 0.100	Accept
T7	A	<0.01	< 0.01	Reject
	B	<0.01	0.068	Accept
	C	<0.01	> 0.100	Accept
T14	A	<0.01	0.03	Accept
	B	<0.01	0.065	Accept
	C	<0.01	> 0.100	Accept
T21	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	0.03	Accept

Table 4.53: Shapiro-Wilk Test Results at 1% Significance Level

Homogeneity of Variances

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T_0	P value	0.255	0.033	0.236
	Significance	No	No	No
$T_0 + 7$ Days	P value	0.136	0.02	0.264
	Significance	No	No	No
$T_0 + 14$ Days	P value	0.212	0.019	0.191
	Significance	No	No	No
$T_0 + 21$ Days	P value	0.248	0.03	0.208
	Significance	No	No	No

Table 4.54: Levene's Test Results at 1% Significance Level

Evolutions ($T_n - T_0$)

The following table presents the means and the standard deviations of the evolutions ($T_n - T_0$) of R0 for skin firmness with test Product A, Product B & Product C.

Product	Time Interval	N	Mean	Standard Dev.	Sig 5%($T_n - T_0$)	p values	Test
A	T_0	36	0.39924	0.05674	Yes	<0.001	Wilcoxon test
	T_0+7 days	36	0.39531	0.05762	Yes	<0.001	Wilcoxon test
	T_0+14 days	36	0.39366	0.05671	Yes	<0.001	Wilcoxon test
	T_0+21 days	36	0.38596	0.05503	Yes	<0.001	Wilcoxon test
B	T_0	35	0.41565	0.04462	Yes	<0.001	Paired T-test
	T_0+7 days	35	0.4107	0.04298	Yes	<0.001	Paired T-test
	T_0+14 days	35	0.40845	0.04397	Yes	<0.001	Paired T-test
	T_0+21 days	35	0.39997	0.04677	Yes	<0.001	Paired T-test
C	T_0	36	0.387	0.0746	Yes	<0.001	Paired T-test
	T_0+7 days	36	0.3839	0.0749	Yes	<0.001	Paired T-test
	T_0+14 days	36	0.3821	0.075	Yes	<0.001	Paired T-test
	T_0+21 days	35	0.371	0.0742	Yes	<0.001	Paired T-test

Table 4.55: Summary of R0 Measurements

Product	T+7 days - T0	T+14 days - T0	T+21 days - T0
A (Mean)	-0.003933	-0.005581	-0.01328
	0.003276	0.005609	0.00868
B (Mean)	-0.004951	-0.0072	-0.01568
	0.003888	0.005537	0.00779
C (Mean)	-0.003153	-0.004925	-0.01165
	0.002362	0.003201	0.00649

Table 4.56: Evolution of parameter

Variations($T_n - T_0$)/ T_0 (%)

The following table summarises the average percentages of the variation ($T_n - T_0$)/ T_0 of R0 for skin firmness with test Product A, Product B & Product C.

Product	($T_0 + 7$ days - T_0)/ T_0	($T_0 + 14$ days - T_0)/ T_0	($T_0 + 21$ days - T_0)/ T_0
A	-0.99%	-1.40%	-3.33%
B	-1.19%	-1.73%	-3.77%
C	-0.81%	-1.27%	-3.01%

Table 4.57: Variation in Percentage of Cutometry R0

Analysis

For Product A

- The statistical analysis shows a significant decrease in R0 for the skin firmness parameter by -0.99%, -1.40%, and -3.33% with test Product A on average for the entire panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), respectively, demonstrating the effect of the product.

- 100% of the panel showed an improvement in the studied parameter at both Day 14 (T_0+14) and Day 21 (T_0+21).

For Product B

- The statistical analysis shows a significant decrease in R0 for the skin firmness parameter by -1.19%, -1.73%, and -3.77% with test Product B on average for the entire panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), respectively, demonstrating the effect of the product.
- 100% of the panel showed an improvement in the studied parameter at both Day 14 (T_0+14) and Day 21 (T_0+21).

For Product C

- The statistical analysis shows a significant decrease in R0 for the skin firmness parameter by -0.81%, -1.27%, and -3.01% on the whole face with test Product B on average for the whole panel respectively at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), demonstrating the effect of the product.
- 100% of the panel presented an improvement in the studied parameter at Day 14 (T_0+14) and Day 21 (T_0+21).

CUTOMETRY R0		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T0	P value	0.0533	0.33	0.054
	Significance at 5%	No	No	No
T0 + 7 Days	P value	0.0785	0.33	0.069
	Significance at 5%	No	No	No
T0 + 14Days	P value	0.0765	0.3135	0.075
	Significance at 5%	No	No	No
T0 + 21Days	P value	0.2316	0.2597	0.056
	Significance at 5%	No	No	No

Table 4.58: Cutometry R0 Comparison in Product

- There were no significant differences in the studied parameter between test Products A, B, and C at T_0 , T_0+14 , and T_0+21 , indicating that this sites are comparable at baseline and throughout the study period.

