

Article

Design, Development, and In Vivo Testing of the Hydrating Effect and pH Maintenance a Cosmetic Formulation Incorporating Oils and an Extract from Peruvian Biodiversity

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Abstract: Vegetable oils and extracts have been used from ancient times for skin care. The aim of this study was to design and evaluate the physicochemical, organoleptic, and microbiological characteristics and the instrumental efficacy in vivo of a cosmetic formula named “ASC Cream”, containing sangre de grado resin extract (*Croton lechleri*) and vegetable oils obtained from moriche palm (*Mauritia flexuosa* L.), goldenberry (*Physalis peruviana*), super sacha peanut (*Plukenetia huayllabambana* sp. nov.), and sacha peanut (*Plukenetia volubilis* L.). Instrumental efficacy, skin hydration and skin pH were tested in vivo in 24 healthy female volunteers between 40 and 65 years old, using non-invasive skin bioengineering equipment from Courage + Khazaka Electronics, both in the short term (30 min, 1 h and 3 h) and long term (14 and 28 days). The main findings were increased immediate hydration (132.4%) and long-term hydration (143.6%), showing a statistically significant average improvement ($p < 0.05$) without altering the skin pH. In conclusion, a balanced combination of the extract and oils significantly increases hydration levels while maintaining skin pH.

Keywords: natural oils; natural extracts; instrumental efficacy; skin hydration



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1. Introduction

The skin is the first line of defense against external factors and threats and acts as an effective barrier like the endocrine and immune system, preserving homeostasis, excretion, body boundaries and metabolism. With optimal water content, the stratum corneum is fully hydrated to maintain the skin strong, elastic, luminous, soft, and smooth. When its water content is low, the skin looks rough, lacks elasticity and may develop peeling and dehydration lines [1].

Peru boasts an extraordinarily wide range of ecosystems and is home to approximately 20,375 plant species. These plants are the focus of basic research leading to the applied research of active ingredients with potential industrial, medicinal, and cosmetic applications [2]. The Peruvian Amazonia is one of the most diverse sources of natural resources; some of its endemic species are *Plukenetia volubilis* L. and *Plukenetia huayllabambana* sp. nov. [3].

The natural oils used in this research such as *Plukenetia volubilis* L. and *Plukenetia huayllabambana* sp. nov. have high contents of polyunsaturated fatty acids of the linolenic and linoleic type, 46.8% and 36.2% for the former and 52% and 28% for the latter [4]. Linolenic acid present in *Plukenetia huayllabambana* has been reported to be much higher than in *Plukenetia volubilis* L. [5]. This species from the Peruvian Amazon is considered a promising source of quality vegetable oil, in addition to its high protein and lipid content [6].

The pulp oil of *Mauritia flexuosa* L. contains large amounts of oleic acid (75%), which is the main component of its fatty acid profile, as well as linoleic and linolenic acids,

carotenoids, polyphenols and tocopherols [7,8]. Its effect as an antioxidant [7] and inflammation mediator has been studied and reported [8].

Linoleic acid is the most predominant fatty acid in *Physalis peruviana* seed oil (73%), which is even higher than in the oil obtained from the peels and berries [9]. It also contains other monounsaturated oils (MUFA), oleic acid and polyunsaturated acids (PUFA), palmitic and stearic acids, polyphenols and tocopherols [10,11]. Oleic acid activates lipid metabolism, restoring the barrier function of the epidermis and retaining moisture in the skin; linoleic acid has the function of maintaining the permeability of the skin barrier, and linolenic acid has an immunomodulatory activity, inhibiting the production of GE2 prostaglandins, which are responsible for inflammation, thus strengthening the immune system [12,13]. A high level of linoleic acid is associated with the prevention of cardiovascular disease [14].

The resin of blood-grade *Croton lechleri*, included in the cosmetic formula, has skin-conditioning effects [15]. In Peru, it is well known and used in folk medicine; studies show its antioxidant, healing, anti-inflammatory, analgesic, antitumor, antibacterial and immunomodulatory properties, attributed to the presence of catechins, proanthocyanidins and the taspine alkaloid in its chemical composition [16].

