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Formulation and Physicochemical Evaluation of a Sodium DNA-Based Moisturizer for Cosmetic Applications

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Abstract

Skin hydration plays a critical role in maintaining skin health and preserving skin barrier integrity, while impairment of the barrier may increase trans epidermal water loss and lead to dry, sensitive, and irritated skin. The growing interest in biomolecule-based cosmetic ingredients has encouraged the development of innovative moisturizers containing Salmon DNA (Sodium DNA), a purified nucleic acid fragment with potential hydrating properties. This study aimed to formulate and characterize Selvique DNA Salmon Hydra Moist, a moisturizer incorporating Sodium DNA together with humectants, emollients, and skin-conditioning agents to support skin hydration and barrier function. The formulation was prepared using Sodium DNA, glycerine, butylene glycol, saccharide isomerase, allantoin, caprylic or capric triglyceride, cyclopentasiloxane, and complementary excipients, followed by physicochemical and microbiological evaluations. The resulting product exhibited desirable characteristics, including a white cream appearance, odourless profile, pH of 5.27, viscosity of 110,000 cPs, and specific gravity of 1.0092 g/mL. Microbiological analysis demonstrated compliance with cosmetic quality requirements, with total plate count and yeast-mold count of 0 cfu/mL and negative results for *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Candida albicans*. The formulation was also classified as non-hazardous according to the ASEAN Cosmetic Directive and remained stable under normal storage conditions. These findings indicate that the developed Salmon DNA-based moisturizer possesses acceptable physicochemical stability and microbiological quality, supporting its potential use as a biomolecule-based cosmetic formulation designed to maintain skin hydration and promote skin barrier function.

Keywords: DNA Salmon; Skin Barrier; Moisturizer

1. INTRODUCTION

The skin is the largest organ of the human body and serves as the primary protective barrier against external factors, including ultraviolet radiation, environmental pollutants, temperature fluctuations, chemical exposure, and microbial invasion [1]. In addition to its protective role, the skin is responsible for maintaining water homeostasis through the integrity of the skin barrier. Disruption of this barrier can increase trans-epidermal water loss, leading to dryness, roughness, dull appearance, irritation, and heightened skin sensitivity [2]. Therefore, maintaining adequate skin hydration has become a major focus in dermatological research and cosmetic product development [3].

Recent advances in cosmetic science have shifted toward the use of bioactive molecules that provide multifunctional benefits beyond conventional moisturization [4]. Among these, salmon-derived DNA, commonly known as Sodium DNA, has emerged as a promising ingredient for premium skincare formulations. Sodium DNA is obtained through the purification of DNA fragments from salmon tissue, resulting in a highly purified biomolecule suitable for cosmetic applications [5]. Previous studies have suggested that DNA fragments possess hygroscopic properties and may contribute to water retention while creating a favourable microenvironment for maintaining skin hydration and supporting overall skin condition [6]. However, the mechanisms underlying these effects and their translation into topical cosmetic formulations remain an active area of investigation, with limited evidence regarding formulation performance and product stability.

Salmon-derived Sodium DNA is commonly isolated from salmon milt, a by-product of the fish processing industry that is naturally rich in highly polymerized deoxyribonucleic acids. Following purification and depolymerization, the resulting sodium DNA exhibits high biocompatibility, low immunogenicity, and favorable safety characteristics, making it suitable for pharmaceutical and cosmetic applications [7]. Because of its natural origin and high purity, Sodium DNA has recently attracted considerable attention as an innovative biomaterial for regenerative medicine and advanced skincare formulations. Sodium DNA consists of low-molecular-weight deoxyribonucleotide fragments that may serve as biological signaling molecules after topical application. These nucleotide fragments have been reported to participate in cellular repair processes by stimulating purinergic receptor pathways, promoting extracellular matrix homeostasis, and supporting normal cellular metabolism. Consequently, Sodium DNA has attracted increasing interest as a multifunctional cosmetic ingredient rather than solely as a conventional moisturizing agent [8].

Numerous experimental and clinical studies have demonstrated that salmon-derived polydeoxyribonucleotides (PDRN) stimulate fibroblast proliferation, enhance collagen synthesis, accelerate angiogenesis, and improve tissue remodeling during wound healing. These biological activities are primarily mediated through activation of adenosine A2A receptors, leading to increased cellular proliferation and regeneration [9]. Because dermal fibroblasts play a central role in maintaining skin structure and extracellular matrix integrity, these regenerative properties suggest promising applications of Sodium DNA in cosmetic formulations intended to support skin appearance and skin quality.

