



Efficacy of Promarine Collagen Tripeptides on Skin, Hair, and Nail Health: A 12-Week Randomized Controlled Trial

Yung-Kai Lin¹, Chia-Hua Liang², Leong-Perng Chan³, Yung-Hsiang Lin⁴,
Shu-Ting Chan⁴ and Chi-Fu Chiang^{4*}

¹*Institute of Food Safety and Risk Management, National Taiwan Ocean University, Keelung, Taiwan. Department of Food Science, National Taiwan Ocean University, Keelung, Taiwan and Graduate Institute of Biomedical Engineering, National Chung Hsing University, Taichung, Taiwan*

²*Department of Cosmetic Science and Institute of Cosmetic Science, Chia Nan University of Pharmacy and Science, Tainan, Taiwan*

³*Department of Otorhinolaryngology-Head and Neck Surgery, Kaohsiung Medical University Hospital, Faculty of Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan*

⁴*Research and Design Center, TCI CO., Ltd., Taipei, Taiwan*

***Corresponding Author:** Chi-Fu Chiang, Research and Design Center, TCI CO., Ltd., Taipei, Taiwan.

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Abstract

Skin, hair, and nails are essential indicators of overall health, functioning not only for aesthetic appeal but also as the body's primary defense against environmental factors. Despite the abundance of skincare, haircare, and nail care products available on the market, many fail to address fundamental issues like collagen depletion, oxidative stress, and structural damage. This study investigates the effects of promarine collagen tripeptides (PCT) on improving skin, hair, and nail health. Sixty subjects were recruited and randomly assigned to either a placebo group or a PCT group. Subjects consumed one bottle of either the placebo or PCT daily for 12 weeks. Assessments of skin, hair, and nail conditions were conducted at baseline (week 0), mid-study (week 6), and post-study (week 12). Self-assessment questionnaires were also collected at weeks 0 and 12 to evaluate perceived improvements. Compared to the placebo group, the PCT group showed significant improvements in skin elasticity, wrinkle reduction, hair strength, and nail health. Self-assessment results from participants also indicated notable perceived improvements. PCT effectively enhance skin, hair, and nail health through various biological pathways, providing a safe and effective supplement to improve overall appearance and well-being.

Keywords: Promarine Collagen Tripeptides; Hair; Nails; Plant Extract; Skin

Introduction

Skin, hair, and nails are vital indicators of overall health and well-being, not only serving aesthetic purposes but also acting as the body's first line of defense against environmental factors [1]. Healthy skin acts as a barrier, protecting internal organs from pollutants, toxins, and microorganisms, while hair provides insulation and protection for the scalp [2]. Nails safeguard the sensitive tips of fingers and toes, aiding in fine motor functions [3]. A radiant appearance of these elements often reflects good nutrition, proper hydration, and balanced hormonal levels. Regular care for skin, hair, and nails is essential, as they are continuously exposed to damaging external factors like UV radiation, harsh weather, and chemical products [4]. Proper care routines ensure these structures remain strong, hydrated, and resistant to damage, contributing to an overall sense of well-being and confidence in personal appearance. Despite the wide variety of skincare, haircare, and nail care products available on the market, many fail to address key issues comprehensively. For skin, many moisturizers focus on superficial hydration but lack the ability to penetrate deeply enough to address underlying problems like collagen depletion, oxidative stress, and inflammation [5]. Haircare products often focus on external shine and volume without tackling deeper structural issues, such as protein damage or follicle health [6]. As for nail care, products may promote strength and growth but often lack ingredients that truly nourish and protect nails from environmental stress or nutrient deficiencies [7]. Additionally, many products contain harsh chemicals, synthetic fragrances, or preservatives, which may exacerbate issues such as dryness, breakage, and sensitivity [8].

Collagen tripeptide, with a molecular weight of approximately 500 Da, is more easily absorbed compared to regular collagen, which enhances its bioavailability [9]. Research shows it boosts collagen synthesis, improving skin elasticity, reducing wrinkles, and enhancing hair and nail strength [10]. *Hibiscus sabdariffa* extract, rich in polyphenols like anthocyanins, provides strong antioxidant protection against free radicals, delaying skin aging and supporting skin firmness [11]. It also promotes scalp health and protects nails from oxidative stress. *Ribes rubrum* extract contains high levels of vitamin C and polyphenols, which aid in collagen production, improve skin tone, and offer anti-inflammatory benefits for the scalp and hair [12]. Blueberry and spinach, rich in vitamins A, C,

