THE DEVELOPMENT OF A LIQUID FOUNDATION EMULSION (WATER/SILICONE) AND THE COMBINATION OF ACTIVE INGREDIENTS WITH TREATMENT BENEFITS OVERNIGHT

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Abstract

Research indicates a rising demand for makeup products with skincare benefits. The aim of this project was to develop a liquid foundation with skin treatment properties without compromising makeup performance, alongside a distinctive mode of application.

Through its structure and the combination of active ingredients, the liquid foundation offers high-performance makeup and skin treatment without aggressing or damaging the integrity of the skin barrier, even if left on overnight, as evidenced by safety, instrumental, and perceived efficacy tests.

To investigate the benefits and validate the safety of the developed product, several tests were conducted where the product was applied continuously (day and night) for a period of 28 days. Instrumental protocols were employed to measure oiliness, hydration, assessment of the skin barrier, firmness, elasticity, and image analysis on the skin along with consumer perception (Home Use Test). Safety validation included tests for dermal, ophthalmological, comedogenic, acneic, and acne potential.

Keywords

Liquid Foundation; Treatment; Make Up; Silicone Water Emulsion.

Introduction

Skin aging is a natural and chronological process in humans, occurring due to numerous causes, which can be divided into two categories: intrinsic and extrinsic [1]. Intrinsic factors are related to genetic causes, decreased cellular function of various organelles such as keratinocytes and fibroblasts, accumulation of intra and extracellular byproducts, mitochondrial damage, among others; while extrinsic factors are related to environmental causes, mainly such as exposure to ultraviolet radiation and pollution inducing the production of free radicals and reactive oxygen species (ROS), and individual behavioral habits such as alcohol and drug intake, stress, smoking, diet, tanning, among others [1,2].

Both intrinsic and extrinsic factors contribute to cutaneous alterations resulting in the loss of collagen, elastin, and reticular fibers which are responsible for the support, elasticity, and firmness of the skin [3,4].

Skin aging and the emergence of its signs such as wrinkles, spots, and sagging affect individuals' self-esteem and social relationships, thus increasing the demand for treatments to prevent, delay, and minimize the signs of aging [2]. Treatments range from changing behavioral habits, using cosmetic products available on the market, as well as other dermatological treatments.

The skin aging process is inevitable, but the use of adequate skincare will slow down and prevent the appearance of aging. Basic skincare consists of cleansing, moisturizing, and protecting the skin [5].

Research shows that consumers are increasingly concerned about skin health and seeking simplified routines to take care of themselves every day, thus the preference for multifunctional and safe products is growing [7]. In other words, it not only functions as decorative cosmetics but also as skincare products [6].

The data reflect how amidst busy routines, younger women find little time for themselves, and how this can negatively impact their appearance and well-being, presenting an opportunity for beauty and personal care products with multifunctional appeal to stand out by helping these

consumers take care of themselves without losing much time, in other words, products that simplify their routines [8].

Motivated by the needs of the new consumer, this study aimed to develop a multifunctional liquid foundation with a disruptive mode of use, i.e., a foundation with skincare treatment without compromising the performance of impeccable makeup characteristics.

The greatest challenge of the structure under study, a water/silicone emulsion, was to meet the characteristic performance of a foundation with flawless finish, uniform coverage, and good durability coupled with effective treatment. We know that some raw materials and combinations hinder the promotion of treatment on the skin, so the combination of all formulation components and their ideal proportions were thoroughly studied and added in a way to provide treatment and performance, thus delivering a multifunctional product and meeting consumer needs expectations.

Materials

A vegan formula of liquid foundation was developed using a water/silicone emulsion structure, where the ingredients and percentages were carefully studied to achieve both makeup performance and skincare treatment, as described in the experiment below.