Nowadays, consumers prefer natural ingredients, and vegetable oils have been incorporated into cosmetic formulations as emollients and occlusive agents, which prevent transepidermal water loss and increase skin hydration, mainly due to their unsaturated fatty acids such as oleic and linoleic acids [17]. Furthermore, such formulations containing natural oils are adjuvants in common skin conditions such as atopic dermatitis, contact dermatitis, psoriasis and acne [18]. Fatty acids are essential for the preservation of structure, emolliency and prevention of the development of skin eczema [17]. Cosmetic formulations using vegetable oils in which linoleic acid was found in higher proportions have shown increased hydration and decreased transepidermal water loss even after a single topical application, and it has been concluded that they promote an improvement of the epidermal barrier [19]. The Research, Technology and Cosmetic Innovation Center (CITIC) of the Universidad San Ignacio de Loyola in Lima, Peru Laboratory developed a cosmetic formula for ASC Cream (Andean Skin Care) that allowed mixing different bioactive compounds from plant species of Peruvian biodiversity that are stable and have synergistic effects.

There is extensive research on the chemical composition and properties of these plant oils, which has highlighted the importance of long-term skin bioengineering studies. Instrumental efficacy studies have been developed on 2-month skin; however, no cosmetic formulation has been found in which the percentage improvement in skin hydration is highly significant [20,21]. In addition, long-term studies on topical creams have also been conducted without adequate sample sizes to support the hydration or elasticity effect [22]. Therefore, this research supports the dermatological properties and long-term efficacy of ASC Cream.

The moisturizing effect and improvement of transepidermal water loss after a single application of raspberry, sesame and coconut seed oils on the skin of young women has also been studied, confirming the positive influence of these oils on the skin barrier function [23]. Therefore, it is important to highlight the evaluation of long-term moisturization after daily application of a cosmetic formula [21]. The evaluation of ASC Cream containing more than one vegetable oil shows a highly significant moisturizing effect after 4 weeks of daily use.

The evaluation of ASC Cream, containing four plant oils and one extract, shows a significant positive influence of the bioactive blend on skin hydration.

2. Materials and Methods

2.1. Elaboration of the Cosmetic Formula

This cosmetic product was made from natural oils of *Mauritia flexuosa*, *Physalis peruviana*, *Plukenetia huayllabambana*, *Plukenetia volubilis* and a *Croton lechleri* resin extract. The formulation of ASC Cream is shown in Table 1.

Table 1. ASC Cream final formulation and component proportion.

Phase	N°	Trade Name	INCI Name	%
A	001	Aqua	Aqua	64.52
	002	Propylene glycol	Propylene glycol	5.00
	003	Sangre de grado	Croton lechleri resin extract	5.00
	004	Triethanolamine	Triethanolamine	0.03
B	005	Sacha inchi	Plukenetia volubilis seed oil	5.00
	006	Super sacha inchi	Plukenetia huayllabambana seed oil	5.00
	007	Sepimax zen	Polyacrylate Crosspolymer-6	0.65
	008	Aguaymanto	Physalis peruviana seed oil	5.00
	009	Aguaje pulp oil	Mauritia flexuosa fruit oil	2.00
	010	Emulgade 1000 NI	Cetearyl alcohol	3.50
	011	Montanov 202	Arachidyl alcohol	3.00
	012	Vitamin E	Tocopheryl acetate	0.20
C	013	Saliguard EHGP	Ethylhexylglycerin phenoxyethanol	1.00
	014	Rosewood (<i>Aniba rosaeodora</i>)	Aniba rosaeodora wood oil	0.10

It is an emulsion in which the aqueous phase (Phase A) is mixed with the oily phase (Phase B) at a temperature between 65–75 °C under constant agitation; then, when the system reaches a temperature below 50 °C, phase C is added.

The Sacha inchi, Aguaymanto and Aguaje oils were purchased from Candela Peru (Lima, Peru); Super sacha inchi from Cloud Forest, (Lima, Peru); Sangre grade resin from Pebani (Lima, Peru). The raw materials Propylene glycol, Triethanolamine, Emulgade 1000 NI, and Vitamin E were purchased from Basf SE (Ludwigshafen, Germany); Montanov 202 from Seppic (Paris, France); Saliguard EHGP from Salicylates and Chemicals (Nagar, India); Rosewood from Essential Oils Peru (Lima, Peru) and water was purchased from the water treatment system of the Faculty of Engineering-USIL.