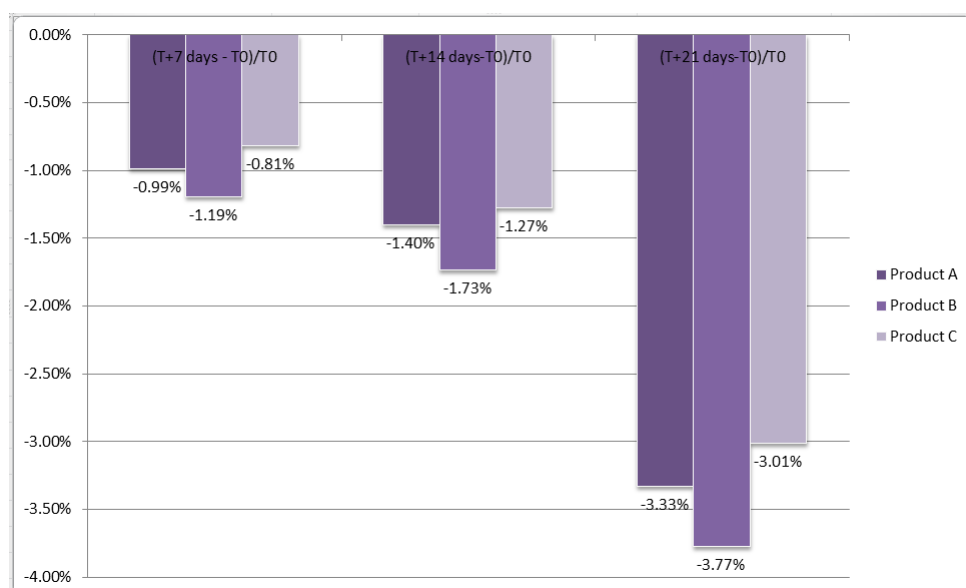


Figure 4.19: Graphical representation for variation

The significant increase in the R2 parameter shows an effect of the product in terms of improvement of Skin Elasticity.

Descriptive Statistics

Variable	N	Mean	StDev	Minimum	Maximum
T0_A	36	0.8203	0.0856	0.558	0.916
T7_A	36	0.8265	0.0874	0.558	0.928
T14_A	36	0.8308	0.0831	0.577	0.928
T21_A	36	0.8422	0.0858	0.573	0.941
T0_B	35	0.81569	0.0589	0.713	0.885
T7_B	35	0.82374	0.05838	0.725	0.887
T14_B	35	0.82846	0.05565	0.731	0.899
T21_B	35	0.84157	0.05042	0.76	0.899
T0_C	36	0.8041	0.0892	0.617	0.894
T7_C	36	0.8092	0.0889	0.627	0.897
T14_C	36	0.8125	0.09	0.632	0.902
T21_C	35	0.8226	0.0886	0.64	0.904

Table 4.59: Descriptive Statistics

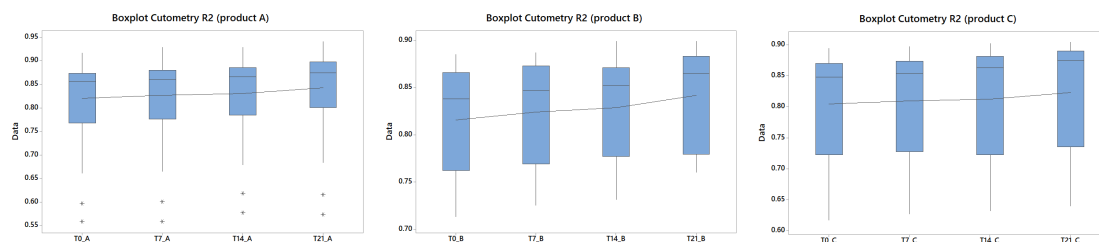


Figure 4.20: Boxplot For cutometry R2 reading

Normality Check

Time Point	Product	Statistic	p-value	Result
T_0	A	<0.01	< 0.01	Reject
	B	<0.01	< 0.01	Reject
	C	<0.01	< 0.01	Reject
T7	A	<0.01	< 0.01	Reject
	B	<0.01	< 0.01	Reject
	C	<0.01	< 0.01	Reject
T14	A	<0.01	< 0.01	Reject
	B	<0.01	< 0.01	Reject
	C	<0.01	< 0.01	Reject
T21	A	<0.01	< 0.01	Reject
	B	<0.01	< 0.01	Reject
	C	<0.01	< 0.01	Reject

Table 4.60: Shapiro-Wilk Test Results at 1% Significance Level

Homogeneity of Variances

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T0	P value	0.445	0.164	0.6
	Significance at 5%	No	No	No
T0 + 7 Days	P value	0.34	0.15	0.677
	Significance at 5%	No	No	No
T0 + 14 Days	P value	0.348	0.119	0.545
	Significance at 5%	No	No	No
T0 + 21 Days	P value	0.179	0.073	0.638
	Significance at 5%	No	No	No

Table 4.61: Levene's Test Results at 5% Significance Level

Raw Values

The following table summarizes the means and standard deviations of the raw values of R2 for skin elasticity treated with test Product A, Product B, and Product C at Day 1 (T_0), Day 7 (T_0+7),

Day 14 (T_0+14), and Day 21 (T_0+21) visits, as well as the corresponding statistical results for the evolution over time (Student's t-test or Wilcoxon test, two-tailed for paired groups at 5%), after checking the normality of the distributions with a Shapiro-Wilk test at 1%).

