SUMMARY

[0005a] In one aspect, there is provided a non-naturally occurring polypeptide comprising the amino acid sequence of SEQ ID NO: 20 with an N-terminal truncation of from 50 to 100 amino acids and a C-terminal truncation of from 50 to 600 amino acids, wherein the non-naturally occurring polypeptide comprises an amino acid sequence having at least 80% sequence identity to SEQ ID NO: 19 or a truncate thereof that is at least 100 amino acids in length.

[0005b] In one aspect, there is provided a composition comprising from 0.001% to 30% w/w of the non-naturally occurring polypeptide as described herein.

[0005c] In one aspect, there is provided a method of providing a cosmetic benefit to the skin of a subject, the method comprising: applying the composition as described herein to the skin of the subject, thereby providing the cosmetic benefit to the skin of the subject.

[0005d] In one aspect, there is provided a polynucleotide comprising a nucleic acid sequence encoding a non-naturally occurring polypeptide as described herein.

[0005e] In one aspect, there is provided a recombinant cell comprising at least one copy of a heterologous nucleic acid sequence encoding the non-naturally occurring polypeptide as described herein.

[0006] In one example, a non-naturally occurring polypeptide is provided consisting of an amino acid sequence having at least 80% sequence identity to an amino acid sequence selected from the group consisting of: SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, and SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and optionally, one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence having at least 85% sequence identity to an amino acid sequence selected from the group consisting of: SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, and SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and optionally, one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence having at least 90% sequence identity to an amino acid sequence selected from the group consisting of: SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, and SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and optionally,

one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence having at least 95% sequence identity to an amino acid sequence selected from the group consisting of: SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, and SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and optionally, one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide of consists of an amino acid sequence having at least 98% sequence identity to an amino acid sequence selected from the group consisting of: SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, and SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and optionally, one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence selected from the

group consisting of: SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, and SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence selected from the group consisting of: SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, and SEQ ID NO: 19; and one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence selected from the group consisting of: SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, and SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids). In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence selected from the group consisting of: SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, and SEQ ID NO: 19. In some cases, the secretion tag is DsbA. In some cases, the non-naturally occurring polypeptide is a recombinant polypeptide.

[0007] In another example, a composition is provided comprising between 0.001% and 30% w/w of a non-naturally occurring polypeptide of any one of the preceding. In some cases, the composition comprises between 0.001% and 1% w/w of the non-naturally occurring polypeptide, between 0.001% and 0.05% w/w of the non-naturally occurring polypeptide, between 0.001% and 0.03% w/w of the non-naturally occurring polypeptide, between 0.001% and 0.02% w/w of the non-naturally occurring polypeptide, between 0.001% and 0.01% w/w of the non-naturally occurring polypeptide, between 0.005% and 0.1% w/w of the non-naturally occurring polypeptide, between 0.005% and 0.03% w/w of the non-naturally occurring polypeptide, between 0.005% and 0.02% w/w of the non-naturally occurring polypeptide, or between 0.005% and 0.01% w/w of the non-naturally occurring polypeptide. In some cases, the composition is capable of stimulating growth of fibroblast cells, stimulating synthesis of tropoelastin, decreasing formation of thymine-thymine (TT) dimer formation, or any combination thereof. In some cases, the composition is formulated for topical application. In some cases, the composition comprises one or more of a topical carrier and a preservative. In some cases, the topical carrier is selected from the group consisting of: water, oil glycereth-8 esters, glycerin, coconut alkanes, hydroxyethyl acrylate/sodium acryloyldimethyl taurate copolymer, pentylene glycol, disodium EDTA, caprylyl glycol, chlorphenesin, phenoxyethanol, liposome, biodegradable microcapsule,

lotion, spray, aerosol, dusting powder, biodegradable polymer, mineral oil, triglyceride oil, silicone oil, glycerin, glycerin monostearate, alcohols, emulsifying agents, liquid petroleum, white petrolatum, propylene glycol, polyoxyethylene, polyoxypropylene, wax, sorbitan monostearate, polysorbate, cetyl ester wax, cetearyl alcohol, 2-octyldodecanol, benzyl alcohol, cyclomethicone, and cyclopentasiloxane. In some cases, the preservative is selected from the group consisting of: tocopherol, diiodomethyl-p-tolylsulfone, 2-Bromo-2-nitropropane-1,3-diol, cis isomer 1-(3-chloroallyl)-3,5,7-triaza-1-azoniaadamantane chloride, glutaraldehyde, 4,4-dimethyl oxazolidine, 7-Ethylbicyclooxazolidine, methyl paraben, sorbic acid, Germaben II, rosemary extract, and EDTA. In some cases, the composition is a cosmetic.

