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The role of Salmon DNA in Skin Regeneration and Anti-Aging

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A B S T R A C T

Salmon DNA, particularly its polydeoxyribonucleotide (PDRN) content, has attracted attention in dermatology due to its potential in skin regeneration and anti-aging applications. This review aims to summarize various research findings on the effectiveness of PDRN. The study was conducted through a literature review of articles published between 2016 and 2023. Findings indicate that PDRN works by activating adenosine A2a receptors, stimulating angiogenesis, cell proliferation, and reducing inflammation. Its combination with vitamin C and niacinamide enhances antioxidant effects and helps preserve the extracellular matrix. Furthermore, the use of long-chain polynucleotide fillers has been shown to significantly improve pore size, skin texture, wrinkles, and sagging, with minimal side effects. In conclusion, PDRN from salmon DNA is a promising bioactive agent for skin rejuvenation, wound healing, and anti-aging therapy in modern dermatological practice.

1. Introduction

Aging well has become a key focus in preventive medicine, with esthetic dermatology playing a significant role in maintaining youthful skin appearance and health. In recent years, modern skin rejuvenation strategies have shifted from the use of synthetic fillers to approaches that stimulate skin cells, promote tissue regeneration, and utilize autologous or natural components. Polynucleotide (PN)-based fillers derived from fish germ cells have gained increasing attention in Europe due to their dual ability to reduce wrinkles and enhance tissue regeneration [1], [2].

Polydeoxyribonucleotide (PDRN) is a purified DNA polymer extracted from the sperm of salmon species, such as Oncorhynchus mykiss and Oncorhynchus keta, and consists of fragments ranging in size from 50 to 1,500 kDa [3]. Polydeoxyribonucleotide (PDRN), extracted from salmon sperm, is widely used in dermatology for its wound-healing, anti-inflammatory, and regenerative properties [4]. It operates by activating adenosine A2A receptors, which regulate inflammation and promote the secretion of growth factors. Additionally, PDRN provides nucleotides for DNA repair through the salvage pathway [5]. It has demonstrated clinical efficacy in treating various conditions, including diabetic ulcers, scars, vascular insufficiency, hyperpigmentation, and photoaging [6].

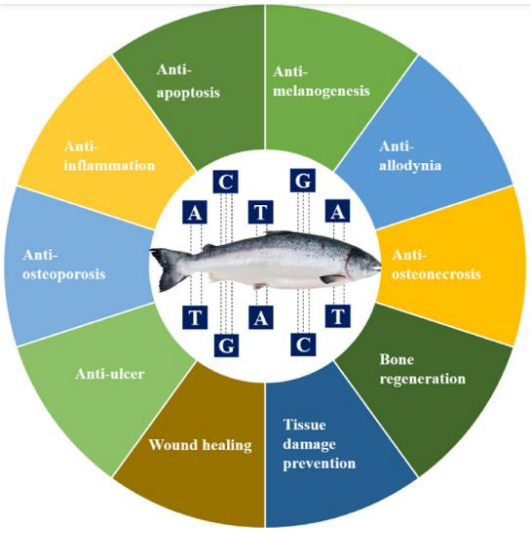

Figure 1. Therapeutic effects of PDRN (Polydeoxyribonucleotide), a bioactive component derived from salmon DNA.

As illustrated in Figure 1, PDRN, a DNA fragment derived from salmon sperm, exerts a wide range of therapeutic effects, including anti-inflammatory, wound healing, anti-melanogenesis, bone regeneration, and anti-apoptotic properties. These pleiotropic activities contribute to its growing relevance in dermatology, particularly in regenerative and anti-aging therapies.

Its ability to enhance wound healing and mitigate post-inflammatory hyperpigmentation (PIH) makes it particularly useful in Asian skin types, which are prone to pigmentation following procedures such as laser resurfacing [7].

