TOPICAL FORMULATIONS OF RECOMBINANT COLLAGENS

CROSS-REFERENCE

[0001] This application claims the benefit of U.S. Provisional Application No. 62/827,662, filed April 1, 2019, which application is incorporated herein by reference in its entirety.

BACKGROUND

[0002] Collagens and similar proteins are the most abundant proteins in the biosphere. Collagens are structural proteins found in the skin, connective tissue, and bones of animals and other tissues. In humans, the amount of collagen present in the body is approximately one third of the total proteins and accounts for about three fourths of the dry weight of skin.

[0003] The structure of natural collagen can be a triple helix in which three polypeptide strands together form a helical coil. The individual polypeptide strands are composed of repeating triplet amino acid sequences designated as GLY-X-Y. X and Y can be any amino acid and the first amino acid is glycine. The amino acids proline and hydroxyproline are found in high concentrations in collagen. The most common triplet is glycine-proline-hydroxyproline (Gly-Pro-Hyp) accounting for approximately 10.5% of the triplets in collagen.

[0004] Gelatin is a product obtained by partial hydrolysis of certain (e.g., natural) collagen. Typically, gelatin is produced by acid hydrolysis, alkaline hydrolysis, and enzymatic hydrolysis or by exposing collagen to heat in an aqueous solution (e.g., boiling the bones and skins of animal, boiling fish scales, etc.).

[0005] Gelatin is used in many products including cosmetics, foods, pharmaceuticals, medical devices, photographic films, adhesives, binders, and many others. The physical and chemical properties of gelatin are tuned to the particular application. These physical/chemical properties include gel strength, melting point temperature, viscosity, color, turbidity, pH, isoelectric point, and others.

SUMMARY

[0005a] In one aspect, provided herein is a method of providing a cosmetic benefit to skin, the method comprising topically applying a polypeptide to the skin, wherein the polypeptide comprises: (a) an amino acid sequence truncated relative to a full-length human type 21 alpha 1 collagen, wherein the amino acid sequence truncated relative to the full-length human type 21 alpha 1 collagen comprises an amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 16; or (b) an amino acid

sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 5; and wherein the cosmetic benefit to the skin is selected from the group consisting of: increased firmness of the skin, increased elasticity of the skin, increased brightness of the skin, increased hydration of the skin, improved tactile texture of the skin, improved visual texture of the skin, increased collagen content of the skin, increased elastin content of the skin, decreased lines present on the skin, decreased wrinkles present on the skin, decreased redness of the skin and any combination thereof.

[0005b] In another aspect, provided herein is the use of a polypeptide in the manufacture of a medicament for treating erythema; preventing or treating ultraviolet radiation damage to the skin; promotion of repair of damaged skin; protection of skin cells against effects of exposure to urban dust; stimulation of collagen production and/or elastin production in the skin, or any combination thereof, wherein the polypeptide comprises: (a) an amino acid sequence truncated relative to a full-length human type 21 alpha 1 collagen, wherein the amino acid sequence truncated relative to the full-length human type 21 alpha 1 collagen comprises an amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 16; or (b) an amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 5.

[0005c] In another aspect, provided herein is a composition comprising (a) a polypeptide comprising (i) an amino acid sequence truncated relative to a full-length human type 21 alpha 1 collagen, wherein the amino acid sequence truncated relative to the full-length human type 21 alpha 1 collagen comprises an amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 16; or (ii) an amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 5; and (b) one or more additional ingredient selected from the group consisting of: vegetable oil, glycereth-8 esters, coconut alkanes, hydroxyethyl acrylate/sodium acryloyldimethyl taurate copolymer, pentylene glycol, disodium ethylenediaminetetraacetic acid (EDTA), caprylyl glycol, chlorphenesin, and phenoxyethanol.

[0006] In certain examples here are various polypeptides, compositions comprising such polypeptides, and methods of using such polypeptides and/or compositions thereof. In certain examples, such polypeptides comprise non-natural and/or recombinant polypeptides, such as comprising one or more amino acid sequence that is truncated relative to a natural collagen, such as a natural collagen described herein. In certain instances, such polypeptides are described herein as a “truncated collagen”. In specific examples, the polypeptide comprises one or more (e.g., two or more) truncated

CLAIMS

WHAT IS CLAIMED IS:

1. A method of providing a cosmetic benefit to skin, the method comprising topically applying a polypeptide to the skin, wherein the polypeptide comprises:

(a) an amino acid sequence truncated relative to a full-length human type 21 alpha 1 collagen, wherein the amino acid sequence truncated relative to the full-length human type 21 alpha 1 collagen comprises an amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 16; or

(b) an amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 5;

and wherein the cosmetic benefit to the skin is selected from the group consisting of: increased firmness of the skin, increased elasticity of the skin, increased brightness of the skin, increased hydration of the skin, improved tactile texture of the skin, improved visual texture of the skin, increased collagen content of the skin, increased elastin content of the skin, decreased lines present on the skin, decreased wrinkles present on the skin, decreased redness of the skin and any combination thereof.

2. Use of a polypeptide in the manufacture of a medicament for treating erythema; preventing or treating ultraviolet radiation damage to the skin; promotion of repair of damaged skin; protection of skin cells against effects of exposure to urban dust; stimulation of collagen production and/or elastin production in the skin, or any combination thereof, wherein the polypeptide comprises:

(a) an amino acid sequence truncated relative to a full-length human type 21 alpha 1 collagen, wherein the amino acid sequence truncated relative to the full-length human type 21 alpha 1 collagen comprises an amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 16; or

(b) an amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 5.