[0008] In another example, a method of treating the skin of a subject is provided, the method comprising administering to the skin of a subject a composition of any one of the preceding, thereby treating the skin of the subject. In some cases, the treating comprises decreasing skin damage, promoting the repair of damaged skin, protecting the skin against UV damage, increasing viability of skin cells, protection of skin cells from the effects of urban dust exposure, or any combination thereof. In some cases, viability of fibroblast cells, keratinocyte cells, or both, present in the skin of the subject is increased. In some cases, synthesis of procollagen by fibroblast cells present in the skin of the subject is increased. In some cases, expression of one or more anti-oxidant gene by keratinocytes present in the skin of the subject is increased. In some cases, the one or more anti-oxidant gene is selected from the group consisting of: SOD2, GPX2, GPX4, GSTK1, GSTZ1, GSTA4, GSTM2, CCS, GPX1, GLRX, PRDX5, PRDX6, and PRDX2. In some cases, expression of one or more pro-apoptotic genes by keratinocytes present in the skin of the subject is decreased. In some cases, the one or more pro-apoptotic gene is selected from the group consisting of: APAF1, BAK1, CASP7, CASP8, FADD, MCL1, and MET. In some cases, production of inflammatory cytokines by a keratinocyte present in the skin of the subject is decreased. In some cases, the inflammatory cytokine is IL-1α. In some cases, viability of keratinocytes present in the skin of the subject is increased.

[0009] In yet another example, a polynucleotide is provided encoding a non-naturally occurring polypeptide according to any one of the preceding. In some cases, the polynucleotide is contained within a vector. In some cases, the polynucleotide comprises a nucleic acid sequence comprising at least 80% sequence identity to a nucleic acid sequence selected from the group consisting of: SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, and SEQ ID NO: 18. In some cases, the polynucleotide comprises a nucleic acid sequence comprising at least 85% sequence identity to a nucleic acid sequence selected from the group consisting of: SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 9,

SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, and SEQ ID NO: 18. In some cases, the polynucleotide comprises a nucleic acid sequence comprising at least 90% sequence identity to a nucleic acid sequence selected from the group consisting of: SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, and SEQ ID NO: 18. In some cases, the polynucleotide comprises a nucleic acid sequence comprising at least 95% sequence identity to a nucleic acid sequence selected from the group consisting of: SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, and SEQ ID NO: 18. In some cases, the polynucleotide comprises a nucleic acid sequence comprising at least 98% sequence identity to a nucleic acid sequence selected from the group consisting of: SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, and SEQ ID NO: 18. In some cases, the polynucleotide comprises a nucleic acid sequence selected from the group consisting of: SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, and SEQ ID NO: 18. In some cases, the polynucleotide further comprises a nucleic acid sequence encoding one or more of a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the nucleic acid sequence is codon-optimized for expression in a host cell.

[0010] In yet another example, a recombinant cell is provided comprising at least one copy of a heterologous nucleic acid sequence encoding a non-naturally occurring polypeptide of any one of the preceding. In some cases, the recombinant cell is a microbial cell. In some cases, the microbial cell is a bacterial cell. In some cases, the bacterial cell is of the species *Escherichia coli*. In some cases, the heterologous nucleic acid sequence has at least 95% sequence identity to a nucleic acid sequence selected from the group consisting of: SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16; and SEQ ID NO: 18. In some cases, the heterologous nucleic acid sequence comprises a nucleic acid sequence selected from the group consisting of: SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16; and SEQ ID NO: 18. In some cases, the heterologous nucleic acid sequence is codon-optimized for expression in a cell. In some cases, the recombinant cell is capable of secreting the non-naturally occurring polypeptide extracellularly.