Skin aging results from both intrinsic and extrinsic factors, manifesting as fine lines, wrinkles, and sagging [8]. Traditional surgical approaches to skin rejuvenation are increasingly being replaced by minimally invasive treatments, such as topical agents, lasers, and dermal fillers. PDRN stands out as a potent anti-aging agent due to its capacity to stimulate collagen synthesis, promote angiogenesis, support soft tissue regeneration, and exert anti-inflammatory effects [9], [10]. Furthermore, recent studies suggest that PDRN exerts opposing effects on the ERK pathway in different cell types—activating ERK in fibroblasts to promote collagen production, while inhibiting it in keratinocytes to suppress inflammatory cytokines [9]. These properties highlight the promising role of PDRN as a multifunctional bioactive compound in modern cosmetic dermatology.

Given the clinical relevance and expanding applications of polydeoxyribonucleotide in dermatology, this review aims to examine recent scientific literature on the role of salmon DNA, particularly PDRN, in skin regeneration and anti-aging therapy. By synthesizing evidence from in vitro, in vivo, and clinical studies published between 2016 and 2025, this study highlights the therapeutic potential, molecular mechanisms, and practical implications of PDRN-based treatments in modern esthetic medicine.

2. Research Method

This study employed a narrative literature review approach to synthesize findings from scientific publications related to the role of salmon DNA, particularly polydeoxyribonucleotide (PDRN), in skin regeneration and anti-aging therapy. A literature review is a recognized and systematic research method aimed at identifying, evaluating, and interpreting all available and relevant literature on a specific topic [11].

A systematic search was conducted using Google Scholar, which is widely regarded as a comprehensive and effective academic search tool for accessing diverse types of scientific literature [12]. The keywords used included “Salmon DNA”, “PDRN”, “skin regeneration”, and “anti-aging”. The search focused on articles published between 2016 and 2023.

The inclusion criteria were: (1) peer-reviewed journal articles, (2) studies discussing biological or clinical applications of salmon DNA or PDRN in dermatology, and (3) publications written in English. The exclusion criteria included non-scientific sources, articles without full-text access, and studies unrelated to dermatological applications.

After applying the selection criteria, a total of eight core articles were selected for in-depth review. These articles include in vitro studies, in vivo experiments, and clinical trials relevant to the dermatological and regenerative applications of salmon DNA.

3. Result and Discussion

Based on the analysis of eight selected studies that met the inclusion criteria, significant findings were identified regarding the role of salmon DNA, particularly polydeoxyribonucleotide (PDRN), in skin regeneration and anti-aging. These studies highlight various biological mechanisms and clinical applications through which PDRN contributes to enhanced skin health and addresses aging-related concerns.

The reviewed literature consistently emphasizes PDRN’s effectiveness in promoting tissue repair, enhancing collagen synthesis, and improving skin elasticity. Each study contributes unique insights, ranging from molecular mechanisms, such as the activation of adenosine A2a receptors and modulation of the ERK signaling pathway, to practical applications, including its use in wound healing, pigmentation reduction, and skin rejuvenation treatments.

Furthermore, the findings collectively suggest that PDRN not only facilitates skin regeneration by accelerating cellular repair and angiogenesis but also offers anti-inflammatory and antioxidant benefits. These effects help protect the extracellular matrix, reduce oxidative damage, and maintain overall skin integrity.

The studies underscore the versatility of Salmon DNA-derived treatments, such as injections, topical formulations, and polynucleotide fillers, in providing comprehensive solutions for dermatological concerns. The synthesis of these results highlights the promising potential of Salmon DNA as a multi-functional bioactive agent in both therapeutic and cosmetic applications. Details of these findings are organized in the Table 1 for a clearer comparative understanding.

Table 1. Summary of the literature on the role of Salmon DNA in Skin Regeneration and Anti-Aging

Researcher/ Year	Title	Research Purposes	Research Methods	Results
H. M. Kim et al. [6] / 2022	A Mixture of Topical Forms of Polydeoxyribonucleotide, Vitamin C, and Niacinamide Attenuated	to evaluate the ability of a topical liquid formula of polydeoxyribonucleotide (PDRN), vitamin C, and niacinamide (PVN)	The key methods used in this study include cell culture experiments, preparation of a topical liquid formulation containing PDRN, vitamin	1) Decreasing melanin synthesis and accumulation in the skin 2) Increasing the expression of collagen and elastin fibers in the skin 3)