2.2. Accelerated Stability Studies

Two ASC Cream batches (1001 and 901) were formulated and subjected to accelerated stability studies at 40 ± 2 °C for 6 months [24].

2.2.1. Organoleptic Characteristics

Both batches of the ASC Cream cosmetic formula were observed for appearance, color and odor during the six-month accelerated stability studies.

2.2.2. Determination of pH

The pH of the cosmetic formulation was determined during accelerated stability studies using a potentiometer (Thermo Scientific, Orion Star A211, Waltham, MA, USA) to 25 °C [25].

2.2.3. Viscosity Determination

The viscosity of the cosmetic formulation was determined during accelerated stability studies using a viscometer (Brookfield AMETEK, DV-E, Middleboro, MA, USA) to 25 °C [26].

2.3. Antimicrobial Efficacy or Microbiological Challenge Tests

This test was performed against the microorganisms *Escherichia coli* ATCC 8739, *Staphylococcus aureus* ATCC 6538, *Pseudomonas aeruginosa* ATCC 9027, *Candida albicans* ATCC 10231 and *Aspergillus brasiliensis* ATCC 16404. The microbial load was monitored at 0, 7, 14 and 28 days; the logarithmic reduction was calculated each time. This test was carried out at SMASAC Laboratories, Lima, Peru.

2.4. In Vivo Instrumental Efficacy Study Protocol

2.4.1. Description of the Study Design

An experimental, analytical, longitudinal, and prospective study was conducted at the Research, Technology and Cosmetic Innovation Center (CITIC) of the Universidad San Ignacio de Loyola in Lima, Peru from October to December 2023.

All healthy volunteers signed an informed consent form before participating in the study. The study was performed in accordance with the Declaration of Helsinki and followed the national legislation of Peru's National Health Institute (INS). The clinical trials regulation was approved by Supreme Decree No. 021-2017-SA24 [27].

2.4.2. Study Settings and Locations

This research was carried out in two CITIC laboratories: the Cosmetic Formulations Laboratory conducted the formulation process and product stability studies, and the Bioengineering and Cosmetic Safety Laboratory measured biomechanical skin attributes. CITIC specializes in applied research and innovation for the generation of formulation patents, and its technological equipment allows the development of skin bioengineering studies. Additionally, it promotes the first postgraduate program in Lima, Peru that teaches cosmetic technology and innovation.

2.4.3. Study Population

The study included healthy volunteers from the database of the CITIC effective as of 2022. Personal data are protected in accordance with the provisions of the Directorate for Personal Data Protection pursuant to Article 34 of Law No. 29733 (Law on Personal Data Protection) and Articles 76, 77, 78, 79 and 81 of the Law on Personal Data Protection Regulation approved by Supreme Decree No. 003-2013-JUS. The personal data collected are used exclusively for the purposes set forth in this document.

2.4.4. Study Sample

The study sample consisted of 24 healthy volunteers aged 40–65 years who provided informed consent prior to participation.

2.4.5. Inclusion Criteria

- Being a healthy female volunteer aged 40–65 years with healthy skin, no wounds, and no tattoos on the front of the legs.
- Agreement to adhere to the procedures and requirements of the study and going to the laboratory on the day and time established for the examinations.
- Acceptance of participation in the study by signing the informed consent form.

2.4.6. Exclusion Criteria

- Presence of any skin disease, tattoos, or scars in the product application area.
- Pregnancy.
- Current use of topical or systemic drugs, such as corticosteroids, immunosuppressants, and antihistamines.
- History of episodes of allergic and irritant reactions to plant and cosmetic raw materials.
- Skin diseases, such as vitiligo, psoriasis, lupus, and atopic dermatitis and other diseases that may directly interfere with the study or put the subject's health at risk during the study process, such as diabetes mellitus, opportunistic infections, hypothyroidism, history of hypoglycemia, and immune insufficiency.

2.4.7. Skin Bioengineering Instruments

High-tech non-invasive skin bioengineering equipment from Courage + Khazaka Electronics, Cologne, Germany, was used. A Courage + Khazaka Corneometer® CM 825 and a Skin-pH-Meter® were used for skin hydration and pH assessments, respectively.

The Corneometer[®] CM 825 uses a cylindrical probe to indirectly measure the water content of the stratum corneum by means of capacitance. Any change in the dielectric constant due to changes in the water content of the epidermis alters the capacitance of the precision capacitor, which is recorded on the device [28].