3. The method of claim 1 or use of claim 2, wherein the amino acid sequence truncated relative to the full-length human type 21 alpha 1 collagen comprises a truncation at the C-

terminal end relative to the full-length human type 21 alpha 1 collagen; a truncation at the N-terminal end relative to the full-length human type 21 alpha 1 collagen; an internal truncation relative to the full-length human type 21 alpha 1 collagen; or a truncation at both the C-terminal end and the N-terminal end relative to the full-length human type 21 alpha 1 collagen.

4. The method of claim 1 or use of claim 2, wherein the amino acid sequence truncated relative to the full-length human type 21 alpha 1 collagen comprises an N-terminal truncation of from 50 to 600 amino acids relative to the human type 21 collagen, and/or a C-terminal truncation of from 50 to 250 amino acids relative to the human type 21 collagen.

5. The method of claim 1 or use of claim 2, wherein the polypeptide consists of the amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 16, or consists of the amino acid sequence of SEQ ID NO: 16.

6. The method of claim 1 or use of claim 2, wherein the polypeptide consists of the amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 5 or consists of the amino acid sequence of SEQ ID NO: 5.

7. The method of any one of claims 1 and 3-6, wherein the firmness of the skin is increased by at least 5%, at least 10%, at least 15%, at least 20%, at least 25%, at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 70%, or at least 75%, as measured by a cutometer.

8. The method of any one of claims 1 and 3-7, wherein the elasticity of the skin is increased by at least 5%, at least 10%, at least 15%, at least 20%, at least 25%, at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 70%, or at least 75%, as measured by a cutometer.

9. The method of any one of claims 1 and 3-8, wherein the hydration of the skin is increased by at least 5%, at least 10%, at least 15%, at least 20%, at least 25%, at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, or at least 75%, as measured by a corneometer.

10. The method of any one of claims 1 and 3-9, wherein the brightness of the skin is increased as determined by an expert clinical grader.

11. The method of any one of claims 1 and 3-10 or the use of any one of claims 2 and 3-6, wherein the collagen content of the skin is increased by at least 5%, at least 6%, at least 7%, at least 8%, at least 9%, at least 10%, at least 11%, at least 12%, at least 13%, at least 14%, or at least 15%, as measured by a SIAscope.

12. The method of any one of claims 1 and 3-11, wherein the tactile texture of the skin is improved as determined by an expert clinical grader.

13. The method of any one of claims 1 and 3-12, wherein the visual texture of the skin is improved as determined by an expert clinical grader.

14. The method of any one of claims 1 and 3-13, wherein the lines present on the skin, and/or the wrinkles present on the skin is decreased as determined by an expert clinical grader.

15. The method of any one of claims 1 and 3-14 or the use of any one of claims 2, 3-6 and 11, wherein the erythema and/or redness present on the skin is decreased by at least 10%, at least 20%, at least 30%, at least 40%, or at least 45%, as determined by an expert clinical grader.

16. The method of any one of claims 1 and 3-15 or the use of any one of claims 2, 3-6, 11 and 15, wherein the polypeptide is to be applied to the skin as a topical composition comprising from 0.001% to 10% w/w of the polypeptide.

17. The method or use of claim 16, wherein the topical composition is a facial cream, a facial lotion, a facial serum, a facial mask, or a facial toner.

18. A composition comprising:

(a) a polypeptide comprising:

(i) an amino acid sequence truncated relative to a full-length human type 21 alpha 1 collagen, wherein the amino acid sequence truncated relative to the full-length human

type 21 alpha 1 collagen comprises an amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 16; or

(ii) an amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 5; and

(b) one or more additional ingredient selected from the group consisting of: vegetable oil, glycereth-8 esters, coconut alkanes, hydroxyethyl acrylate/sodium acryloyldimethyl taurate copolymer, pentylene glycol, disodium ethylenediaminetetraacetic acid (EDTA), caprylyl glycol, chlorphenesin, and phenoxyethanol.

19. The composition of claim 18, wherein the polypeptide consists of the amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 16, or consists of the amino acid sequence of SEQ ID NO: 16.

20. The composition of claim 18, wherein the polypeptide consists of the amino acid sequence having at least 80% sequence identity to the amino acid sequence of SEQ ID NO: 5, or consists of the amino acid sequence of SEQ ID NO: 5.

21. The composition of any one of claims 18-20, wherein the composition is formulated for application to the skin or hair.

22. The composition of any one of claims 18-21, wherein the composition is a personal care product.

23. The composition of claim 22, wherein the personal care product is selected from the group consisting of: a skin cleanser, a soap, a cleansing cream, a cleansing lotion, a facial cleanser, a cleansing milk, a cleansing pad, a facial wash, a facial cream, a body cream, a facial moisturizer, a body moisturizer, a facial serum, a facial mask, a body mask, a facial toner, a facial mist, an eye cream, an eye treatment, an exfoliator formula, a lip balm, a lipstick, a hair shampoo, a hair conditioner, a body shampoo, a hair serum, a scalp serum, a hair mist, a hair spray, an eye shadow, a concealer, a mascara, and a color cosmetic.