Researcher/ Year	Title	Research Purposes	Research Methods	Results
	Skin Pigmentation and Increased Skin Elasticity by Modulating Nuclear Factor Erythroid 2-like 2	delivered via a microneedling therapy system (MTS) to attenuate photoaging and pigmentation in a UV-B-radiated animal model.	C, and niacinamide (PVN), in vivo experiments using a mouse model of UV-B-induced skin damage, RNA extraction and cDNA synthesis, protein isolation, and various biochemical and histological analyses.	Decreasing the expression and activity of MMPs that degrade the extracellular matrix The effects of PVN were more prominent compared to individual PDRN or hydroquinone treatments, and were mediated by increasing NRF2/HO-1 expression, decreasing NADPH oxidase activity, and increasing SOD activity to reduce oxidative stress.
T. K Noh et al. [10] / 2016	Novel Anti-Melanogenesis Properties of Polydeoxyribonucleotide, a Popular Wound Healing Booster	The research purpose is to investigate the anti-melanogenesis properties of polydeoxyribonucleotide (PDRN), a wound healing booster that is commonly used in dermatological practice.	- Use of a mouse melanocyte cell line (Mel-Ab) as an experimental model - Use of human melanocytes and keratinocytes as experimental models - Development of a coculture model with human melanocytes and keratinocytes - Treatment of the cell lines and cocultures with PDRN or Placentex for 4-5 days - Measurement of melanin content, tyrosinase activity, and protein levels of melanogenesis-related factors	PDRN and the PDRN-containing product Placentex® inhibit melanogenesis in both mouse melanocytes and human melanocyte-keratinocyte cocultures, leading to decreases in melanin content, tyrosinase activity, and key melanogenic proteins like MITF and TRP-1. This is accompanied by increases in the phosphorylation of signaling proteins ERK and AKT. Intradermal injection of Placentex® also led to clinical improvements in facial hyperpigmentation in human patients.
M. Galeano et al. [5] / 2021	Polydeoxyribonucleotide: A Promising Biological Platform to Accelerate Impaired Skin Wound Healing	The research purpose of this paper is to provide a full overview of the applications of polydeoxyribonucleotide (PDRN) on skin regeneration.	- Systematic review of the literature on the use of polydeoxyribonucleotide (PDRN) for wound healing, focusing on studies published in the last 25 years - Review of in vitro, in vivo, and clinical studies investigating the effects of PDRN on wound healing, using different administration routes and models of impaired wound healing - Organization of the studies by the type of experimental model used (e.g., in vitro, in vivo, clinical)	The key result of this paper is that polydeoxyribonucleotide (PDRN) has been shown to improve wound healing in various impaired wound healing models, both in vitro and in vivo, through its ability to activate adenosine A2a receptors and the salvage pathway, leading to reduced inflammation, increased angiogenesis and cell proliferation, which accelerate the wound healing process.
S Geahcahan et al. [13] / 2022	Marine Collagen: A Promising Biomaterial for Wound Healing, Skin Anti-Aging, and Bone Regeneration	The research purposes of this paper are to review the potential applications of marine collagen in wound healing, skin anti-aging, and bone and cartilage regeneration.	- Chemical and enzymatic hydrolysis to produce marine collagen peptides - In vitro scratch assays to assess wound healing and cell migration - Isolation and purification of marine collagen from various sources (fish, jellyfish, sponges) - Animal studies (rats, rabbits, sheep) to evaluate the effects of marine collagen on wound healing, skin aging, and bone regeneration - Cell culture experiments to assess the impact of marine collagen on cell proliferation, differentiation, and	The key results from the paper are that marine collagen and its derivatives, such as collagen peptides and hydroxylates, have been shown to be effective in promoting wound healing, improving skin elasticity and reducing signs of aging, and enhancing bone and cartilage regeneration.