Its structure is composed of a combination of gentle emollients that contribute to preventing water loss and enhance sensorial properties; a synergy of emulsifiers that provide lightness to the product; pigment technology with hybrid surface treatment consisting of vegetable amino acid, fatty acid, and silane, acting synergistically and adhering better and more uniformly to the skin, thus prolonging the durability of the foundation; the addition of flexible silicone resin that forms a flexible and invisible film on the skin, promoting excellent durability, water resistance, and sweat resistance; a combination of silicone elastomer with sensory-modifying powders of different particle sizes and natural illuminating pearls that deposit on the skin, promoting an optical diffusion effect that immediately disguises minor imperfections, also providing oil control throughout the day, leading to a perfect skin finish; enriched with carefully selected treatment

actives, vitamins, and prebiotics that complement each other, aiding in the skin's immune health and providing effective long-term treatment technology, namely:

Carnosine is a naturally occurring peptide in the body, with properties that reinforce the skin's defense system, preventing and repairing damage induced by solar spectrum and free radicals, as well as providing anti-pollution and anti-glycation effects. It protects and enhances collagen and other structural proteins from degradation, thereby promoting protection against aging.

Betaine, an amino acid derived from beetroot, acts as an osmoprotector by managing the water content in living cells, preventing cellular dehydration. This effect promotes skin hydration and protects proteins from denaturation by stabilizing protein structure, strengthening the skin barrier.

Propanediol; lespedeza capitata leaf/stem extract; aqua (water) contain the main active compounds carlinoside and isoschaftoside, two glycosylated flavonoids directly involved in maintaining the circadian clock. This improves circadian rhythm resynchronization, regulates rhythm-dependent biological functions (aquaporin-3), enhances the efficiency of the Nrf2 detoxification pathway, and controls oxidative stress induced by blue light.

Aqua (water); glycerin; methylpropanediol; polysorbate 80; 4-terpineol; caesalpinia spinosa gum; salix alba bark extract contain plant-derived components wrapped in a technology composed of polysaccharides that prolong release and action time. It balances the skin microbiome, promotes maintenance of the skin's natural balance, and controls oiliness.

A blend of vitamins containing Tocopheryl Acetate with antioxidant potential combats free radicals directly, maintaining healthier skin, while Niacinamide offers a wide range of topical benefits. It is a precursor to essential NAD and NADP coenzymes in ATP production, preventing UV-induced ATP decline and preserving cellular energy homeostasis, significantly increasing DNA repair, reducing immunosuppression induction, and maintaining skin homeostasis. It selectively stimulates collagen synthesis, helping to maintain skin elasticity.

A combination of prebiotics such as plant-derived Niacinamide and Biosaccharide gum-1 obtained from bacterial fermentation of plant substrates, composed of anionic polysaccharides, selectively stimulate the growth of beneficial skin microbial flora through bioselectivity and biostimulation. They protect and stimulate the skin's first line of defense, preventing colonization by undesirable, pathogenic, or opportunistic bacteria, thus maintaining microbiome balance, protection, and strengthening of cutaneous barrier integrity.

Methods

In this study, clinical trials were conducted at a research institute, lasting for 28 days, during which participants used the product according to the indicated mode of use: applying the liquid foundation to the face using a brush, sponge, or fingertips, twice daily – in the morning, after washing the face, and at night, before bedtime. Sixty-six participants were selected, with the inclusion criteria being: participants of both sexes, aged between 18 and 45 years old; combination or oily skin; tendency to acne; presence of acne-related skin spots; all races as classified by IBGE (Brazilian Institute of Geography and Statistics); intact skin in the product application area; agreement not to use any other topical product in the test area during the study period; agreement to comply with trial procedures; and signing of the informed consent form.

1. **Corneometry (hydration) and TEWL (skin barrier) study**

Corneometry is a technique used to measure the hydration of the upper layers of the epidermis, based on the electrical capacitance of the skin, which is proportional to the water content (0 - very dry skin to 130 - very hydrated skin). In addition to hydration, it is crucial to assess transepidermal water loss (TEWL) to understand the integrity of the skin barrier. TEWL, measured by the Tewameter®, indicates the water evaporated from the skin and its hydration. Data should be interpreted carefully, as increased TEWL may be due to increased hydration or damage to the skin barrier.