[0011] In yet another example, a composition is provided comprising a recombinant cell of any one of the preceding, and a culture media comprising a non-naturally occurring polypeptide of any one of the preceding.

[0012] In yet another example, a method of producing a non-naturally occurring polypeptide is provided, the method comprising: a) incubating a recombinant cell of any one of the preceding in a culture media, wherein the recombinant cell secretes the recombinant polypeptide into the culture media; b) collecting the culture media comprising the recombinant polypeptide secreted thereto; and c) purifying the recombinant polypeptide from the culture media.

[0013] In another example, a non-naturally occurring polypeptide is provided consisting of an amino acid sequence having at least 80% sequence identity to an amino acid sequence according to SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and optionally, one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence having at least 85% sequence identity to an amino acid sequence according to SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and optionally, one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence having at least 90% sequence identity to an amino acid sequence according to SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and optionally, one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence having at least 95% sequence identity to an amino acid sequence according to SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and optionally, one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence having at least 98% sequence identity to an amino acid sequence according to SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and optionally, one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence according to SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids); and one or more selected from the group consisting of: a secretion tag, a histidine tag, a fluorescent protein, and a protease cleavage site. In some cases, the non-naturally occurring polypeptide consists of an

amino acid sequence according to SEQ ID NO: 19, or a truncate thereof (e.g., a polypeptide having at least 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, or 150 amino acids). In some cases, the non-naturally occurring polypeptide consists of an amino acid sequence according to SEQ ID NO: 19. In some cases, the secretion tag is DsbA. In some cases, the non-naturally occurring polypeptide is a recombinant polypeptide. In another example, a composition is provided comprising between 0.001% and 30% w/w of the non-naturally occurring polypeptide. In some cases, the composition comprises between 0.001% and 1% w/w of the non-naturally occurring polypeptide, between 0.001% and 0.05% w/w of the non-naturally occurring polypeptide, between 0.001% and 0.03% w/w of the non-naturally occurring polypeptide, between 0.001% and 0.02% w/w of the non-naturally occurring polypeptide, between 0.001% and 0.01% w/w of the non-naturally occurring polypeptide, between 0.005% and 0.1% w/w of the non-naturally occurring polypeptide, between 0.005% and 0.03% w/w of the non-naturally occurring polypeptide, between 0.005% and 0.02% w/w of the non-naturally occurring polypeptide, or between 0.005% and 0.01% w/w of the non-naturally occurring polypeptide. In some cases, the composition is capable of one or more selected from the group consisting of: stimulating growth of fibroblast cells, increasing viability of fibroblast cells or keratinocyte cells, stimulating synthesis of tropoelastin, stimulating synthesis of procollagen, stimulating expression of one or more anti-oxidant gene, reducing expression of one or more pro-apoptotic gene, decreasing production of one or more inflammatory cytokines, and decreasing formation of thymine-thymine (TT) dimer formation. In some cases, the composition is formulated for topical application. In some cases, the composition comprises one or more of a topical carrier and a preservative. In some cases, the topical carrier is selected from the group consisting of: water, oil glycereth-8 esters, glycerin, coconut alkanes, hydroxyethyl acrylate/sodium acryloyldimethyl taurate copolymer, pentylene glycol, disodium EDTA, caprylyl glycol, chlorphenesin, phenoxyethanol, liposome, biodegradable microcapsule, lotion, spray, aerosol, dusting powder, biodegradable polymer, mineral oil, triglyceride oil, silicone oil, glycerin, glycerin monostearate, alcohols, emulsifying agents, liquid petroleum, white petrolatum, propylene glycol, polyoxyethylene, polyoxypropylene, wax, sorbitan monostearate, polysorbate, cetyl ester wax, cetearyl alcohol, 2-octyldodecanol, benzyl alcohol, cyclomethicone, and cyclopentasiloxane. In some cases, the preservative is selected from the group consisting of: tocopherol, diiodomethyl-p-tolylsulfone, 2-Bromo-2-nitropropane-1,3-diol, cis isomer 1-(3-chloroallyl)-3,5,7-triaza-1-azoniaadamantane chloride, glutaraldehyde, 4,4-dimethyl oxazolidine, 7-Ethylbicyclooxazolidine, methyl paraben, sorbic acid, Germaben II, rosemary extract, and EDTA. In some cases, the composition is a cosmetic. In another example, a recombinant cell is

provided comprising at least one copy of a heterologous nucleic acid sequence encoding the non-naturally occurring polypeptide. In some cases, the recombinant cell is of the species *Escherichia coli*.