Researcher/ Year	Title	Research Purposes	Research Methods	Results
			extracellular matrix production	
M. Cavallini et al. [1] / 2021	PN-HPT® (Polynucleotides Highly Purified Technology) in facial middle third rejuvenation. Exploring the potential	The research purpose is to explore the potential of Polynucleotides Highly Purified Technology (PN-HPT®) for facial middle third rejuvenation in an open-design, exploratory prospective cohort study.	- Open-design, exploratory prospective cohort study in 40 women - 3 treatment sessions over 6 weeks: - Baseline: 10 mg/ml PN-HPT® + 10 mg/ml hyaluronic acid - 3 weeks later: 20 mg/ml PN-HPT® only - 6 weeks after baseline: same as baseline - Supplemental 7.5 mg/ml PN-HPT® allowed in periocular/eyelid areas - Assessments: photographs, clinician-rated scales for skin quality/texture, patient satisfaction	The key results were significant improvements in overall skin quality and texture, wrinkles/roughness, elasticity, brightness, and reduction in post-acne scar severity, along with high patient satisfaction.
A. Khan et al.[14] / 2022	Polydeoxyribonucleotide: A promising skin anti-aging agent	The research purpose of this paper is to assess the potential use of polydeoxyribonucleotide (PDRN) as an anti-aging agent for the skin.	- Extraction and purification of PDRN from salmon sperm cells - In vitro experiments using murine and human cell lines to assess the anti-inflammatory properties of PDRN	The key results from the paper are that PDRN has numerous beneficial properties for skin, including anti-inflammatory, anti-apoptotic, anti-melanogenetic, and wound healing effects, as well as the ability to promote angiogenesis, collagen synthesis, and skin regeneration. These effects are mediated through the activation of the adenosine A2A receptor.
K. Y Park et al. [15] / 2016	Long-chain polynucleotide filler for skin rejuvenation: efficacy and complications in five patients	The research purpose of this study was to evaluate the efficacy and safety of long-chain polynucleotide (PN) filler injections for skin rejuvenation in Korean women.	- Participants: 5 Korean women, 2 in their 30s and 3 in their 40s - Treatment: 4 injections of a long-chain polynucleotide (PN) filler product called Rejuran V R, given at 2-week intervals - Injection procedure: Intradermal injections using a 33-gauge needle, with a total dose of 1 mL per cheek (2 mL per person) and about 0.05 mL per injection point, for a total of 40 injection points per cheek - Outcome assessments: Biophysical measurements (e.g., skin thickness, pore size, wrinkles, sagging) at baseline, 2 weeks after final treatment, and 4 weeks after final treatment - Participants were instructed to maintain their usual skincare routines during the study period	The results of the study showed that intradermal long-chain polynucleotide (PN) filler injections led to significant improvements in various skin parameters, including pore size, skin thickness, skin tone, melanin, wrinkles, and sagging, as measured by biophysical instruments. Patients in their 30s saw marked improvements in pore size and skin thickness, while patients in their 40s saw noticeable improvements in skin tone, melanin, wrinkles, and sagging. The PN filler injections also led to marked improvements in skin moisture and reduction in dead skin cells, with greater improvements in dead skin cells seen at 12 weeks compared to 2 weeks. The treatment was well-tolerated, with only mild side effects that resolved quickly, and all patients were satisfied with the results and willing to undergo the treatment again.
S. M Shin et al. [9] / 2023	Polydeoxyribonucleotide exerts opposing effects on ERK activity in human skin keratinocytes and fibroblasts	The research purpose is to elucidate the molecular mechanism by which polydeoxyribonucleotide (PDRN) promotes skin	- Cell culture of human epidermal keratinocytes (HEKs) and human dermal fibroblasts (HDFs) - Cell proliferation and cytotoxicity	The key results of this study are that PDRN had opposing effects on ERK signaling in human dermal fibroblasts versus human epidermal

Researcher/ Year	Title	Research Purposes	Research Methods	Results
		healing by confirming the effect of PDRN treatment on epidermal keratinocytes and dermal fibroblasts, and by assessing collagen and inflammatory cytokine levels regulated by the extracellular signal-regulated kinase (ERK) signaling pathway.	assay using the water-soluble tetrazolium-8 (WST-8) assay - Cell migration assay using a scratch wound healing assay - Enzyme-linked immunosorbent assay (ELISA) for collagen type I and III - Western blotting to analyze MAPK signaling pathways - Reverse transcription-quantitative PCR (RT-qPCR) to measure inflammatory cytokine expression	keratinocytes, leading to differential effects on cell proliferation, migration, collagen synthesis, and inflammatory cytokine expression. In fibroblasts, PDRN activated the ERK pathway, increasing collagen production and decreasing MMP expression. In keratinocytes, PDRN inhibited the ERK pathway, suppressing the expression of pro-inflammatory cytokines.