Product	Time Interval	N	Mean	Standard Dev.	Sig 5% ($T_n - T_0$)	p values	Test
A	T_0	36	0.8203	0.0856	Yes	<0.001	Wilcoxon test
	T_0+7 days	36	0.8265	0.0874	Yes	<0.001	Wilcoxon test
	T_0+14 days	36	0.8308	0.0831	Yes	<0.001	Wilcoxon test
	T_0+21 days	36	0.8422	0.0858	Yes	<0.001	Wilcoxon test
B	T_0	35	0.81569	0.0589	Yes	<0.001	Wilcoxon test
	T_0+7 days	35	0.82374	0.05838	Yes	<0.001	Wilcoxon test
	T_0+14 days	35	0.82846	0.05565	Yes	<0.001	Wilcoxon test
	T_0+21 days	35	0.84157	0.05042	Yes	<0.001	Wilcoxon test
C	T_0	36	0.8041	0.0892	Yes	<0.001	Wilcoxon test
	T_0+7 days	36	0.8092	0.0889	Yes	<0.001	Wilcoxon test
	T_0+14 days	36	0.8125	0.09	Yes	<0.001	Wilcoxon test
	T_0+21 days	35	0.8226	0.0886	Yes	<0.001	Wilcoxon test

Table 4.62: Summary of R2 Measurements

Evolutions ($T_n - T_0$)

The following table presents the means and the standard deviations of the evolutions ($T_n - T_0$) of R2 for skin elasticity with test Product A, Product B & Product C.

Product	T+7 days - T0	T+14 days - T0	T+21 days - T0
A (Mean)	0.006222	0.01053	0.02192
	0.004176	0.00631	0.00792
B (Mean)	0.008057	0.01277	0.02589
	0.004505	0.00662	0.01416
C (Mean)	0.005083	0.00842	0.0198
	0.004265	0.0974	0.01175

Table 4.63: Evolution of parameter

Variations ($(T_n - T_0)/T_0$ (%))

The following table summarises the average percentages of the variation ($(T_n - T_0)/T_0$) of R2 for skin elasticity with test Product A, Product B & Product C.

Analysis

For Product A

Product	$(T_0 + 7 \text{ days} - T_0)/T_0$	$(T_0 + 14 \text{ days} - T_0)/T_0$	$(T_0 + 21 \text{ days} - T_0)/T_0$
A	0.76%	1.28%	2.67%
B	0.99%	1.57%	3.17%
C	0.63%	1.05%	2.46%

Table 4.64: Variation in Percentage of Cutometry R2

- The statistical analysis shows a significant increase in R2 for the skin elasticity parameter by 0.76%, 1.28%, and 2.67% with test Product A on average for the whole panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), demonstrating the product's effect in terms of anti-melanin effect.
- 100% of the panel presented an improvement in the studied parameter at Day 14 (T_0+14) and Day 21 (T_0+21).

For Product B

- The statistical analysis shows a significant decrease in R2 for the skin elasticity parameter by 0.99%, 1.57%, and 3.17% with test Product B on average for the whole panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), demonstrating the product's effect in terms of anti-melanin effect.
- 100% of the panel presented an improvement in the studied parameter at Day 14 (T_0+14) and Day 21 (T_0+21).

For Product C

- The statistical analysis shows a significant decrease in R2 for the skin elasticity parameter by 0.63%, 1.05%, and 2.46% on the whole face with test Product B on average for the whole panel respectively at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), demonstrating the product's effect in terms of anti-melanin effect..
- 100% of the panel presented an improvement in the studied parameter at Day 14 (T_0+14) and Day 21 (T_0+21).

CUTOMETRY R2		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T₀	P value	0.3789	0.4338	1
	Significance at 5%	No	No	No
T₀ + 7 Days	P value	0.4444	0.3244	0.854
	Significance at 5%	No	No	No
T₀ + 14Days	P value	0.4745	0.4745	0.9633
	Significance at 5%	No	No	No
T₀ + 21Days	P value	0.2272	0.3666	0.7915
	Significance at 5%	No	No	No

Table 4.65: Cutometry R2 Comparison in Product

- The study found no significant differences between Product A, Product B, and Product C at multiple time points (T_0 , T_0+7 , T_0+14 , and T_0+21) for the measured parameter. This suggests that both study sites are comparable at baseline, indicating similar characteristics across all products and sites.

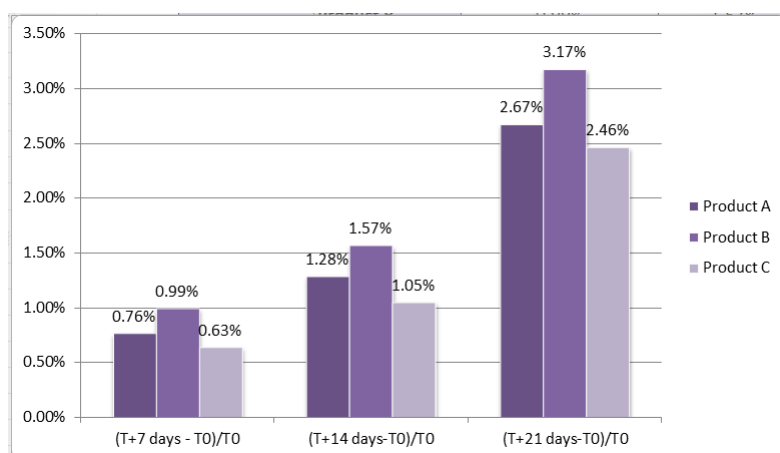


Figure 4.21: Graphical representation for variation

4.10 Skin Brightening

The significant increase in the score for parameter shows an effect of the product in terms of Skin Brightening.