2. Sebumetry study (oiliness)

The Sebumeter measures the amount of sebum on the skin photometrically, using a special plastic strip that becomes translucent when coated with sebum. The strip is pressed against the skin and its transparency is evaluated by a photocell. The amount of sebum is expressed in absolute values (µg sebum/cm²).

3. Image study (pores)

For the pore count, VISIA® - Image Pro Plus software with digital technology is used to photograph the surface layers of the research participants' faces. The images are then analysed using specific pore counting software.

4. Cutometry study (firmness and elasticity)

The equipment measures skin firmness based on the degree of deformity by a predetermined negative pressure. For this study, the variables R0 and R7 were used, which best represent the skin firmness and elasticity data, respectively. These measurements made by the equipment were presented in variables expressed in arbitrary values (intrinsic to the equipment) from 0.000 to 1.000, called cutometric units.

5. In vitro determination of visible light protection

The transmittance spectra were obtained using a Shimadzu UV-Vis Spectrophotometer UV 2450 with integrating sphere (ISR-240A). The spectra were scanned between 400nm and 700nm. Substrate used: Helioplate HD6, HelioScreen Labs. Spectra were obtained in triplicate and 2mg of product was applied per cm2.

6. Safety - Evaluation of Dermal and Ophthalmological Acceptability, Comedogenic and Acnogenic Potential of Cosmetic Products

The aim of the test was to prove the absence of the product's comedogenic and acnegenic potential, in addition to confirming, under normal conditions of use, the absence of the risk of irritation and the capture of sensations of discomfort in the study population through dermatological and ophthalmological clinical evaluations before and after 28 days of continuous use.

This single centre, blinded, non-comparative clinical study was designed to assess dermatological and ophthalmological safety, as well as the product's non-comedogenic and acnegenic potential, through clinical evaluations. During the initial visit (D0), the participants signed an informed consent form, underwent a clinical assessment by a dermatologist and an ophthalmologist, had comedones and inflammatory lesions counted (only applicable to 43 participants), received the investigational product and the use diary. After 28 days of product use (D28), adherence to product use was checked, a new dermatological and ophthalmological clinical safety assessment was carried out, comedones and inflammatory lesions were counted again for the applicable participants, and the study was finalised. After completing the study, of the 66 participants selected, 8 participants were considered lost to follow-up as they did not return for the final assessment and 58 completed the study. After assessing all the participants who completed the study, the product was shown to be safe for use in humans, being classified as dermatologically, clinically and ophthalmologically tested. Of the 43 participants who carried out the initial count of comedones and inflammatory lesions, 6 were classified as lost to follow-up and 37 completed the study. To assess comedogenicity and acnegenicity, the Shapiro-Wilk normality test was applied to check the distribution of the data. The Wilcoxon test was then used for non-parametric data and paired samples to identify statistical differences between the experimental time D28 and the initial time (D0).

7. Perceived Effectiveness

The perceived efficacy study is research conducted to assess consumers' perception of the effectiveness of a product or treatment. This type of study aims to understand how consumers perceive the benefits and results of the product in real-life usage scenarios.