E, and minerals, enhances skin barrier function, combats oxidative damage, and supports blood flow to the scalp and nails, promoting their health [13]. B vitamins, especially B7 (biotin), play a key role in cellular metabolism, promoting hair and nail growth while strengthening the skin's barrier [14]. Vitamin C is essential for collagen production, aiding in wrinkle reduction and skin repair, while also protecting hair follicles and nail beds from oxidative damage [15]. Hyaluronic acid, a powerful hydrating molecule, retains moisture in the skin, improving elasticity and reducing fine lines [16]. It also maintains scalp hydration and prevents nail dehydration, supporting healthy, resilient structures. Together, these ingredients contribute to the overall health and appearance of skin, hair, and nails through various biological pathways.

In this study, the product (name is promarine collagen tripeptides, PCT), provided by Coral Club. This product consists of collagen tripeptide (MAXI collagen), *H. sabdariffa* extract, *R. rubrum* extract, blueberry extract, spinach extract, B complex, and vitamin C. The primary objective of this research is to evaluate the efficacy of PCT on improving skin, hair, and nail health. Sixty subjects were randomly assigned to either a placebo or PCT group. They consumed one bottle of the placebo or PCT daily for 12 weeks. Skin, hair, and nail conditions were evaluated at baseline (week 0), mid-study (week 6), and post-study (week 12). Self-assessment questionnaires were also collected at weeks 0 and 12 to measure perceived improvements.

Materials and Methods

Clinical trial design

The study was registered in clinicaltrials.gov (NCT06306105), was performed under a protocol approved by the Antai Medical Care Cooperation Antai-Tian-Sheng memorial Hospital Institutional Review Board (Approval Number: TSMH-IRB 23-118-B), and was conducted according to the code of ethics on human experimentation established by the Declaration of Helsinki (1964) and its amendments. Written informed consent was obtained from all participants after a full explanation of the study. A double-blinded, placebo controlled, randomized study was conducted. The trial period began on March 4, 2024, and the study was completed on August 31, 2024. The subjects were randomly assigned to two groups with 30 subjects in each group. The subject inclusion criteria require subjects to be 18 years of age or older. The exclusion criteria

are as follows: individuals who do not consent to participate; those diagnosed by a physician with skin diseases, cirrhosis, or chronic renal insufficiency; individuals with known allergies to cosmetics, medications, or foods; pregnant or breastfeeding women; individuals taking medication for chronic illnesses; those who, within 12 weeks prior to the test, have undergone laser facial treatment, chemical peels, or prolonged sun exposure (exceeding 3 hours in direct sunlight); those who, within 12 weeks prior to the test, have used medication on their scalp, undergone hair transplants, or received other scalp treatments; individuals who, within 12 weeks prior to the test, have received hair extensions or nail beauty treatments; students instructed by the test administrator; individuals who do not consent to the publication of their experimental results or photos; and vegetarians. During the experiment, subjects should maintain their usual diet, lifestyle, and cosmetic usage habits as they did prior to the study. Activities such as massages, skincare treatments at beauty salons, and medical procedures are prohibited. Throughout the testing period, subjects should minimize exposure to strong outdoor sunlight, such as during travel or vacation. If outdoor activities are necessary, proper sun protection measures should be taken, including wearing a hat, using an umbrella, wearing sun-protective clothing, and applying sunscreen. While consuming the product, subjects may experience gastrointestinal discomfort, such as abdominal pain or diarrhea. If any adverse reactions occur, subjects should immediately stop consumption and seek nearby medical assistance.

Supplement ingredients

The PCT composition included collagen tripeptide (MAXI collagen), *H. sabdariffa* extract, *R. rubrum* extract, blueberry extract, spinach extract, B complex, vitamin C, citric acid, steviol glycosides, apple flavor liquid, and water. The placebo composition included citric acid, steviol glycosides, apple flavor liquid, and water. The placebo and PCT had the same appearance, shape, and packaging in terms of size and style. The form and flavor of the placebo closely resembled those of the PCT group. The daily dosage and frequency of administration were the same for both groups. Neither the subjects nor the operators knew the contents of the products administered to the different groups; only the project leader and the manufacturer were aware of the differences

between the placebo and the PCT. Subjects were instructed to take one bottle (50g/bottle/day) every morning on an empty stomach for a total of 12 weeks.