Normality Check

Time Point	Product	Statistic	p-value	Result
T_0	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	0.074	Accept
T7	A	<0.01	> 0.100	Accept
	B	<0.01	0.096	Accept
	C	<0.01	> 0.100	Accept
T14	A	<0.01	> 0.100	Accept
	B	<0.01	0.012	Accept
	C	<0.01	> 0.100	Accept
T21	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept

Table 4.66: Shapiro-Wilk Test Results at 1% Significance Level

Homogeneity of Variances

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T_0	P value	0.989	0.858	0.874
	Significance at 5%	No	No	No
$T_0 + 7$ Days	P value	0.989	0.858	0.874
	Significance at 5%	No	No	No
$T_0 + 14$ Days	P value	0.618	0.985	0.626
	Significance at 5%	No	No	No
$T_0 + 21$ Days	P value	0.889	0.896	0.819
	Significance at 5%	No	No	No

Table 4.67: Levene's Test Results at 5% Significance Level

Raw Values

The following table summarizes the means and standard deviations of scores for skin brightening treated with test Product A, Product B, and Product C at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21) visits, along with the corresponding statistical results for the

evolution over time (using either the Student's t-test or Wilcoxon test, two-tailed for paired groups at 5%, after verifying the normality of distributions via a Shapiro-Wilk test at 1%).

Product	Time Interval	N	Mean	Standard Dev.	Sig 5%($T_n - T_0$)	p values	Test
A	T_0	36	7.139	1.199	No	*	Paired T-test
	T_0+7 days	36	7.139	1.199	No	<0.001	Paired T-test
	T_0+14 days	36	7.306	1.191	No	<0.001	Paired T-test
	T_0+21 days	36	7.556	1.157	No	<0.001	Paired T-test
B	T_0	35	6.829	1.15	No	*	Paired T-test
	T_0+7 days	35	6.829	1.15	No	<0.001	Paired T-test
	T_0+14 days	35	7.029	1.15	No	<0.001	Paired T-test
	T_0+21 days	35	7.286	1.1	No	<0.001	Paired T-test
C	T_0	36	6.944	1.194	No	*	Paired T-test
	T_0+7 days	36	6.944	1.194	No	<0.001	Paired T-test
	T_0+14 days	36	7.111	1.141	No	<0.001	Paired T-test
	T_0+21 days	35	7.229	1.239	No	<0.001	Paired T-test

Table 4.68: Summary of Skin Brightening Measurements

Evolutions ($T_n - T_0$)

The following table presents the means and the standard deviations of the evolutions ($T_n - T_0$) of score for Skin Brightening with test Product A, Product B & Product C.

Product	T+7 days - T0	T+14 days - T0	T+21 days - T0
A (Mean)	0	0.1667	0.4167
	0	0.378	0.5
B (Mean)	0	0.2	0.4571
	0	0.4058	0.5054
C (Mean)	0	0.1667	0.2857
	0	0.378	0.4583

Table 4.69: Evolution of parameter

Variations ($(T_n - T_0)/T_0$ (%))

The following table summarises the average percentages of the variation $(T_n - T_0)/T_0$ of score for Skin Brightening with test Product A, Product B & Product C.

Analysis

For Product A

Product	$(T_0 + 7 \text{ days} - T_0)/T_0$	$(T_0 + 14 \text{ days} - T_0)/T_0$	$(T_0 + 21 \text{ days} - T_0)/T_0$
A	0.00%	2.34%	5.84%
B	0.00%	2.93%	6.69%
C	0.00%	2.40%	4.11%

Table 4.70: Variation in Percentage of Skin Brightening

- The statistical analysis indicates a significant increase in skin brightening scores by 0%, 2.34%, and 5.84% with test Product A on average across the entire panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), demonstrating the product's anti-melanin effect.
- At Day 14 (T_0+14) and Day 21 (T_0+21), 16% and 41% of the panel, respectively, showed an improvement in the studied parameter.

For Product B

- The statistical analysis reveals a significant increase in the score for the skin tone evenness parameter by 0%, 2.93%, and 6.69% with test Product B on average across the entire panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), demonstrating the product's anti-melanin effect.
- At Day 14 (T_0+14) and Day 21 (T_0+21), 20% and 45% of the panel, respectively, showed an improvement in the studied parameter.

For Product C

- The statistical analysis indicates a significant increase in the score for skin tone evenness by 0%, 2.4%, and 4.11% on the whole face with test Product B on average across the entire panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), demonstrating the product's anti-melanin effect.
- At Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), 16% and 28% of the panel, respectively, showed an improvement in the studied parameter.
- No significant difference between test Product A, Product B, and Product C at baseline (T_0), as well as at subsequent time points T_0+7 , T_0+14 , and T_0+21 for the studied parameter. both study sites are deemed comparable at baseline, suggesting similar characteristics across all products and sites throughout the study period.

Skin Brightening		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T0	P value	0.27	0.493	0.678
	Significance at 5%	No	No	No
T0 + 7 Days	P value	0.27	0.493	0.678
	Significance at 5%	No	No	No
T0 + 14Days	P value	0.322	0.482	0.762
	Significance at 5%	No	No	No
T0 + 21Days	P value	0.317	0.255	0.839
	Significance at 5%	No	No	No