[0014] In certain examples herein are various polypeptides, compositions comprising such polypeptides, and methods of using such polypeptides and/or compositions thereof. In certain examples, such polypeptides comprise non-naturally occurring and/or recombinant polypeptides, such as comprising one or more amino acid sequence that is truncated relative to a naturally occurring elastin (e.g., a full-length elastin), such as a naturally occurring elastin described herein. In certain instances, such polypeptides are described herein as a "truncated elastin". In specific examples, the polypeptide comprises one or more (e.g., two or more) truncated amino acid sequence of a naturally occurring human elastin.

[0015] In one example, a non-naturally occurring full length or a non-naturally occurring truncated human elastin molecule is provided. In one example, the truncated human elastin molecule is produced by a host cell. The non-naturally occurring elastin may be a human elastin. In an example, the non-naturally occurring elastin may be a full-length or a truncated elastin (e.g., relative to a naturally occurring and/or a full-length elastin).

[0016] In one example, a non-naturally occurring polypeptide (e.g., a truncated human elastin) is provided, wherein the non-naturally occurring polypeptide does not comprise one or more contiguous amino acid sequences, and wherein each of the one or more contiguous amino acid sequences has the sequence of VGVAPG (SEQ ID NO: 1). In another example, the non-naturally occurring polypeptide (e.g., a truncated human elastin) does not comprise two or more of the contiguous amino acid sequence VGVAPG. For example, in an example, the non-naturally occurring polypeptide (e.g., a truncated human elastin) does not comprise the amino acid sequence VGVAPGVGVAPG (SEQ ID NO: 2) or the non-naturally occurring polypeptide (e.g., a truncated human elastin) does not comprise the amino acid sequence VGVAPGVGVAPGVGVAPG (SEQ ID NO: 3). In some cases, a non-naturally occurring polypeptide described herein (e.g., a truncated human elastin) reduces extracellular matrix degradation or does not promote or cause extracellular matrix degradation.

[0017] In various examples, a non-naturally occurring polypeptide disclosed herein (e.g., a truncated human elastin) may have a molecular weight of between 1 kDa and 60 kDa, between 5 kDa and 55 kDa, between 5 kDa and 50 kDa, between 5 kDa and 45 kDa, between 5 kDa and 40 kDa, between 5 kDa and 35 kDa, between 5 kDa and 30 kDa, between 5 kDa and 25 kDa, between 5 kDa and 20 kDa, between 5 kDa and 15 kDa, between 5 kDa and 10 kDa, between 10

kDa and 40 kDa, between 10 kDa and 35 kDa, between 10 kDa and 30 kDa, between 10 kDa and 25 kDa, or between 10 kDa and 20 kDa.

[0018] In yet another example, a non-naturally occurring polypeptide (e.g., a truncated human elastin) is provided, wherein the non-naturally occurring polypeptide is truncated at the C-terminal end relative to a naturally occurring and/or full-length human elastin, the N-terminal end relative to a naturally occurring and/or full-length human elastin, internally truncated relative to a naturally occurring and/or full-length human elastin, or truncated at both the C-terminal end and the N-terminal end relative to a naturally occurring and/or full-length human elastin. In some cases, a non-naturally occurring polypeptide described herein comprises a truncation (e.g., at the N-terminal end, at the C-terminal end, and/or an internal truncation) relative to SEQ ID NO: 20.

[0019] A non-naturally occurring polypeptide described herein (e.g., a truncated human elastin) may be between 10 and 700 amino acids in length, between 10 and 600 amino acids in length, between 10 and 500 amino acids in length, between 10 and 400 amino acids in length, between 10 and 300 amino acids in length, between 10 and 200 amino acids in length, between 10 and 100 amino acids in length, between 10 and 50 amino acids in length, between 50 and 800 amino acids in length, between 50 and 700 amino acids in length, between 50 and 600 amino acids in length, between 50 and 500 amino acids in length, between 50 and 400 amino acids in length, between 50 and 300 amino acids in length, between 50 and 200 amino acids in length, or between 50 and 100 amino acids in length. In another example, a non-naturally occurring polypeptide described herein (e.g., a truncated human elastin) may be a molecule that is shorter by at least 1, 5, 10, 20, 50, 100, or more amino acids than full-length human tropoelastin or a full-length human elastin.