Skin assessment

Skin elasticity was measured using a Cutometer MPA580 (CK, Germany), based on the principle of negative pressure absorption. This device evaluates skin elasticity by assessing the resistance created by skin being drawn into the probe and measures its recovery. The testing site was the upper cheek area. Skin moisture content was assessed using a Corneometer CM825 (CK, Germany), utilizing electrical capacitance to quantify the skin's moisture level and hydration capacity at the upper cheek. Additionally, overall skin wrinkles were analyzed using the VISIA™ Complexion Analysis (U.S.A.) system, which captured images with a high-resolution 36-megapixel camera and standardized lighting. This allowed for the comparison of skin textures, quantifying the distribution and depth of skin lines. The entire face was analyzed, focusing on deeper and lighter wrinkles. Lastly, collagen density in the skin was measured with the DermaLab® Series SkinLab Combo (Cortex, Denmark), which used high-frequency ultrasound to perform a dermal collagen scan, determining collagen density at the upper cheek area.

Hair assessment

Hair shaft diameter was measured using a digital external micrometer (Mitutoyo, C/N293-100, Japan), where higher values indicated thicker and stronger hair shafts, and three hair strands were sampled for this measurement as well. Hair shedding was measured by collecting and weighing hair shed in the drainage trap during hair washes at weeks 5 and 11. Subjects were instructed to check the drainage for any other objects before each wash, then collect and dry the shed hair for analysis.

Nail assessment

Nail color improvement was measured using a Chroma Meter MM500 (Minolta, Japan) based on the CIE (Commission Internationale de l'Eclairage) system to determine the L^* value, with a scale ranging from 0 to 100, where higher values indicate a brighter appearance. The measurement was taken from the

thumbnail. The external appearance of the nails was observed and recorded photographically to track any changes. Nail growth was evaluated by marking the edge of the nail at the cuticle of the middle finger to determine the baseline growth rate.

Statistical analysis

The data analysis was conducted using Student’s t-test to compare pre- and post-treatment results within each group. Any major parameter that showed significant differences with $p < 0.05$ indicated a statistically significant improvement.

Results

PCT improved skin condition

Table 1 showed the average age and gender distribution of the subjects. The majority of subjects were female, with 96.7% (58 out of 60) being female and only 3.3% (2 out of 60) being male. The average age in the PCT group was 48.9 ± 12.7 years, while in the placebo group, the average age was slightly higher at 52.1 ± 10.4 years. After continuously consuming the PCT for 12 weeks, the skin collagen density was significantly increased by 10.6% compared to the baseline, and was significantly increased by 7.8% compared to the placebo group (Figure 1A). The skin wrinkles were significantly decreased by 27.9% compared to the baseline, and was significantly decreased by 31.9% compared to the placebo group (Figure 1B). The skin elasticity was significantly increased by 4.3% compared to the baseline, and was significantly increased by 5.3% compared to the placebo group (Figure 1C). The skin hydration was significantly increased by 9.4% compared to the baseline, and was significantly increased by 10.1% compared to the placebo group (Figure 1D). The skin questionnaire results showed significant improvements in the PCT group by week 12. Dry and flaky skin severity significantly decreased from 100.0% to 69.0%, rough skin significantly decreased from 100.0% to 76.5%, and sallow complexion significantly decreased from 100.0% to 80.2%, indicating positive effects on hydration, smoothness, and skin tone (Figure 1E).

Characteristics	PCT	Placebo
	(n = 30)	(n = 30)
Female	29 (96.7%)	29 (96.7%)
Male	1 (3.3%)	1 (3.3%)
Average age (years)	48.9 ± 12.7	52.1 ± 10.4

Table 1: Subject’s age and gender information.