The Skin-pH-Meter[®] measures skin pH.

2.4.8. Procedures and Techniques

The application and tests were performed on the front of the leg, in an area of 7 cm × 5 cm. For short-term measurements, this area was divided into three equal surfaces. The distribution of ASC Cream was randomly distributed between the right and left legs.

2.4.9. Working Procedure

- On day 1 of the visit, the volunteers were informed of the study objective, methodology, duration, expected benefits and limitations. They read the consent form and signed it. They were also instructed about the mode and frequency of product use. Measurements were carried out at two time points: immediate measurements at 30 min, 1 h and 3 h and long-term measurements at 14 days and 28 days, respectively.
- Prior to both immediate and long-term measurements, participants were acclimatized in a room with a temperature of 20 ± 2 °C and $50\% \pm 5\%$ relative humidity for at least 30 min before baseline measurements.
- For short-term measurements, hydration and pH were measured on the front of the legs, recording the baseline condition for each indicator. Subsequently, the product was applied (first application), and measurements were taken 30 min, 1 h and 3 h after the first application.
- For long-term measurements, participants were instructed to apply the product twice a day, and they were instructed not to apply it the day before their visits (day 14 and day 28). In subsequent controls (visits on days 14 and 28), participants were acclimatized in the same way as in visit 1.

2.5. Statistical Analysis

Measurements were performed in triplicate for each participant. Corneometry and pH results were analyzed statistically with the IBM SPSS Statistics 29.0 software. Values are expressed as mean, standard error, percentage of improvement, and percentage of positive cases in the short and long term. Given the amount of data, Shapiro–Wilk normality tests were used, and Student's *t* test was used for parametric tests.

3. Results

3.1. Accelerated Stability

Satisfactory results in terms of emulsion stability and stability of its physicochemical characteristics, such as pH, viscosity, and organoleptic features.

The organoleptic characteristics of the ASC Cream batches are shown in Table 2; both batches had the same organoleptic characteristics during the 6 months of the study.

Table 3 shows the results obtained on the two laboratory batches of ASC Cream, which are within the recommended pH for cutaneous application [29]. The samples were stored for 6 months at 40 ± 2 °C as part of the accelerated stability study protocol, based on NTS No. 182-MINSA/DIGEMID-2022 [24]. According to this technical standard, significant changes in accelerated stability studies involve alterations in pH, change in organoleptic characteristics and phase separation; these changes in characteristics were not observed in ASC Cream during the accelerated stability study. The results in terms of physicochemical parameters are preliminary, as these are laboratory batches; these characteristics will be corroborated when industrial production or larger batches are manufactured as part of the technology transfer.

Table 2. Organoleptic characterization of the ASC Cream formula.

N° Formula/Code: CITIC-46-F007		Organoleptic Characterization		
Batch Number	Duration (Weeks)	Aspect	Color	Odor
Batch 1001	0	Homogenous	Lightly brownish	Characteristic
	2			
	4			
	8			
	12			
	16			
	20			
	24			
Batch 901	0	Homogenous	Lightly brownish	Characteristic
	2			
	4			
	8			
	12			
	16			
	20			
	24			

Table 3. Physical and chemical characterization of ASC Cream.

N° Formula/Code: CITIC-46-F007		Physicochemical Parameters	
Batch Number	Duration (Weeks)	pH (25 °C)	Viscosity (25 °C)
Batch 1001	0	5.72	21,000
	2	5.31	20,500
	4	5.1	20,100
	8	4.95	19,800
	12	4.85	19,100
	16	4.72	19,500
	20	4.56	17,420
	24	4.47	17,600
Batch 901	0	6.3	21,200
	2	6.15	20,900
	4	5.98	20,100
	8	5.81	19,800
	12	5.65	19,500
	16	5.41	19,200
	20	5.21	18,900
	24	5.37	16,200

3.2. Antimicrobial Efficacy

ASC Cream met the assessment criteria for:

Bacteria: A log reduction of no less than 2.0 from the baseline count was reported at 14 days (4.6×10^5 CFU/mL, 3.9×10^5 CFU/mL, and 8.2×10^4 CFU/mL for *Escherichia coli* ATCC 8739, *Staphylococcus aureus* ATCC 6538 and *Pseudomonas aeruginosa* ATCC 9027, respectively). No increase was observed at 28 days regarding the value observed at day 14.