3.1. PDRN for Anti-Pigmentation and Melanogenesis

Two studies in the review focus on PDRN's ability to reduce pigmentation and inhibit melanogenesis.

The first study was conducted by Hyoung Moon Kim et al., titled A Mixture of Topical Forms of Polydeoxyribonucleotide, Vitamin C, and Niacinamide Attenuated Skin Pigmentation and Increased Skin Elasticity by Modulating Nuclear [6]. Research purposes is to evaluate the ability of a topical liquid formula of polydeoxyribonucleotide (PDRN), vitamin C, and niacinamide (PVN) delivered via a microneedling therapy system (MTS) to attenuate photoaging and pigmentation in a UV-B-radiated animal model. The key methods used in this study include cell culture experiments, preparation of a topical liquid formulation containing PDRN, vitamin C, and niacinamide (PVN), in vivo experiments using a mouse model of UV-B-induced skin damage, RNA extraction and cDNA synthesis, protein isolation, and various biochemical and histological analyses. The results found in this research are:

1. Decreasing melanin synthesis and accumulation in the skin
2. Increasing the expression of collagen and elastin fibers in the skin
3. Decreasing the expression and activity of MMPs that degrade the extracellular matrix

The effects of PVN were more prominent compared to individual PDRN or hydroquinone treatments, and were mediated by increasing NRF2/HO-1 expression, decreasing NADPH oxidase activity, and increasing SOD activity to reduce oxidative stress.

To complement these findings, another study titled Novel Anti-Melanogenesis Properties of Polydeoxyribonucleotide, a Popular Wound Healing Booster, conducted by Tai Kyung Noh et al., [10]. The research purpose is to investigate the anti-melanogenesis properties of polydeoxyribonucleotide (PDRN), a wound healing booster that is commonly used in dermatological practice. With the methodology uof a mouse melanocyte cell line (Mel-Ab) as an experimental model. Use of human melanocytes and keratinocytes as experimental models. Development of a coculture model with human melanocytes and keratinocytes.

Treatment of the cell lines and cocultures with PDRN or Placentex for 4-5 days. Measurement of melanin content, tyrosinase activity, and protein levels of melanogenesis-related factors. The main result PDRN and the PDRN-containing product Placentex® inhibit melanogenesis in both mouse melanocytes and human melanocyte-keratinocyte cocultures, leading to decreases in melanin content, tyrosinase activity, and key melanogenic proteins like MITF and TRP-1. This is accompanied by increases in the phosphorylation of signaling proteins ERK and AKT. Intradermal injection of Placentex® also led to clinical improvements in facial hyperpigmentation in human patients.

3.2. PDRN for Tissue Regeneration and Wound Healing

Moving to its role in tissue regeneration, two studies highlight PDRN's contributions to wound healing and restoration of connective tissue integrity.

The first is a review titled Marine Collagen: A Promising Biomaterial for Wound Healing, Skin Anti-Aging, and Bone Regeneration, authored by Geahcahan et al. [13]. The research purposes of this paper are to review the potential applications of marine collagen in wound healing, skin anti-aging, and bone and cartilage regeneration. The methods used Chemical and enzymatic hydrolysis to produce marine collagen peptides. In vitro scratch assays to assess wound healing and cell migration. Isolation and purification of marine collagen from various sources (fish, jellyfish, sponges). Animal studies (rats, rabbits, sheep) to evaluate the effects of marine collagen on wound healing, skin aging, and bone regeneration. Cell culture experiments to assess the impact of marine collagen on cell proliferation, differentiation, and extracellular matrix production.

The key results from the paper are that marine collagen and its derivatives, such as collagen peptides and hydroxylates, have been shown to be effective in promoting wound healing, improving skin elasticity and reducing signs of aging, and enhancing bone and cartilage regeneration.