Table 4.71: Skin Brightening Comparison in Product

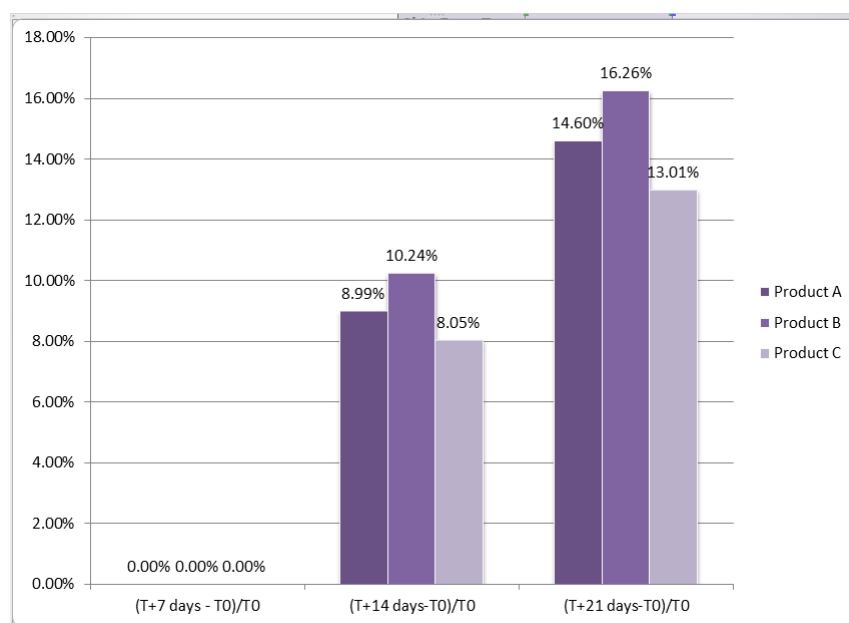


Figure 4.22: Graphical representation for variation

4.11 Skin even tone

The significant increase in the score for skin tone evenness shows an effect of the product in terms of Skin Even tone.

Normality Check

Time Point	Product	Statistic	p-value	Result
T_0	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept
T7	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept
T14	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept
T21	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept

Table 4.72: Shapiro-Wilk Test Results at 1% Significance Level

Homogeneity of Variances

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T_0	P value	0.126	0.732	0.059
	Significance at 5%	No	No	No
$T_0 + 7$ Days	P value	0.126	0.732	0.059
	Significance at 5%	No	No	No
$T_0 + 14$ Days	P value	0.841	0.242	0.308
	Significance at 5%	No	No	No
$T_0 + 21$ Days	P value	0.56	0.874	0.667
	Significance at 5%	No	No	No

Table 4.73: Levene's Test Results at 5% Significance Level

Raw Values

The following table summarizes the means and standard deviations of scores for skin tone evenness treated with test Product A, Product B, and Product C at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21) visits, along with the corresponding statistical results for the evolution over time (Student's t-test or Wilcoxon test, two-tailed for paired groups at 5%), after checking the normality of the distributions by a Shapiro-Wilk test at 1%).

Product	Time Interval	N	Mean	Standard Dev.	Sig 5% ($T_n - T_0$)	p values	Test
A	T_0	36	4.944	0.826	No	*	Paired T-test
	T_0+7 days	36	4.944	0.826	No	<0.001	Paired T-test
	T_0+14 days	36	5.389	0.838	No	<0.001	Paired T-test
	T_0+21 days	36	5.667	0.828	No	<0.001	Paired T-test
B	T_0	35	4.743	0.657	No	*	Paired T-test
	T_0+7 days	35	4.743	0.657	No	<0.001	Paired T-test
	T_0+14 days	35	5.229	0.843	No	<0.001	Paired T-test
	T_0+21 days	35	5.514	0.887	No	<0.001	Paired T-test
C	T_0	36	4.833	0.655	No	*	Paired T-test
	T_0+7 days	36	4.833	0.655	No	<0.001	Paired T-test
	T_0+14 days	36	5.222	0.76	No	<0.001	Paired T-test
	T_0+21 days	35	5.429	0.778	No	<0.001	Paired T-test

Table 4.74: Summary of Skin Even Tone Measurements

Evolutions ($T_n - T_0$)

The following table presents the means and the standard deviations of the evolutions ($T_n - T_0$) of score for skin tone evenness with test Product A, Product B & Product C.

Product	T_0+7 days - T_0	T_0+14 days - T_0	T_0+21 days - T_0
A (Mean)	0	0.4444	0.722
	0	0.504	0.659
B (Mean)	0	0.4857	0.771
	0	0.5071	0.598
C (Mean)	0	0.3889	0.6286
	0	0.4944	0.547

Table 4.75: Evolution of parameter

Variations ($(T_n - T_0)/T_0$ (%))

The following table summarises the average percentages of the variation $(T_n - T_0)/T_0$ of score for skin tone evenness with test Product A, Product B & Product C.

Product	$(T_0 + 7 \text{ days} - T_0)/T_0$	$(T_0 + 14 \text{ days} - T_0)/T_0$	$(T_0 + 21 \text{ days} - T_0)/T_0$
A	0.00%	8.99%	14.60%
B	0.00%	10.24%	16.26%
C	0.00%	8.05%	13.01%

Table 4.76: Variation in Percentage of Skin Even Tone

Analysis

For Product A

- The statistical analysis shows a significant increase in the score for skin tone evenness by 0%, 8.99%, and 14.6% with Test Product A on average for the whole panel, respectively, at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21). This demonstrates the effect of the product.
- 44% and 72% of the panel presented an improvement in the studied parameter at Day 14 (T_0+14) and Day 21 (T_0+21), respectively.

For Product B

- The statistical analysis shows a significant increase in score for skin tone evenness parameter by 0%, 10.24% & 16.26% with test Product B on average for the whole panel respectively at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21). This demonstrates the effect of the product.
- 48% and 77% of the panel presented an improvement in the studied parameter at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), respectively.

For Product C

- The statistical analysis shows a significant increase in score for skin tone evenness by 0%, 8.05% & 13.01% on the whole face with test Product B on average for the whole panel respectively at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21). This demonstrates the effect of the product.
- 38% and 62% of the panel presented an improvement in the studied parameter at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), respectively.
- There is no significant difference between Test Product A, Product B, and Product C in the studied parameter at T_0 , T_0+7 , T_0+14 , and T_0+21 , indicating that all sites are comparable at baseline throughout the study period.