Yeasts and molds: No increase was observed at 14 and 28 days with respect to the baseline count of 7.6×10^4 CFU/mL for *Candida albicans* ATCC 10231 and 6.5×10^4 CFU/mL for *Aspergillus brasiliensis* ATCC 16404.

It can be concluded that the preservatives used result in a safe product from a microbiological point of view.

3.3. Instrumental Efficacy In Vivo

3.3.1. Evaluation of Skin Hydration

ASC Cream showed higher hydration values ($p < 0.05$) over the 4 weeks compared to its baseline control (Table 4, Figure 1).

Table 4. Hydration results by corneometry.

Control	Basal Control	Immediate 30 min	1 h	3 h	2 Weeks	4 Weeks
<i>n</i>	24	24	24	24	24	24
Average	17.10	39.74	34.75	33.26	37.45	41.65
Max	29.40	65.50	51.12	52.76	55.00	54.08
Min	7.94	23.86	17.84	21.64	23.50	26.68
SE	1.28	2.01	1.59	1.37	1.52	1.76
IC 95%	2.64	4.17	3.28	2.82	3.15	3.65
% Positive cases	-	100%	100%	100%	100%	100%
Positive cases number	-	24	24	24	24	24
<i>p</i> -Value	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Average improvement as a percentage	-	132.4%	103.2%	94.5%	119.0%	143.6%

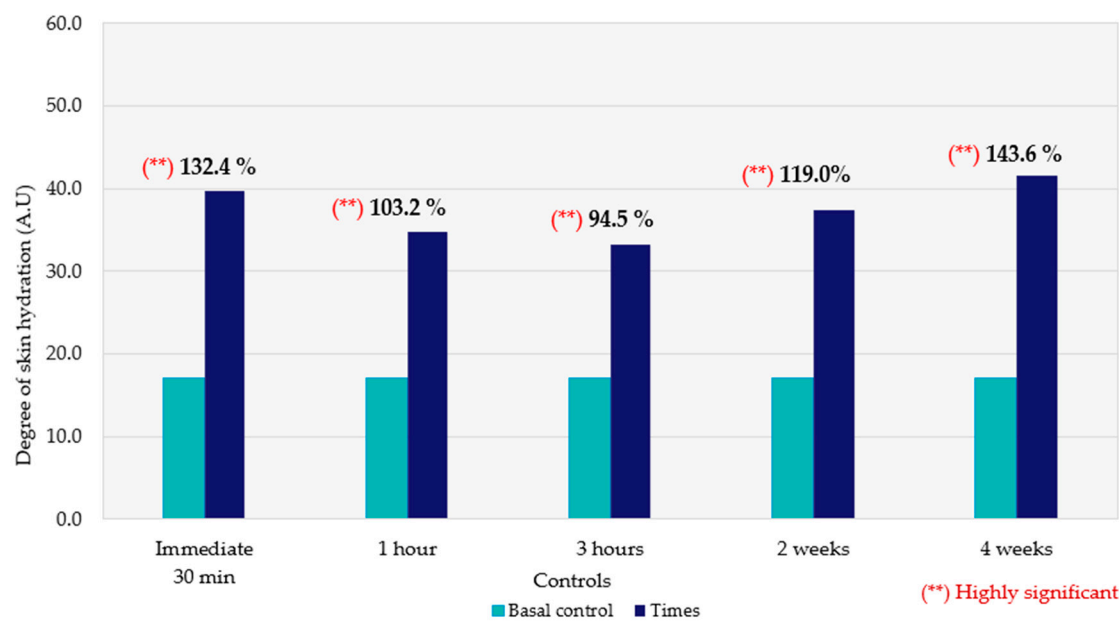


Figure 1. Comparison of skin hydration values measured with the Corneometer CM825 after application of ASC Cream up to 4 weeks.

3.3.2. Skin pH Assessment

After 4 weeks, ASC Cream exhibited statistically significant short- and long-term differences; however, this increase is within the normal range of lateral leg pH (4.5–6.5). (Table 5, Figure 2.)

Table 5. Comparison of skin values.