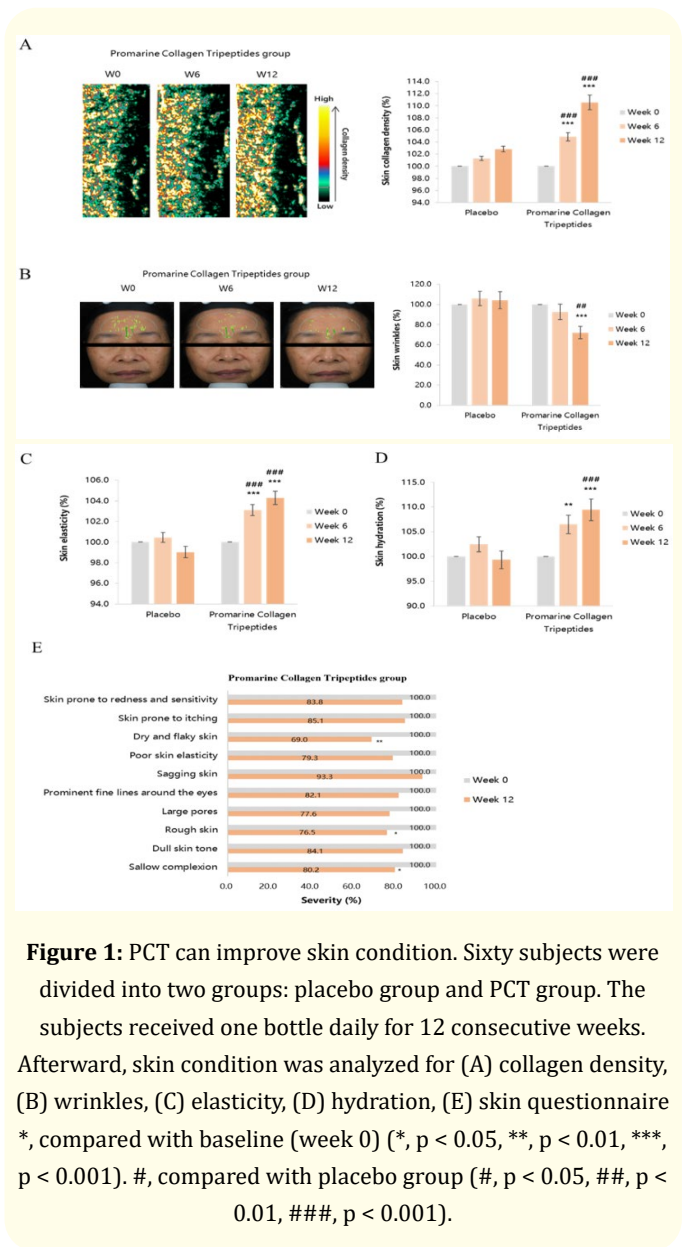


Figure 1: PCT can improve skin condition. Sixty subjects were divided into two groups: placebo group and PCT group. The subjects received one bottle daily for 12 consecutive weeks. Afterward, skin condition was analyzed for (A) collagen density, (B) wrinkles, (C) elasticity, (D) hydration, (E) skin questionnaire *, compared with baseline (week 0) (*, $p < 0.05$, **, $p < 0.01$, ***, $p < 0.001$). #, compared with placebo group (#, $p < 0.05$, ##, $p < 0.01$, ###, $p < 0.001$).

PCT improved hair condition

After continuously consuming the PCT for 12 weeks, the hair diameter was significantly increased by 14.4% compared to the baseline, and was significantly increased by 15.2% compared to the placebo group (Figure 2A). The amount of hair loss after hair washing was significantly decreased by 25.4% compared to the baseline (Figure 2B). The hair questionnaire results showed that after 12 weeks of using the PCT, the subjects’ scalp and hair conditions slightly improved (Figure 2C).

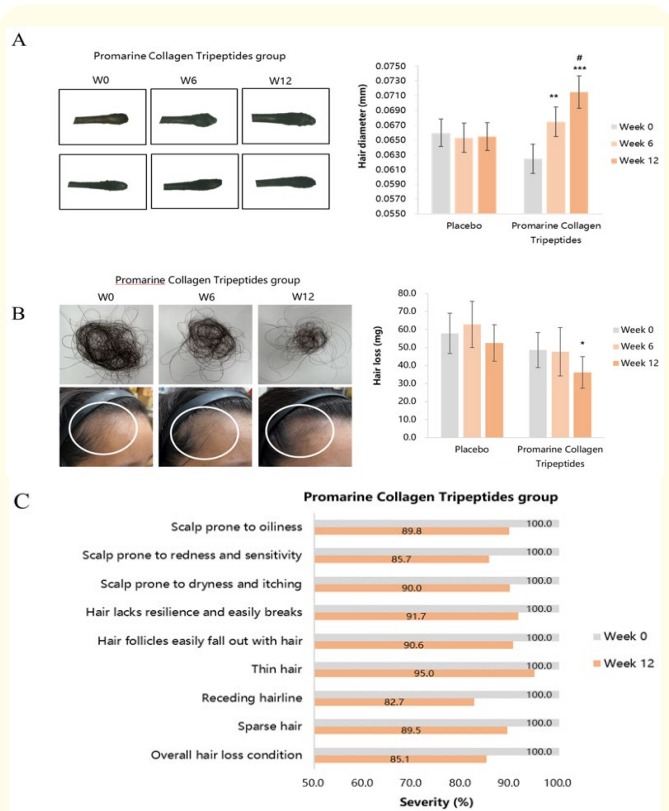


Figure 2: PCT can improve hair condition. Sixty subjects were divided into two groups: placebo group and PCT group. The subjects received one bottle daily for 12 consecutive weeks. Afterward, hair condition was analyzed for (A) diameter, (B) amount of hair loss, (C) hair questionnaire. *, compared with baseline (week 0) (*, $p < 0.05$, **, $p < 0.01$, ***, $p < 0.001$). #, compared with placebo group (#, $p < 0.05$, ##, $p < 0.01$, ###, $p < 0.001$).