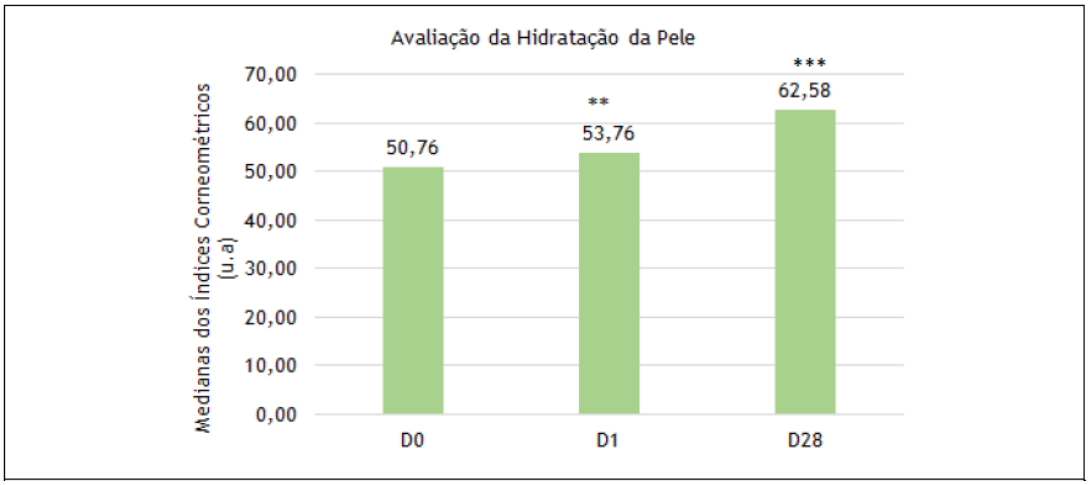
Participants were duly briefed and informed about the objectives and methods of the study, having signed the Informed Consent Form. Assessment of perceived efficacy via subjective method was conducted by administering a questionnaire to research participants after 24 hours and 28 days of continuous product use, followed by dermatological and ophthalmological safety evaluation. Statements about the product's characteristics and perceived efficacy were made, and responses were provided through ratings assigned on a hedonic scale, with each rating reflecting the degree of agreement with the statement. Frequency analysis of hedonic ratings was performed for each evaluated question based on the product efficacy assessment results.

More than 70% of the participants stated that the product left the skin less shiny/oily throughout the day; had a light and pleasant texture; disguised the appearance of blackheads and pimples; perceived more uniform skin tone/neutralized redness; disguised/reduced pores; left the skin hydrated; the product could be used overnight; the product is resistant to overnight use (remains on the face after waking up); with product use, they noticed matte skin from morning to morning; kept the skin dry throughout the day.

Results and Discussion

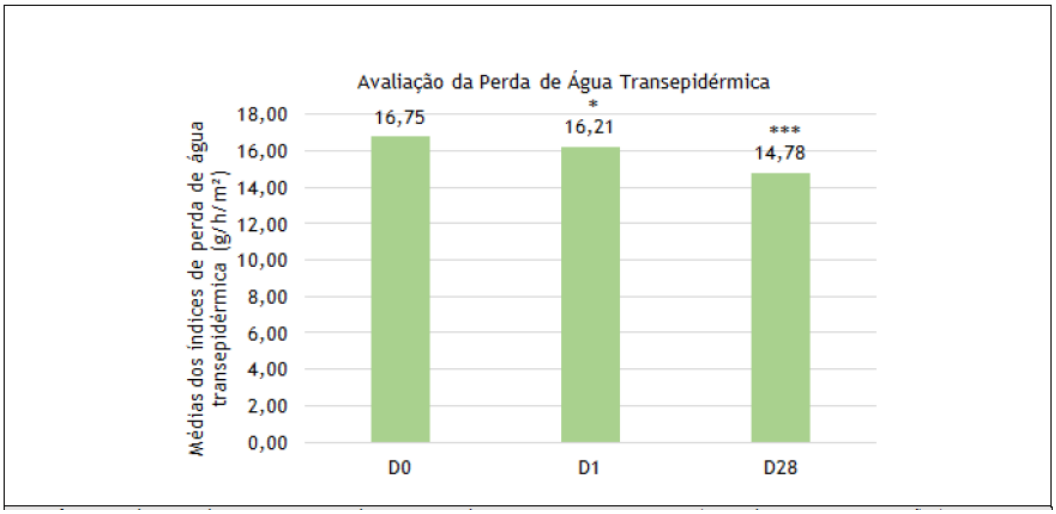
1. Corneometry (hydration) and TEWL (skin barrier) study

The liquid foundation developed, combined with actives, demonstrated a significant increase in moisturisation, with a 10% increase after 7 days of continuous use ($p<0.05$). This indicates that the product effectively moisturises the skin.