In addition to its regenerative activity, Sodium DNA has also demonstrated anti-inflammatory properties by reducing the production of pro-inflammatory cytokines and modulating inflammatory responses in damaged tissues. These effects may contribute to improved skin comfort and support recovery of environmentally stressed skin [10]. Such characteristics have expanded the application of salmon-derived nucleotides from wound management to cosmetic formulations targeting sensitive and aging skin.

Although Sodium DNA has been extensively investigated in regenerative medicine, its application in cosmetic moisturizers remains relatively limited. Its highly hydrophilic molecular structure enables interaction with water molecules, potentially enhancing moisture retention on the skin surface [11]. When combined with conventional humectants such as glycerin, butylene glycol, and saccharide isomerate, Sodium DNA may contribute to a complementary moisturizing mechanism that supports skin hydration while maintaining skin barrier homeostasis. Nevertheless, evidence regarding formulation performance and physicochemical stability of Sodium DNA-containing moisturizers is still scarce, indicating the need for further formulation-based investigations [12].

Current research has primarily focused on the biological and regenerative potential of salmon-derived DNA in medical or biomedical applications, whereas studies evaluating its incorporation into cosmetic moisturizers are still relatively limited [11]. Furthermore, the effectiveness of a skincare ingredient depends not only on its intrinsic biological activity but also on its compatibility with other formulation components and its ability to remain stable and functional within the finished product. This highlights the need for the development and scientific evaluation of innovative moisturizer formulations containing Sodium DNA to support evidence-based cosmetic innovation [12].

Despite the growing evidence regarding the regenerative activity of salmon-derived DNA in biomedical applications, studies concerning its incorporation into cosmetic moisturizer formulations remain scarce. Therefore, this study aimed to develop and physicochemical characterize a Sodium DNA-based moisturizer designed for cosmetic use [12]. The novelty of this work lies in integrating Sodium DNA with a multifunctional moisturizing system and evaluating its formulation characteristics as a biomolecule-based cosmetic product.

2. MATERIALS AND METHODS

2.1. Material

The formulation of Selvique DNA Salmon Hydra Moist was developed using a multifunctional moisturizing system that combines biomolecular active ingredients, humectants, emollients, occlusive agents, rheology modifiers, emulsifying components, preservatives, and pH-adjusting agents [13]. The primary active ingredient was Sodium DNA (salmon-derived DNA), incorporated as a biomolecular component intended to enhance skin hydration and support skin barrier function [14].

The materials used in this formulation consisted of Aqua as the solvent; Caprylic/Capric Triglyceride and Hydrogenated Polydecene as emollients; Cyclopentasiloxane and Dimethicone/Vinyl Dimethicone Cross polymer as silicone-based conditioning agents to improve skin feel and reduce trans epidermal water loss; Glycerin, Butylene Glycol, and Saccharide Isomerase as humectants to enhance water retention within the stratum corneum; Niacinamide as a multifunctional skin-conditioning ingredient; Allantoin as a soothing agent; and Sodium DNA as the principal bioactive compound.

To ensure appropriate viscosity and formulation stability, Sodium Polyacryloyldimethyl Taurate and Acrylates/C10-30 Alkyl Acrylate cross polymer were used as rheology modifiers, while Trideceth-10 functioned as a surfactant and emulsifying aid. Phenoxyethanol and 1,2-Hexanediol served as preservative components to maintain microbiological stability throughout storage. Citric Acid, Sodium Citrate, and Triethanolamine were included to adjust and maintain the formulation pH, whereas Disodium EDTA acted as a chelating agent to improve overall formulation stability.

All ingredients employed in this study were cosmetic-grade raw materials obtained from commercial suppliers and were used as received without further purification. The combination of these materials was designed to provide hydration through complementary mechanisms, including increasing water retention, minimizing moisture loss from the skin surface, and improving the sensory characteristics of the moisturizer to achieve a smooth, non-greasy, and comfortable application.

2.2. Instrument

The principal instruments used in this study included a digital pH meter (Brand, Country) for measuring the pH of the moisturizer formulation, a rotational viscometer (Brand, Country) for viscosity determination, a density meter or equivalent specific gravity measuring instrument (Brand, Country) for evaluating product density, and an analytical balance (Brand, Country) for determining the net weight of the formulation. Microbiological quality assessment was performed using standard laboratory equipment and culture media available in a certified microbiology laboratory to determine the total plate count (TPC), yeast and mold count (YMC), and the presence of *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Candida albicans*. Product safety and stability information was further supported by the corresponding Safety Data Sheet (SDS) and finished product analytical reports. Routine laboratory glassware and general laboratory accessories are not specifically described.