Further emphasizing the regenerative capacity of PDRN, the study Polydeoxyribonucleotide: A Promising Biological Platform to Accelerate Impaired Skin Wound Healing by Mariarosaria Galeano et al. [5]. The research purpose of this paper is to provide a full overview of the applications of polydeoxyribonucleotide (PDRN) on skin regeneration. The method their used is Systematic review of the literature on the use of polydeoxyribonucleotide (PDRN) for wound healing, focusing on studies published in the last 25 years. Review of in vitro, in vivo, and clinical studies investigating the effects of PDRN on wound healing, using different administration routes and models of impaired wound healing - Organization of the studies by the type of experimental model used (e.g., in vitro, in vivo, clinical).

The key result of this paper is that polydeoxyribonucleotide (PDRN) has been shown to improve wound healing in various impaired wound healing models, both in vitro and in vivo, through its ability to activate adenosine A2a receptors and the salvage pathway, leading to reduced inflammation, increased angiogenesis and cell proliferation, which accelerate the wound healing process.

3.3. PDRN for Skin Rejuvenation and Collagen Synthesis

In terms of aesthetic applications, three studies evaluated PDRN's role in improving skin texture, elasticity, and general rejuvenation.

The first, titled PN-HPT® (Polynucleotides Highly Purified Technology) in facial middle third rejuvenation: Exploring the potential, was conducted by Cavallini et al. [1]. The research purpose is to explore the potential of Polynucleotides Highly Purified Technology (PN-HPT®) for facial middle third rejuvenation in an open-design, exploratory prospective cohort study. Open-design, exploratory prospective cohort study in 40 women, 3 treatment sessions over 6 weeks. Baseline: 10 mg/ml PN-HPT® + 10 mg/ml hyaluronic acid - 3 weeks later: 20 mg/ml PN-HPT® only. 6 weeks after baseline: same as baseline. Supplemental 7.5 mg/ml PN-HPT® allowed in periocular/eyelid areas. Assessments: photographs, clinician-rated scales for skin quality/texture, patient satisfaction. The key results were significant improvements in overall skin quality and texture, wrinkles/roughness, elasticity, brightness, and reduction in post-acne scar severity, along with high patient satisfaction.

The next study, Polydeoxyribonucleotide: A Promising Skin Anti-Aging Agent by Aawrish Khan et al. [14]. The research purpose of this paper is to assess the potential use of polydeoxyribonucleotide (PDRN) as an anti-aging agent for the skin. Methodology of the research is extraction and purification of PDRN from salmon sperm cells. In vitro experiments using murine and human cell lines to assess the anti-inflammatory properties of PDRN. The key results from the paper are that PDRN has numerous beneficial properties for skin, including anti-inflammatory, anti-apoptotic, anti-melanogenetic, and wound healing effects, as well as the ability to promote angiogenesis, collagen synthesis, and skin regeneration. These effects are mediated through the activation of the adenosine A2A receptor.

Finally, a clinical study by Park et al. titled Long-Chain Polynucleotide Filler for Skin Rejuvenation: Efficacy and Complications in Five Patients [15]. The research purpose of this study was to evaluate the efficacy and safety of long-chain polynucleotide (PN) filler injections for skin rejuvenation in Korean women. Method use in this research is participants: 5 Korean women, 2 in their 30s and 3 in their 40s. Treatment: 4 injections of a long-chain polynucleotide (PN) filler product called Rejuran V R, given at 2-week intervals. Injection procedure: Intradermal injections using a 33-gauge needle, with a total dose of 1 mL per cheek (2 mL per person) and about 0.05 mL per injection point, for a total of 40 injection points per cheek. Outcome assessments: Biophysical measurements (e.g., skin thickness, pore size, wrinkles, sagging) at baseline, 2 weeks after final treatment, and 4 weeks after final treatment. Participants were instructed to maintain their usual skincare routines during the study period. The results of the study showed that intradermal long-chain polynucleotide (PN) filler injections led to significant improvements in various skin parameters, including pore size, skin thickness, skin tone, melanin, wrinkles, and sagging, as measured by biophysical instruments. Patients in their 30s saw marked improvements in pore size and skin thickness, while patients in their 40s saw noticeable improvements in skin tone, melanin, wrinkles, and sagging. The PN filler injections also led to marked improvements in skin moisture and reduction in dead skin cells, with greater improvements in dead skin cells seen at 12 weeks compared to 2 weeks. The treatment was well-tolerated, with only mild side effects that resolved quickly, and all patients were satisfied with the results and willing to undergo the treatment again.