Graph I - Measurements of the corneometric indices of the participants before (D0) 24 hours after application (D1/T24h) and after 28 (D28) days (N=20). **P<0.01 and ***P<0.001 in relation to D0.

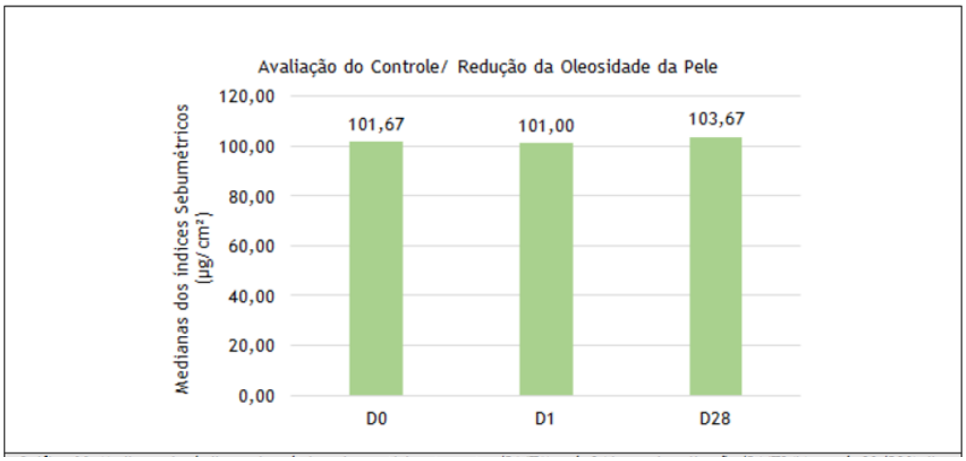
In addition, the TEWL analysis showed a significant reduction in transepidermal water loss, with a 7 per cent decrease after 7 days of continuous use ($p<0.05$), indicating that the product improves and strengthens the skin barrier.



Graph II - Transepidermal water loss index measurements of participants before (D0) 24 hours after application (D1/T24h) and after 28 (D28) days (N=20). *P<0.05 and ***P<0.001 in relation to D0.

2. Sebumetry study (oiliness)

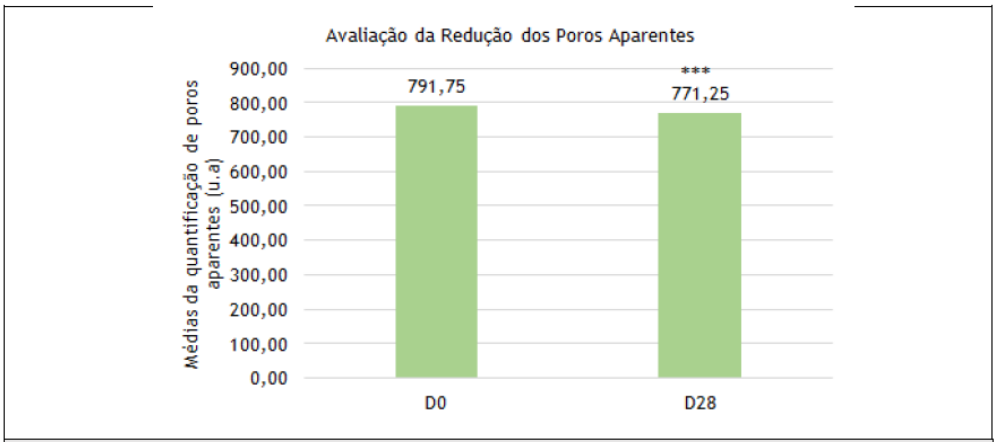
The liquid foundation developed, combined with active ingredients, did not increase the natural oiliness of the research participants' skin after 28 days of continuous use.