2.3. Method

This study employed a formulation and cosmetic quality evaluation approach to develop Selvique DNA Salmon Hydra Moist, a moisturizer containing Salmon DNA (Sodium DNA) as the principal bioactive ingredient. The research was designed to establish a reproducible formulation process and to evaluate the physicochemical, microbiological, and safety characteristics of the final product. The overall methodology consisted of literature review, formulation development, product preparation, and quality evaluation.

2.3.1 Formulation Development

The moisturizer formulation, designated as *Selvique DNA Salmon Hydra Moist*, was developed based on an extensive review of scientific literature regarding the moisturizing properties of Sodium DNA and other cosmetic ingredients commonly used to support skin hydration and skin barrier function. Active ingredients and excipients were selected according to their functional roles, compatibility, safety profiles, and potential synergistic effects within the formulation [15].

The formulation development process consisted of the following steps:

1. Reviewing scientific publications and technical documents related to Sodium DNA and moisturizing cosmetic formulations.
2. Selecting and determining the concentration of active ingredients and excipients.
3. Preparing the formulation under controlled laboratory conditions.
4. Incorporating the ingredients according to the formulation sequence and mixing until a homogeneous cream was obtained.
5. Conducting preliminary quality evaluations of the finished product.

2.3.2 Physicochemical Evaluation

The finished moisturizer formulation was evaluated for its organoleptic and physicochemical characteristics. Organoleptic assessment included observation of appearance, color, texture, consistency, homogeneity, and odor [12].

Physicochemical testing included [16]:

1. pH measurement using a calibrated digital pH meter;
2. Viscosity determination using a rotational viscometer;
3. Specific gravity measurement using a density meter;
4. Net weight determination using an analytical balance.

The obtained results were compared with predetermined product specifications to ensure product quality, consistency, and physical stability.

2.3.3 Microbiological Evaluation

Microbiological quality assessment was conducted according to standard cosmetic quality control procedures [17]. The analyses included determination of the total plate count (TPC), yeast and mold count (YMC), and detection of microbial contaminants, specifically *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Candida albicans*. The results were compared with applicable cosmetic microbiological quality requirements [18].

2.3.4 Safety and Stability Evaluation

Product safety and stability were evaluated using the available Safety Data Sheet (SDS), raw material documentation, and finished product analytical reports [19]. The assessment included review of hazard classification, handling and storage recommendations, physicochemical stability information, and available quality control data supporting product stability under recommended storage conditions [20].

2.3.5 Ethical Consideration

This study focused on formulation development and quality evaluation of a cosmetic product and did not involve human participants, animal experimentation, or collection of personal data. Therefore, ethical approval was not required.

3. RESULT AND DISCUSSION

Results and discussion contain research findings and discussion. Write down the findings obtained from the results of the research that has been carried out and must be supported by adequate data. Research results and findings must be able to answer questions or hypotheses.

3.1. Formulation Development of Selvique DNA Salmon Hydra Moist

3.1.1. Formulation Design and Functional Roles of Ingredients

Selvique DNA Salmon Hydra Moist was successfully formulated as a multifunctional moisturizer by combining biomolecule-based active ingredients with a modern moisturizing system. The formulation was designed to maintain skin hydration, support skin barrier function, and provide a pleasant sensory profile during daily application.

Sodium DNA (Salmon DNA) served as the principal active ingredient due to its hydrophilic properties and potential to enhance skin hydration. To complement its activity, the formulation incorporated multiple humectants, including glycerin, butylene glycol, and saccharide isomerase, which facilitate water retention within the stratum corneum. Niacinamide was included as a skin-conditioning agent to support barrier integrity, while caprylic/capric triglyceride, cyclopentasiloxane, and dimethicone/vinyl dimethicone cross polymer contributed emollient and sensory-enhancing effects by reducing moisture loss and improving product spreadability. The emulsion system was stabilized using sodium polyacryloyldimethyl taurate, acrylates/C10-30 alkyl acrylate crosspolymer, hydrogenated polydecene, and trideceth-10, whereas phenoxyethanol and 1,2-hexanediol ensured microbiological preservation.

The combination of these ingredients provides complementary mechanisms of action, including moisture retention, reduction of trans epidermal water loss, and improvement of skin feel, thereby supporting the intended function of the moisturizer.

3.2. Physicochemical Characteristics of the Formulated Product

The developed formulation exhibited acceptable physicochemical characteristics suitable for topical cosmetic application. Organoleptic evaluation showed that the product possessed a homogeneous cream consistency with a white appearance and no detectable odor. Instrumental analyses further demonstrated that the formulation maintained a skin-compatible pH and appropriate rheological properties[21].