PCT improved nail condition

After continuously consuming the PCT for 12 weeks, the nail brightness was significantly increased by 2.0% compared to the baseline (Figure 3A). In terms of nail growth, the PCT group showed an increase of 0.77 cm compared to baseline, and also exhibited an increase of 0.15 cm compared to the placebo group (Figures 3B and 3C). The nail questionnaire results showed that the PCT group experienced a reduction in nail issues such as slower nail growth, dull nail surface, roughness, softness, and cracking (Figure 3D). This indicates that the product has a significant positive effect on nail health.

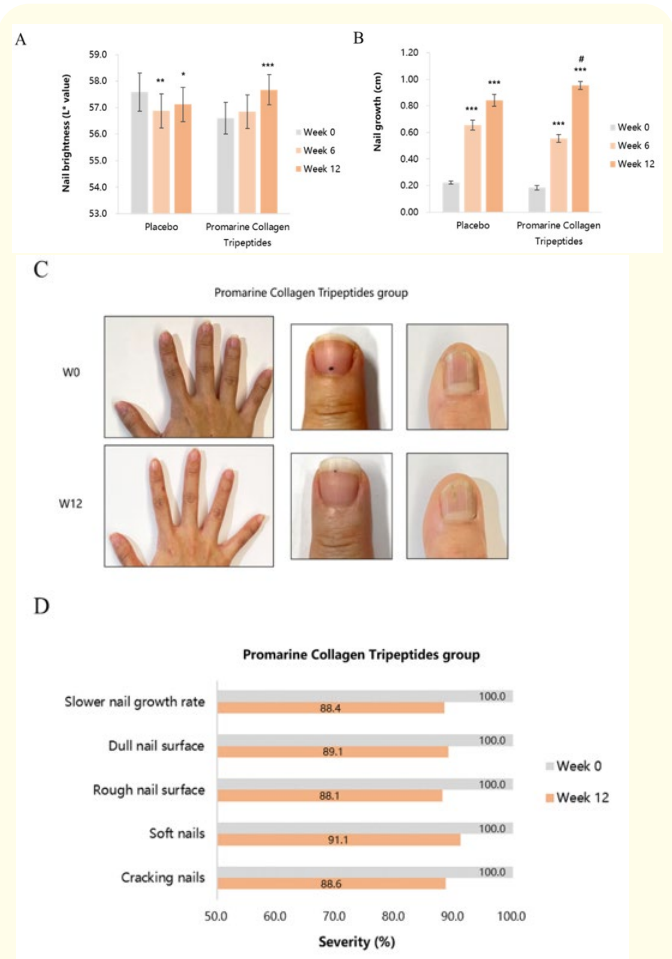


Figure 3: PCT can improve nail condition. Sixty subjects were divided into two groups: placebo group and PCT group. The subjects received one bottle daily for 12 consecutive weeks. Afterward, nail condition was analyzed for (A) brightness, (B) nail growth, (C) nail photos, (D) nail questionnaire. *, compared with baseline (week 0) (*, $p < 0.05$, **, $p < 0.01$, ***, $p < 0.001$). #, compared with placebo group (#, $p < 0.05$, ##, $p < 0.01$, ###, $p < 0.001$).

Discussion

This trial demonstrated that PCT significantly improved skin, hair, and nail health after 12 weeks of continuous consumption. Subjects experienced notable increases in skin collagen density, elasticity, and hydration, along with reductions in wrinkles and dryness. Hair diameter increased, and hair loss after washing was

reduced, while scalp and hair conditions improved. Additionally, nail brightness and growth improved, with reductions in common nail issues such as roughness, softness, and cracking.