Graph III - Sebum index measurements of participants before (D0/T0) 24 hours after application (D1/T24h) and after 28 (D28) days (N=20).

3. Image study (pores)

The liquid foundation developed, combined with actives, demonstrated a significant reduction in apparent pores after 28 days of continuous use.



Graph IV - Apparent pore qualification measurements at the start of the study (D0) and after 28 (D28) days of continuous use (N=20). ***P<0.01 in relation to D0.

4. Cutometry study (firmness and elasticity)

The liquid foundation developed, combined with active ingredients, provided a significant improvement ($p<0.05$) in skin firmness and elasticity after 28 days of continuous use.

Parameter R0 - Firmness effect

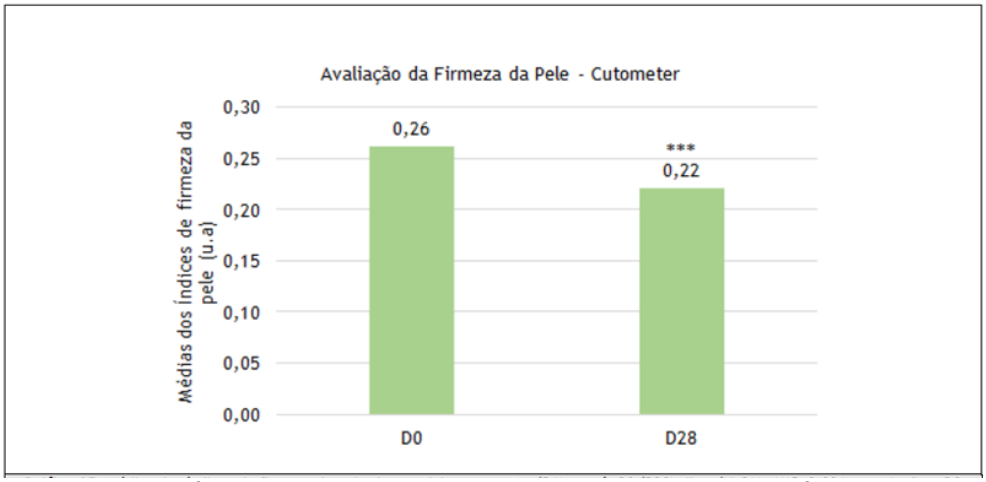
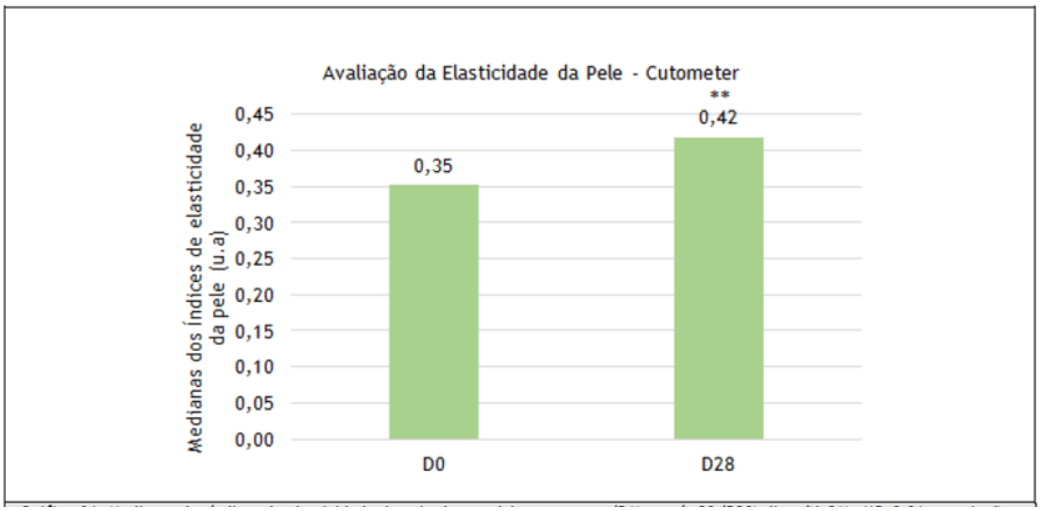