Figure 1. DNA Salmon Moisturizer

Table 1. Physicochemical characteristics of Selvique DNA Salmon Hydra Moist.

Parameter	Result
Appearance	Cream
Color	White
Odor	Odorless
Viscosity	110,000 cPs
pH	5.27
Specific gravity	1.0092 g/mL

The measured pH of 5.27 falls within the physiological range of healthy skin and is therefore considered appropriate for topical application. Maintaining a pH close to that of the skin may help preserve barrier function and minimize irritation. The viscosity value of 110,000 cPs indicates that the formulation possesses a sufficiently rich consistency while remaining spreadable and suitable for routine use [21]. In addition, the specific gravity of 1.0092 g/mL reflects uniform formulation characteristics and supports product consistency during manufacturing and storage [22].

3.3. Discussion of Functional Ingredients

3.3.1 Contribution of Sodium DNA and Moisturizing Components

The incorporation of Sodium DNA distinguishes the formulation from conventional moisturizers by introducing a biomolecule-based active ingredient with hydrophilic characteristics that may contribute to moisture retention and overall skin conditioning [23,24]. Its combination with established humectants such as glycerin, butylene glycol, and saccharide isomerase provides a multi-mechanistic hydration system designed to attract and retain water within the skin [25,26].
Niacinamide further complements this mechanism by supporting skin barrier maintenance [27], while allantoin contributes skin-conditioning properties that may improve user comfort, particularly for sensitive skin [28]. The balanced combination of humectants, emollients, and conditioning agents is expected to produce synergistic effects that enhance hydration while maintaining a pleasant sensory experience [29].

3.3.1 Sensory Performance and Formulation Stability

The inclusion of caprylic/capric triglyceride together with silicone-based ingredients such as cyclopentasiloxane and dimethicone/vinyl dimethicone cross polymer resulted in a formulation with smooth application characteristics and a non-sticky finish. These properties are desirable for daily cosmetic use because they improve user acceptance while contributing to moisture retention through partial occlusion [28].
The stability of the cream system was further supported by the selected rheology modifiers and emulsifying components, which maintained a homogeneous texture throughout storage [21]. The pH-adjusting system and chelating agent also contributed to maintaining formulation stability and compatibility [30].

3.3. Discussion of Functional Ingredients

Microbiological evaluation demonstrated that the formulated moisturizer complied with cosmetic quality requirements [18]. Total plate count and yeast-mold count were both reported as 0 cfu/mL, while no contamination by *Staphylococcus aureus*, *Pseudomonas aeruginosa*, or *Candida albicans* was detected [18].
These findings indicate that the preservative system consisting of phenoxyethanol and 1,2-hexanediol effectively maintained microbiological quality under the evaluated conditions. Furthermore, review of the Safety Data Sheet (SDS) and finished product documentation indicated that the formulation was not classified as hazardous under the ASEAN Cosmetic Directive, exhibited normal storage stability, and was intended for external cosmetic use [19].
Overall, the obtained results demonstrate that Selvique DNA Salmon Hydra Moist possesses favorable physicochemical characteristics, acceptable microbiological quality, and a scientifically designed combination of biomolecule-based and conventional moisturizing ingredients. The formulation therefore represents a promising approach for the development of

premium skincare products intended to support skin hydration and skin barrier function, particularly for consumers in tropical environments. This study is among the first reports describing the formulation of a Sodium DNA moisturizer using cosmetic-grade Sodium DNA with comprehensive physicochemical characterization intended for topical cosmetic applications [31].

5. CONCLUSION

The present study successfully developed Selvique DNA Salmon Hydra Moist, a biomolecule-based moisturizer formulated with Sodium DNA in combination with humectants, emollients, skin-conditioning agents, and a stable emulsion system. The resulting formulation exhibited acceptable physicochemical characteristics, including a homogeneous cream appearance, white color, odorless profile, a skin-compatible pH of 5.27, viscosity of 110,000 cPs, and a specific gravity of 1.0092 g/mL. Microbiological evaluation demonstrated compliance with cosmetic quality requirements, with total plate count and yeast-mold count of 0 cfu/mL and no detectable *Staphylococcus aureus*, *Pseudomonas aeruginosa*, or *Candida albicans*. Safety assessment based on the Safety Data Sheet and finished product documentation further indicated that the formulation is stable under normal storage conditions and is not classified as hazardous according to the ASEAN Cosmetic Directive. These findings suggest that the developed formulation possesses satisfactory quality attributes and has potential for application as a biomolecule-based moisturizer intended to support skin hydration and skin barrier maintenance. Further studies involving stability testing over extended storage periods and clinical evaluation in human subjects are recommended to confirm its long-term performance and efficacy.

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