Control	Basal Control	Immediate 30 min	1 h	3 h	2 Weeks	4 Weeks
<i>n</i>	24	24	24	24	24	24
Average	5.71	5.92	5.85	5.93	5.29	5.34
Max	6.00	6.16	6.06	6.09	5.91	6.18
Min	5.23	5.74	5.46	5.66	4.49	4.80
SE	0.05	0.02	0.03	0.02	0.08	0.09
IC 95%	0.09	0.05	0.07	0.05	0.16	0.18
% Positive cases	-	79%	75%	88%	8%	29%
Positive cases number	-	19	18	21	2	7
<i>p</i> -Value	-	0.000	0.006	0.000	0.000	0.001

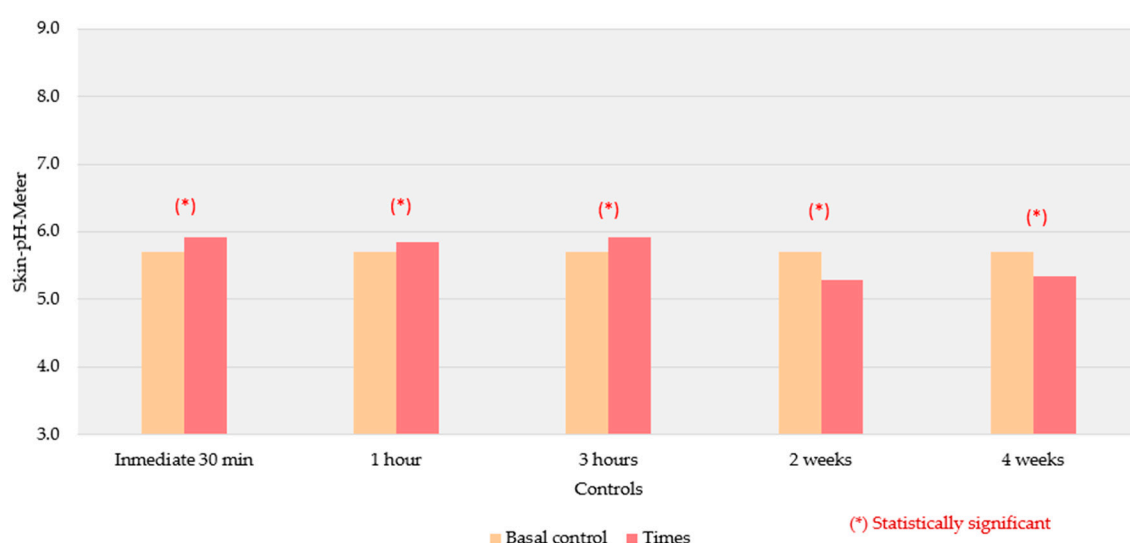


Figure 2. Comparison of skin pH values measured with the Skin-pH-Meter® after application of ASC Cream up to 4 weeks.

4. Discussion

Throughout the treatment, 100% positive results were obtained, which strongly supports the hydrating effect of ASC Cream. All external factors that could have influenced the results, such as probe pressure, relative humidity, relative temperature, and seasonal period, were controlled during measurements [30].

ASC Cream is an o/w emulsion-type formula, containing 0.65% Sepimax Zen, which is a gel that gives the cream a non-Newtonian behavior, meaning that it can vary its viscosity when subjected to shear forces [31]. Therefore, the decrease in viscosity does not represent instability; there is no phase separation, its organoleptic characteristics and cosmetic form are maintained, and it remains a cream that is easy to spread on the skin. Sepimax Zen, whose INCI name is Polyacrylate Crosspolymer-6, is a gel former and contributes to the stability of emulsions containing large amounts of oils [32]; this ingredient is what imparts the thinning behavior to our product, which is why, although the viscosity decreases as time passes at a high temperature of 40 °C, it is stable and there is no phase separation.

Some authors claim that the bioactive compounds of cosmetic formulations containing vegetable extracts or oils may have synergistic or antagonistic effects [19]. However, our study shows that the design and elaboration of cosmetic products containing several oils containing essential fatty acids and catechins improves the hydration effect and maintenance of skin pH, ensuring synergism between these components. The results obtained in this skin bioengineering study scientifically support these claims. The extracellular

matrix is characterized as hydrophilic due to the high presence of glycosaminoglycans produced by the fibroblast [33]. Based on these previous studies, it can be assumed that ASC Cream could be stimulating the synthesis of these polymers, so its daily application is recommended to ensure its moisturizing efficacy, as it is relevant for improving skin capacitance. The same occurs with the amide and polyol varieties included in commercial moisturizing and hydrating cosmetic products, which should also be applied daily [34]. The epidermal hydration caused by moisturizers demonstrates a favorable influence on the biomechanical properties of the skin [22], which may be a reason to extend the study of ASC Cream to examine its behavior in viscoelastic characteristics.