Skin Even Tone		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T0	P value	0.259	0.529	0.563
	Significance at 5%	No	No	No
T0 + 7 Days	P value	0.259	0.529	0.563
	Significance at 5%	No	No	No
T0 + 14Days	P value	0.424	0.38	0.974
	Significance at 5%	No	No	No
T0 + 21Days	P value	0.457	0.216	0.669
	Significance at 5%	No	No	No

Table 4.77: Skin Even Tone Comparison in Product

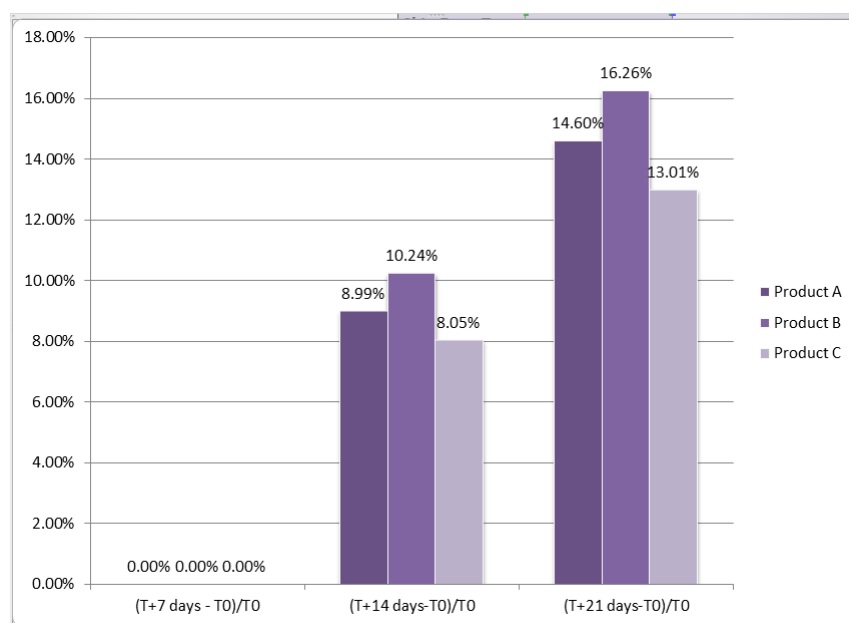


Figure 4.23: Graphical representation for variation

4.12 Density of dark spots (acne PIH)

The decrease in the score shows an effect of the product in terms of reduction in density of dark spots.

Normality Check

Time Point	Product	Statistic	p-value	Result
T_0	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept
T7	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept
T14	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept
T21	A	<0.01	> 0.100	Accept
	B	<0.01	> 0.100	Accept
	C	<0.01	> 0.100	Accept

Table 4.78: Shapiro-Wilk Test Results at 1% Significance Level

Homogeneity of Variances

4.12.1

Time Point	Levene's Test	Product A vs B	Product B vs C	Product A vs C
T_0	P value	0.997	0.826	0.817
	Significance at 5%	No	No	No
$T_0 + 7$ Days	P value	0.997	0.826	0.817
	Significance at 5%	No	No	No
$T_0 + 14$ Days	P value	0.997	0.826	0.817
	Significance at 5%	No	No	No
$T_0 + 21$ Days	P value	0.997	0.559	0.532
	Significance at 5%	No	No	No

Table 4.79: Levene's Test Results at 5% Significance Level

Raw Values

The following table summarizes the means and standard deviations of score for dark spots treated with test Product A, Product B & Product C at Day1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), Day 21 (T_0+21) day visit as well as the corresponding statistical results for the evolution in time (Student t-test or Wilcoxon test, two-tailed for paired groups at 5%, after checking the normality of the distributions by a Shapiro-Wilk test at 1%).

Product	Time Interval	N	Mean	Standard Dev.	Sig 5%($T_n - T_0$)	p values	Test
A	T_0	36	4.431	0.645	No	*	Paired T-test
	T_0+7 days	36	4.431	0.645	No	*	Paired T-test
	T_0+14 days	36	4.431	0.645	No	*	Paired T-test
	T_0+21 days	36	4.431	0.645	No	*	Paired T-test
B	T_0	35	4.471	0.696	No	*	Paired T-test
	T_0+7 days	35	4.471	0.696	No	*	Paired T-test
	T_0+14 days	35	4.471	0.696	No	*	Paired T-test
	T_0+21 days	35	4.471	0.696	No	*	Paired T-test
C	T_0	36	4.569	0.645	No	*	Paired T-test
	T_0+7 days	36	4.569	0.645	No	*	Paired T-test
	T_0+14 days	36	4.569	0.645	No	*	Paired T-test
	T_0+21 days	35	4.614	0.595	No	*	Paired T-test

Table 4.80: Summary of Density of Dark Spots (Acne PIH) Measurements

Evolutions ($T_n - T_0$)

The following table presents the means and the standard deviations of the evolutions ($T_n - T_0$) of the score for dark spots with Test Product A, Product B, and Product C.

Table 4.81: Evolution of parameter

Product	T_0+7 days - T_0	T_0+14 days - T_0	T_0+21 days - T_0
A (Mean)	9.64	16.084	17.58
	7.34	4.979	6.69
B (Mean)	11.26	17.402	20.38
	8.59	5.537	7.23
C (Mean)	10.89	16.33	17.04
	7.35	6.2	6.57

Variations ($(T_n - T_0)/T_0$ (%))

The following table summarises the average percentages of the variation $(T_n - T_0)/T_0$ of score for dark spots with test Product A, Product B & Product C.