Collagen tripeptides, due to their low molecular weight structure, demonstrate advantages in absorption and bioavailability [17]. The small molecular size of tripeptides facilitates penetration through the intestinal wall, allowing them to quickly enter the bloodstream and rapidly reach peak plasma concentrations, indicating highly efficient absorption [18]. Studies have shown that collagen tripeptides are absorbed at a significantly faster rate within the body compared to larger collagen molecules [19]. Once in the bloodstream, tripeptides directly stimulate fibroblasts in the skin, promoting new collagen production, thereby enhancing skin elasticity, firmness, and moisture retention [20]. For hair, the amino acids in collagen tripeptides support keratin synthesis, increasing hair thickness and shine, improving hair resilience, and reducing damage [21]. In terms of antioxidant effects, collagen tripeptides can neutralize free radicals, reducing oxidative stress damage to skin and hair follicles, further slowing down the aging process [22]. Additionally, collagen tripeptides provide essential nutrients for nail growth, enhancing nail brightness and strength and reducing brittleness [23]. The polyphenols and organic acids in *H. sabdariffa*, such as anthocyanins, have demonstrated high bioavailability and can be effectively absorbed through the intestines, allowing them to exert antioxidant effects within tissues and enhance overall health [24]. Additionally, the polyphenolic compounds in *H. sabdariffa*, especially anthocyanins, have shown potential to stimulate collagen synthesis [25]. Research suggests that these compounds can promote fibroblast proliferation in the skin, thereby enhancing collagen production. In terms of antioxidant properties, *H. sabdariffa* extract has potent antioxidant activity; its polyphenolic components neutralize free radicals, reducing cellular damage caused by oxidative stress, which helps to slow aging and maintain the health of skin and hair follicles [26]. Regarding hair follicle growth and hair shine, the polyphenols and vitamins in *H. sabdariffa* promote blood circulation and supply essential nutrients to the hair follicles [27]. Studies indicate that *H. sabdariffa* has beneficial effects on scalp and hair health, enhancing hair shine and resilience. For nail health, the antioxidants and nutrients in *H. sabdariffa* support keratin synthesis, aiding in nail growth and structural strength while reducing brittleness [28].

The primary active components in *R. rubrum*, such as vitamin C and anthocyanins, have been shown to possess high bioavailability, allowing effective intestinal absorption and potent antioxidant effects [29]. These active compounds remain stable within tissues, contributing to overall health. *R. rubrum* is rich in vitamin C and polyphenols, which play an essential role in promoting collagen synthesis [30]. Vitamin C is a crucial cofactor in collagen production, accelerating collagen synthesis within fibroblasts and enhancing skin structure and elasticity [15]. In terms of antioxidant properties, the anthocyanins and polyphenols in *R. rubrum* exhibit strong antioxidant effects, effectively neutralizing free radicals and reducing oxidative stress-induced cellular damage, which helps maintain skin health [31]. For hair follicle generation and hair shine, the vitamin C and polyphenols in *R. rubrum* promote blood circulation and supply essential nutrients to hair follicles, with studies indicating their beneficial effects on hair luster and strength [12]. In terms of nail health, the antioxidants and nutrients in *R. rubrum* support keratin synthesis, improving nail strength and structure and reducing brittleness [32]. Blueberry, spinach are rich in nutrients such as vitamins A, C, and K, iron, magnesium, and folate. Vitamins A and C in spinach exhibit high bioavailability, allowing effective intestinal absorption and distribution to various tissues, where they exert antioxidant and reparative effects, contributing to overall health enhancement [33]. Vitamin C in spinach is an essential cofactor for collagen synthesis, promoting collagen production within fibroblasts, thereby enhancing skin structure and elasticity [34]. In terms of antioxidant properties, spinach powder is abundant in flavonoids, lutein, and β -carotene, which are potent antioxidants capable of neutralizing free radicals and reducing oxidative stress-induced cellular damage [35]. This action helps protect skin and hair follicle cells, delaying aging processes. The iron and B vitamins in spinach are crucial for promoting blood circulation and maintaining hair follicle health; research has shown that iron and folate support scalp blood supply, enhancing hair luster and strength, and helping to prevent hair loss [36]. For nail health, the iron, vitamin K, and calcium in spinach support keratin synthesis, helping to strengthen nail structure and hardness [37].