The epidermis is a semi-permeable barrier that maintains a physiological gradient in water evaporation [17]. This capacity is attributed to glycerol produced by the sebaceous glands. Hydrating creams help reduce transepidermal water loss, improving hydration [35]. ASC Cream would improve natural hydration factors by forming a more consistent hydrolipidic layer which retains water, keeping skin highly hydrated.

Due to the hydrophobicity of its acyl chain, oleic acid is known to spontaneously and easily penetrate the stratum corneum to the epidermal–dermal junction, contributing to skin permeability and the formation of separate domains enriched with oleic acid [36]. It also helps to restore the barrier function of the epidermis and allows a greater amount of moisture to be retained [12]. Linolenic acid (omega 3) strengthens the immune system and inhibits the production of prostaglandins GE2, which are responsible for inflammation. Linoleic acid as an acyl glycosylated ceramide component maintains the water permeability barrier of the skin [13]. These natural oils have penetration-enhancing effects due to their chain length and double bonds, which promote skin permeability through lipid fluidization in the stratum corneum, even more than saturated fatty acids [37]. This bioactive mixture benefits the hydration power of ASC Cream without altering normal skin pH.

Quantification of polyphenols such as flavonoids in hydroalcoholic extracts has evidenced the anti-enzymatic activity of the elastase and collagenase enzymes [38]. Several types of flavonoids have been identified in *Croton lechleri* [16,39], which may promote collagen increase. This may be supported by an additional study of the cream to identify its viscoelastic properties.

Long-term assessments of other vegetable oils such as canola have been conducted in a wider age range and evidenced a moisturizing increase; however, they did not show a significant difference with baseline controls [19]. The combination of the vegetable oils included in the ASC Cream formulation reports statistically significant results that strongly support its hydrating effect.

In other studies of skin hydration with cosmetic products where the active ingredients were catole coconut, licuri and almond oils, which also contained the fatty acids mentioned above, significant increases in hydration values were observed after 20 days [21]. However, the area of topical application should be clearly established, as well as the application instructions for volunteers to avoid confusion. In addition, considering that the time from stratum corneum formation to its removal is 20 to 30 days in young adults [40], long-term studies should last 4 weeks or longer.

The skin on the legs is more likely to be affected by dryness than the skin on the forearms [41]. ASC Cream may foreseeably be used on diabetics, who develop skin dehydration that leads to vulnerability to dermatological conditions, especially on the lower limbs. The results of this research were satisfactory in the population of healthy volunteers, which could be continued with populations of people with dry skin [42]. In addition, by containing plant species from the Peruvian biodiversity in their formulation, they can boost the economic activity of the inhabitants of the respective regions.

After 4 weeks, ASC Cream exhibited statistically significant differences in the short and long term. However, this increase is within the normal pH range of the side-of-the-leg skin (4.5–6.5) and to maintain the care of the acid mantle [43–47]. No volunteers showed any visible adverse reaction in the application area throughout the treatment, demonstrating that ASC Cream does not alter skin pH. Free fatty acids can maintain skin

pH between 4.0 and 6.5; dermatoses are mostly characterized by an impaired skin barrier, increasing the pH of the skin surface [48]. Skin pH helps control the physical properties and stability of the lipid membrane, preserving skin structure and health [49]. When pH increases, corneodesmolysis occurs and the synthesis of ceramides by glucosylceramides is retarded [50].

5. Conclusions

ASC Cream is an exclusive formulation that combines four oils and a natural extract, all with different chemical compositions, rich in omega 3, omega 6, omega 9 and polyphenols that combined synergistically potentiate their effectiveness for the maintenance and improvement of skin health. These five natural ingredients were correctly mixed in an o/w emulsion vehicle, allowing a better availability at the skin level, favoring, after a good dispersion, its efficacy at the application site. Because of the efficacy found, it could be recommended to help treat skin conditions such as dehydration and its associated problems effectively and safely.

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