Product	$(T_0 + 7 \text{ days} - T_0)/T_0$	$(T_0 + 14 \text{ days} - T_0)/T_0$	$(T_0 + 21 \text{ days} - T_0)/T_0$
A	0%	0%	0%
B	0%	0%	0%
C	0%	0%	0%

Table 4.82: Variation in Percentage of Density of Dark Spots (acne PIH)

Analysis

For Product A

- The statistical analysis shows no significant decrease in the score for dark spots with Test Product A on average for the whole panel at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), indicating the effect of the product.

For Product B

- The statistical analysis shows no significant decrease in score for dark spots parameter with test Product B on average for the whole panel respectively at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), indicating the effect of the product.

For Product C

- The statistical analysis shows no significant decrease in score for dark spots with test Product C on average for the whole panel respectively at Day 1 (T_0), Day 7 (T_0+7), Day 14 (T_0+14), and Day 21 (T_0+21), indicating the effect of the product.

Density of dark spots (acne PIH)		COMPARISON IN PRODUCT		
		Product A vs B	Product A vs C	Product B vs C
T0	P value	0.54	0.94	0.602
	Significance at 5%	No	No	No
T0 + 7 Days	P value	0.3427	0.2303	0.559
	Significance at 5%	No	No	No
T0 + 14Days	P value	0.124	0.821	0.27
	Significance at 5%	No	Yes	No
T0 + 21Days	P value	0.009	0.963	0.017
	Significance at 5%	Yes	No	Yes

Table 4.83: Density of dark spots (acne PIH) Comparison in Product

- No significant difference in the studied parameter was noted between Test Product A, Product B, and Product C at T_0 , T_0+7 , T_0+14 .
- significant difference in the studied parameter was noted between Test Product A and Product B, Product B and Product C, Product A and C at T_0+21 , T_0+14 and T_0+21 resp.

Chapter 5

ETHICAL AND LEGAL CONSIDERATIONS

5.1 Study Personnel

The investigator assures that the study manager and everyone who participates in this study have the required qualifications and abilities to carry it out.

5.2 Data Archiving

The documents are archived for a period as per recommendation of sponsor or 5 years. Dual archiving is ensured by using both paper and IT storage media. Paper files are archived by Mascot Spincontrol until the end of the archiving period. Electronics files are archived on 1 large capacity USB hard disks. The disk is stored for 5 years. The investigator keeps a copy of the protocol signed by both himself and by the Study Sponsor as well as the original case report form, questionnaires and all associated documents, the consent forms, and all project-related documents of any type for a 5-year period following delivery of the final report.

All these documents are accessible upon request for inspection by the study sponsor, their representative or by administrative authorities.

The investigator informs the study sponsor of his intention to proceed with their destruction after the 5 years period.

5.3 Amendment to protocol

The study sponsor is hereby informed that any modifications requiring a protocol amendment leads to additional costs. Each amendment includes the number of amendments and the date it is carried out. The references of the modified paragraphs appear in the amendment. To accept one amendment, the Study Sponsor and the Investigator sign it.

5.4 Insurance

The damages caused by the failure of the investigator or a third party shall be imputable to Mascot Spincontrol. Adequate insurance cover of the subject for liability arising from any serious event or death during the conduct of the study will be taken by Mascot Spincontrol India Pvt. Ltd. through an insurance contract with The Oriental Insurance Company Limited, Mumbai, India. (Insurance policy number 121200/48/2023/6655).

5.5 Anonymity of subject

The subjects are identified for the study sponsor using a five-character alphanumeric code and a number. The investigator makes a commitment not to raise the anonymity of the subjects. The study sponsor cannot have access to the confidential data relative to the subjects registered in the data base of Mascot-Spincontrol.

5.6 Consent To participate in study

An information form is given to each subject providing full details about the study and:

- its objectives, methods, and duration;
- possible expected aesthetic benefits, constraints, and potential risks;
- the non-inclusion criteria, the amount of the payment, the right of access to data files and their later destruction. This information enables the subjects to sign their participation consent form freely and unequivocally, in the knowledge that they are fully aware of the testing details.

5.7 Use of Image

If the study involves the use of photographs, the volunteers are informed, in the consent form, that their image without direct identification may be used by Mascot-Spincontrol all over the world, with no time limit on this usage. The volunteers are also informed that Mascot-Spincontrol may also provide images to the sponsor for publishing or duplication.

5.8 Confidentiality

All the information, data, and results of the study are confidential. Everyone having access to such data are informed of their confidentiality.

Any medical information concerning a subject's state of health and the results of the clinical examinations carried out during the recruitment, selection and admission phases before a study is subject to the medical secrecy regulations, in no case should such information be communicated to the study sponsor using a subject's identity.

5.9 Study Incidents

Any incidents occurring during the study are promptly reported to the study monitor. Both parties agree that they will immediately inform one another in case of unanticipated problems that hinder the study. They decide on any changes or modifications required in order to continue the testing by mutual agreement. If they do not arrive at an agreement, the study sponsor has the right to stop the study by notifying the investigator by a registered letter. In this event, the cost of the study amounts to the trials that have been effectively performed prior to this interruption. All advance payments made in excess of this amount are refunded to the study sponsor.

5.10 Quality Assurance

Our quality system has been developed to meet guidelines relevant to our type of activity for ingredients and cosmetic product efficiency and tolerance testing.

As such, our Quality System is in full compliance with ICH-E6 -Good Clinical Practice (GCP) guidelines in our test companies: Mascot spin control (India) and Tours (France).