The combined action of collagen tripeptides and polyphenols in *H. sabdariffa* extract, such as anthocyanins, along with vitamin C, may promote collagen production. Studies indicate that vitamin

C, as an essential cofactor in collagen synthesis, helps accelerate collagen formation [30]. The antioxidant effects of anthocyanins and vitamin C can prevent collagen degradation, thereby enhancing skin structure [38]. *H. sabdariffa*, *R. rubrum*, and spinach powder all contain potent antioxidant compounds (e.g., polyphenols, anthocyanins, flavonoids, vitamins A and C) that, when acting together, help neutralize free radicals, reduce cellular damage from oxidative stress, and slow down aging [24]. For hair follicle health and hair shine, the iron and B vitamins in spinach powder enhance blood circulation, facilitating nutrient delivery to hair follicles and improving hair quality [33]. This, in combination with collagen tripeptides that support keratin synthesis, strengthens hair structure and enhances shine. Regarding nail health, collagen tripeptides combined with vitamin C, iron, calcium, and antioxidants in spinach powder support keratin synthesis, strengthen nail structure, and improve resilience. The study shows that the synergistic effect of multiple nutrients can improve nail strength and growth rate. Therefore, this combination of ingredients may have synergistic effects in collagen production, antioxidant activity, and improved blood circulation, contributing to enhanced health of skin, hair, and nails.

Conclusion

This clinical trial demonstrated that continuous supplementation with PCT for 12 weeks significantly improved the health of skin, hair, and nails. Subjects showed marked increases in skin collagen density, elasticity, and hydration, along with reductions in wrinkles and dryness. Hair diameter increased, hair loss decreased, and improvements were observed in scalp and hair conditions. Nail brightness and growth rate also improved, with significant reductions in nail roughness and brittleness. Due to its low molecular weight structure and excellent absorption, collagen tripeptides effectively promoted skin, hair, and nail health. PCT could be broadly applied in beauty and health products, particularly those targeting anti-aging, collagen regeneration, and hair health. Combined with ingredients like *H. sabdariffa*, *R. rubrum*, blueberry and spinach, it achieved synergistic antioxidant effects and enhanced blood circulation, contributing to overall skin, hair, and nail health and slowing the aging process.

Bibliography

1. Lai-Cheong J and J McGrath. "Structure and function of skin, hair and nails". *Medicine* 49 (2021): 337-342.
2. Grice EA and JA Segre. "The skin microbiome". *Nature Reviews Microbiology* 9.4 (2011): 244-253.
3. Sano H and R Ogawa. "Clinical evidence for the relationship between nail configuration and mechanical forces". *Plastic and Reconstructive Surgery - Global Open* 2.3 (2014): e115.
4. Khalid M and M Abdollahi. "Environmental distribution of personal care products and their effects on human health". *Iranian Journal of Pharmaceutical Sciences* 20.1 (2021): 216-253.
5. Liang Y, et al. "Skin ageing: A progressive, multi-factorial condition demanding an integrated, multilayer-targeted remedy". *Clinical, Cosmetic and Investigational Dermatology* 16 (2023): 1215-1229.
6. Gavazzoni Dias MF. "Hair cosmetics: An overview". *International Journal of Trichology* 7.1 (2015): 2-15.
7. Reinecke JK and MA Hinshaw. "Nail health in women". *International Journal of Women's Dermatology* 6.2 (2020): 73-79.
8. Radis-Baptista G. "Do synthetic fragrances in personal care and household products impact indoor air quality and pose health risks?" *Journal of Xenobiot* 13.1 (2023): 121-131.
9. Lu S., et al. "Anti-skin aging effects and bioavailability of collagen tripeptide and elastin peptide formulations in young and middle-aged women". *Journal of Dermatologic Science and Cosmetic Technology* 1.2 (2024): 100019.
10. Al-Atif H. "Collagen supplements for aging and wrinkles: A paradigm shift in the fields of dermatology and cosmetics". *Dermatology Practical and Conceptual* 12.1 (2022): e2022018.
11. Amer SA., et al. "Potential effects of anthocyanin-rich roselle (*Hibiscus sabdariffa* L.) extract on the growth, intestinal histomorphology, blood biochemical parameters, and the immune status of broiler chickens". *Antioxidants (Basel)* 11.3 (2022): 544-564.
12. Sun M., et al. "Effects of natural polyphenols on skin and hair health: A review". *Molecules* 27.22 (2022): 7832-7845.