3.4. Molecular Mechanism of PDRN: ERK Signaling Pathway

Beyond clinical applications, one study delved into the molecular basis of PDRN's skin-healing properties, specifically its influence on the ERK signaling pathway.

The study Polydeoxyribonucleotide Exerts Opposing Effects on ERK Activity in Human Skin Keratinocytes and Fibroblasts by Sun Mee Shin et al. [9]. The research purpose is to elucidate the molecular mechanism by which polydeoxyribonucleotide (PDRN) promotes skin healing by confirming the effect of PDRN treatment on epidermal keratinocytes and dermal fibroblasts, and by assessing collagen and inflammatory cytokine levels regulated by the extracellular signal-regulated kinase (ERK) signaling pathway. The method used in this research is Cell culture of human epidermal keratinocytes (HEKs) and human dermal fibroblasts (HDFs). Cell proliferation and cytotoxicity assay using the water-soluble tetrazolium-8 (WST-8) assay. Cell migration assay using a scratch wound healing assay. Enzyme-linked immunosorbent assay (ELISA) for collagen type I and III. Western blotting to analyze MAPK signaling pathways. Reverse transcription-quantitative PCR (RT-qPCR) to measure inflammatory cytokine expression. The key results of this study are that PDRN had opposing effects on ERK signaling in human dermal fibroblasts versus human epidermal keratinocytes, leading to differential effects on cell proliferation, migration, collagen synthesis, and inflammatory cytokine expression. In fibroblasts, PDRN activated the ERK pathway, increasing collagen production and decreasing MMP expression. In keratinocytes, PDRN inhibited the ERK pathway, suppressing the expression of pro-inflammatory cytokines.

3.5. Synthesis of Findings

The eight reviewed articles demonstrate that PDRN, especially when derived from salmon DNA, has multifaceted therapeutic effects in dermatology. It modulates pigmentation, promotes collagen production, accelerates wound healing, and rejuvenates the skin. These actions are mediated through molecular mechanisms such as adenosine A2A receptor activation, ERK/AKT signaling, and oxidative stress reduction. Collectively, the studies support PDRN as a safe and effective bioactive compound for skin regeneration and anti-aging applications.

4. Conclusion

Recent studies have highlighted the significant role of salmon DNA, particularly its polydeoxyribonucleotide (PDRN) content, in promoting skin regeneration and addressing signs of aging. PDRN has proven effective in enhancing skin quality, accelerating wound healing, and reducing hyperpigmentation due to its bioactive properties that support tissue regeneration and cellular repair. By activating adenosine A2a receptors, PDRN accelerates wound healing through processes such as angiogenesis, cell proliferation, and inflammation reduction, with demonstrated success in various wound models both in vitro and in vivo. Moreover, PDRN injections, either alone or in combination with substances like hyaluronic acid or vitamin C, have been shown to improve collagen and elastin production, reduce wrinkles, and enhance skin texture and elasticity across a wide range of patients. In addition, PDRN exhibits anti-melanogenesis properties by suppressing melanin production and tyrosinase activity, effectively reducing skin hyperpigmentation. Its antioxidant effects, particularly when combined with vitamin C and niacinamide, help mitigate oxidative stress and protect the extracellular matrix by inhibiting degrading enzymes, thereby preserving skin integrity and slowing aging. Furthermore, long-chain polynucleotide-based fillers containing PDRN demonstrate excellent results in addressing skin concerns such as enlarged pores, sagging, and wrinkles, with minimal side effects and good patient tolerance. Overall, these findings establish salmon DNA, with its PDRN content, as a promising bioactive agent in modern dermatology, offering effective solutions for skin regeneration, wound healing, and anti-aging therapies.

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