The entire dossier of a study (protocol, results, report, and any other study-related documents)

is subject to a Quality Management audit which conforms to the regulatory texts and procedures in force.

Verifications of data generated in this study are performed in accordance with the Quality Assurance of the studies documents. The investigator cooperates in ensuring any additional auditing required by the study sponsor to ensure that the study progresses in accordance with regards the protocol and the current procedures.

5.11 Regulations

This study is carried out in conformity with the most recent recommendations of the World Medical Association (64th WMA Declaration of Helsinki, Fortaleza, Brazil, October 2013). This study complies with the “Schedules of the Drugs and Cosmetics Act”.

5.12 Practical Consideration

A preliminary agreement between the Investigator and the study sponsor, concerned by the present contract, is necessary for any publication or communication directly concerning the two parties. They must both take the initiative to inform each other if a change is to occur.

Randomisation

Randomization - XXX-NF02-ZI-MH23					
Selected Products		Selected Localizations		Subjects	
Product A Product B Product C		Whole Face		108	
Subject Number	Subject Code	Product	Subject Number	Subject Code	Product
001		Product C	055		Product B
002		Product A	056		Product C
003		Product A	057		Product B
004		Product B	058		Product B
005		Product C	059		Product B
006		Product B	060		Product A
007		Product B	061		Product B
008		Product A	062		Product A
009		Product B	063		Product A
010		Product A	064		Product C
011		Product A	065		Product B
012		Product C	066		Product A
013		Product A	067		Product C
014		Product A	068		Product C
015		Product C	069		Product B
016		Product C	070		Product C
017		Product A	071		Product C
018		Product B	072		Product A
019		Product C	073		Product B
020		Product B	074		Product A
021		Product C	075		Product C
022		Product B	076		Product B
023		Product C	077		Product A
024		Product C	078		Product C
025		Product A	079		Product B
026		Product B	080		Product C
027		Product C	081		Product C
028		Product B	082		Product A
029		Product A	083		Product B
030		Product A	084		Product B
031		Product C	085		Product C
032		Product C	086		Product C
033		Product B	087		Product C
034		Product B	088		Product C
035		Product A	089		Product A
036		Product A	090		Product C
037		Product C	091		Product A
038		Product A	092		Product C
039		Product C	093		Product B
040		Product B	094		Product A
041		Product A	095		Product B
042		Product A	096		Product B
043		Product C	097		Product B
044		Product B	098		Product C
045		Product C	099		Product A
046		Product A	100		Product B
047		Product C	101		Product A
048		Product A	102		Product A
049		Product B	103		Product A
050		Product A	104		Product A
051		Product B	105		Product B
052		Product B	106		Product B
053		Product C	107		Product B
054		Product C	108		Product A

Questionnaire

Subject Code :

Subject No.:

Subject's Self Evaluation Ref: XXX-NF02-ZI-MH23

Visit: At Day 7, Day 14, Day 21

Grading Scale: 5 = Completely agree,
4 = Somewhat agree,
3 = Neither agree nor disagree,
2 = Somewhat disagree,
1 = Completely disagree

Instant whitening/ Brightening

Sr. No.	Items	Answer
1.	Makes my skin look visibly brighter/ Fairer	
2.	Makes skin look even toned	
3.	Makes my skin glow	
4.	Skin appears soft, smooth and bright	
5.	Does not leave white patches on skin	
6.	Does not make my skin feel stretchy/dry	
7.	It hides spots / Marks / blemishes on my skin	
8.	Makes skin look even toned (uniform colour, free of patches)	
9.	It hides my dark circles/ lightens the appearance of dark circles	
10.	It makes my skin look flawless and Radiant	

All day effect

Sr. No.	Items	Answer
1.	Makes my skin look visibly brighter/ Fairer all day long	
2.	It helps to control sweat through the day/ Keeps skin sweat free all day long	
3.	It helps to my skin oil-free all day	
4.	It keeps skin non-oily, non-sticky through the day	
5.	Keeps my face looking fresh all day long	
6.	Keeps my skin soft & smooth all day long	

Subject Code :

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Subject No.:

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7.	Protects my skin from tired & dull look all day long	
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Long term efficacy

Sr. No.	Items	Answer
1.	It makes my skin lighter/ fairer over time	
2.	It improves my overall complexion	
3.	Helps my skin protect from Sun Darkening / Tanning	
4.	Visibly reduces spots / Marks / blemishes on my skin	
5.	It reduces skin patchiness/ uneven skin tone	
6.	Reduces dark circles under my eyes	
7.	Makes my skin visibly fairer in last 7 days / 2 week/ 3 weeks	
8.	Make my skin more even toned after 7 days / 2 week/ 3 weeks	
9.	Protects from harmful sun rays	

Skin Moisturization

Sr. No.	Items	Answer
1.	Makes my skin feel soft and smooth immediately after application	
2.	Moisturisers my skin	
3.	Makes me feel fresh after application	
4.	Keeps my skin moisturised all day long	

Safe to use

Sr. No.	Items	Answer
1.	Does not cause any irritation /redness/ itching	
2.	Doesn't cause pimples / Acne	
3.	It is suitable for my skin type	
4.	It is safe for everyday use	
5.	It is mild and gentle on my skin	

6. Any other adverse actions observed: _____

Signature of the CRA with date: _____

Reference

- Youtube Video <https://www.youtube.com/watch?v=rulIUAN0U3w>
- cdisc Education <https://www.cdisc.org/education>
- McGrawHill-Cosmetic.Dermatology.Principles.and.Practice.2009.RET
- Worksheet [Dataset](#)