13. Roberts JL and R Moreau. "Functional properties of spinach (*Spinacia oleracea* L.) phytochemicals and bioactives". *Food Function* 7.8 (2016): 3337-3353.
14. Peterson CT, et al. "B vitamins and their role in immune regulation and cancer". *Nutrients* 12.11 (2020): 3380-3404.
15. Pullar JM, et al. "The roles of vitamin C in skin health". *Nutrients* 9.8 (2017): 866-893.
16. Papakonstantinou E, et al. "Hyaluronic acid: A key molecule in skin aging". *Dermatoendocrinology* 4.3 (2012): 253-258.
17. Kim DU, et al. "Oral intake of low-molecular-weight collagen peptide improves hydration, elasticity, and wrinkling in human skin: A randomized, double-blind, placebo-controlled study". *Nutrients* 10.7 (2018): 826-839.
18. Renukuntla J, et al. "Approaches for enhancing oral bioavailability of peptides and proteins". *International Journal of Pharmaceutics* 447.1-2 (2013): 75-93.
19. Park J, et al. "Low-molecular collagen peptide supplementation and body fat mass in adults aged ≥ 50 years: A randomized, double-blind, placebo-controlled trial". *Clinical Nutrition Research* 12.4 (2023): 245-256.
20. Aguirre-Cruz, G., et al. "Collagen hydrolysates for skin protection: Oral administration and topical formulation". *Antioxidants (Basel)* 9.2 (2020): 181-198.
21. Lee JO, et al. "AP collagen peptides (APCPs) promote hair growth by activating the GSK-3 β /beta-catenin pathway and improve hair condition". *Experimental Dermatology* 33.7 (2024): e15137.
22. Papaccio F, et al. "Focus on the contribution of oxidative stress in skin aging". *Antioxidants (Basel)* 11.6 (2022): 1121-1154.
23. Hessel D, et al. "Oral supplementation with specific bioactive collagen peptides improves nail growth and reduces symptoms of brittle nails". *Journal of Cosmetic Dermatology* 16.4 (2017): 520-526.
24. Herranz-Lopez M, et al. "Multi-targeted molecular effects of Hibiscus sabdariffa polyphenols: An opportunity for a global approach to obesity". *Nutrients* 9.8 (2017): 907-933.
25. Riaz G and R Chopra. "A review on phytochemistry and therapeutic uses of Hibiscus sabdariffa L". *Biomed Pharmacotherapy* 102 (2018): 575-586.
26. Wang D, et al. "Potential of Hibiscus sabdariffa L. and Hibiscus acid to reverse skin aging". *Molecules* 27.18 (2022): 6076-6088.
27. Bassino E, et al. "Protective role of nutritional plants containing flavonoids in hair follicle disruption: A review". *International Journal of Molecular Sciences* 21.2 (2020): 523-540.
28. Montalvo-Gonzalez E, et al. "Physiological effects and human health benefits of Hibiscus sabdariffa: A review of clinical trials". *Pharmaceutics (Basel)* 15.4 (2022): 464-497.
29. Goncalves AC, et al. "Employ of anthocyanins in nanocarriers for nano delivery: In vitro and in vivo experimental approaches for chronic diseases". *Pharmaceutics* 14.11 (2022): 2272-2307.
30. Boyera N, et al. "Effect of vitamin C and its derivatives on collagen synthesis and cross-linking by normal human fibroblasts". *International Journal of Cosmetic Science* 20.3 (1998): 151-158.
31. Sahiner M, et al. "Therapeutic and nutraceutical effects of polyphenolics from natural sources". *Molecules* 27.19 (2022): 6225-6253.
32. Piraccini BM, et al. "Clinical and instrumental objective evidence of the efficacy of a new water-based nail-strengthening solution containing Pistacia lentiscus and hyaluronic acid applied for up to 6 months to improve the appearance of weak, brittle nails". *Dermatology Therapy (Heidelb)* 10.1 (2020): 119-131.
33. El-Sayed SM. "Use of spinach powder as functional ingredient in the manufacture of UF-Soft cheese". *Heliyon* 6.1 (2020): e03278.
34. Michalak M, et al. "Bioactive Compounds for Skin Health: A Review". *Nutrients* 13.1 (2021): 203-234.
35. Maury GL, et al. "Antioxidants in plants: A valorization potential emphasizing the need for the conservation of plant biodiversity in Cuba". *Antioxidants (Basel)* 9.11 (2020): 1048-1084.
36. Almohanna HM, et al. "The role of vitamins and minerals in hair loss: A review". *Dermatology Therapy (Heidelb)* 9.1 (2019): 51-70.
37. Scheinfeld N, et al. "Vitamins and minerals: Their role in nail health and disease". *Journal of Drugs Dermatology* 6.8 (2007): 782-787.
38. Michalak M. "Plant-derived antioxidants: Significance in skin health and the ageing process". *International Journal of Molecular Sciences* 23.2 (2022): 585-604.