Gráfico V – Medidas dos índices de firmeza da pele dos participantes antes (D0) e após 28 (D28) dias (N=20). ****P<0,001 em relação a D0.*

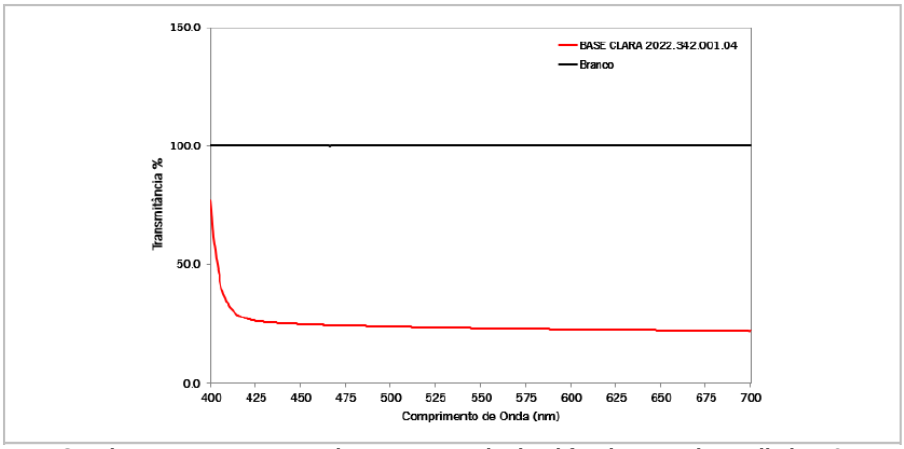
Parameter R7 - Skin Elasticity



Graph VI - Skin elasticity index measurements of participants before (D0) and after 28 (D28) days (N=20). ***P<0.01 in relation to D0.

5. In vitro determination of visible light protection

According to the spectrophotometric method used to determine visible light protection, the sample showed an average blockage of 75% of total visible light radiation and an average blockage of 75% of blue visible radiation, so it was effective enough to withstand the following absorption claim for high-energy visible light (HEVis) and blue light.



Graph VII - Average transmittance curve obtained for the sample studied, n=3.

6. Safety - Evaluation of Dermal and Ophthalmological Acceptability, Comedogenic and Acnogenic Potential of Cosmetic Products

Under the conditions in which the product described above was evaluated and in the sample of participants studied, after 28 days of continuous use the data allow us to say that the product has been shown to reduce/prevent the formation of comedones and inflammatory lesions, thus proving to be safe for use in humans in the recommended area of application.

7. Perceived Effectiveness

More than 70% of participants said that the product left their skin less shiny/oily throughout the day; it has a light and pleasant texture; it disguised the appearance of blackheads and pimples; they felt their skin was more uniform in terms of colour/it neutralised redness; it disguised/reduced pores; it left their skin moisturised; the product can be used at night; the product is resistant to nights of sleep (it stays on the face after waking up); with the use of the product they felt their skin was dull from morning to morning; it left their skin dry throughout the day.

Conclusion

The aim of the work was to develop a multifunctional liquid foundation with a silicone-water emulsion structure with a disruptive mode of use, i.e. a liquid foundation with treatment without compromising the performance of make-up and safe for the skin. Based on the description of the composition, the tests and the results reported above, we were able to observe the structural effectiveness of the foundation in terms of make-up performance and the treatment it promotes under the skin with the application of differentiated day and night use (continuous use). We can conclude that through this study we were able to obtain satisfactory treatment and performance results and prove a safe and skin-friendly mode of disruptive use.

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Conflict of Interest Statement

None.

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