[0020] In specific examples, a non-naturally occurring polypeptide herein comprises an amino acid sequence selected from the group consisting of: SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, SEQ ID NO: 19, and a homolog thereof (e.g., having at least 80%, at least 85%, at least 90%, at least 95%, or at least 98% sequence identity thereto). In more specific examples, a non-naturally occurring polypeptide herein consists of an amino acid sequence selected from the group consisting of: SEQ ID NO: 5, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 10, SEQ ID NO: 13, SEQ ID NO: 15, SEQ ID NO: 17, SEQ ID NO: 19, and a homolog thereof (e.g., having at least 80%, at least 85%, at least 90%, at least 95%, or at least 98% sequence identity thereto).

[0021] In another example, a non-naturally occurring polypeptide described herein further comprises one or more amino acid sequences selected from the group consisting of: a secretion

tag, a histidine tag, a green fluorescent protein tag, and a protease cleavage site. In one example, the secretion tag is DsbA, PelB, OmpA, TolB, MalE, lpp, TorA, Hy1A, DegP, or a hybrid secretion tag that comprises a portion of one secretion tag fused to a portion of a second secretion tag. In a specific example, the secretion tag is DsbA.

[0022] In certain examples, compositions are provided herein. In some examples, such a composition comprises any polypeptides (e.g., truncated and/or non-naturally occurring elastin) described herein. In one example, provided herein are compositions that comprise any suitable amount such as between 0.001% w/w and 30% w/w, of any polypeptide (e.g., truncated and/or non-naturally occurring elastin) provided herein. In some cases, the composition comprises between 0.001% w/w and 1% w/w, between 0.001% w/w and 0.05% w/w, between 0.001% w/w and 0.03% w/w, between 0.001% w/w and 0.02% w/w, between 0.001% w/w and 0.01% w/w, between 0.005% w/w and 0.1% w/w, between 0.005% w/w and 0.03% w/w, between 0.005% w/w and 0.02% w/w, or between 0.005% w/w and 0.01% w/w of any polypeptide (e.g., truncated and/or non-naturally occurring elastin) provided herein.

[0023] In certain examples, a composition provided herein is a topical composition, such as a composition that is formulated and/or suitable for topical administration or use. The topical compositions provided herein may include any polypeptide described herein (e.g., truncated and/or non-naturally occurring elastin, e.g., in any suitable amount) and at least one additional ingredient. In one example, provided herein is a method, such as of providing a benefit (e.g., as described herein) to the skin of a subject, the method comprising topically administering the topical composition to the skin of a subject. In specific examples, the topical compositions may be used in methods for decreasing skin damage, promoting the repair of damaged skin, stimulating production of collagen by skin cells, improving skin health and moisturization, improving the appearance of skin. In certain examples, the topical compositions may be used in methods for increasing, promoting, stimulating, or otherwise increasing elastin production in the skin. In certain examples, the topical compositions may be used in methods for stimulating the growth of fibroblast cells, and/or stimulating synthesis of tropoelastin, and/or decreasing the formation of thymine-thymine (TT) dimer formation in cells. The topical compositions can further comprise at least one additional ingredient comprising a topical carrier or a preservative.

[0024] In an example, the topical compositions comprise one or more topical carriers selected from the group consisting of: water, oil glycereth-8 esters, glycerin, coconut alkanes, hydroxyethyl acrylate/sodium acryloyldimethyl taurate copolymer, pentylene glycol, disodium EDTA, caprylyl glycol, chlorphenesin, phenoxyethanol, liposome, biodegradable microcapsule, lotion, spray, aerosol, dusting powder, biodegradable polymer, mineral oil, triglyceride oil,

silicone oil, glycerin, glycerin monostearate, alcohols, emulsifying agents, liquid petroleum, white petrolatum, propylene glycol, polyoxyethylene, polyoxypropylene, wax, sorbitan monostearate, polysorbate, cetyl ester wax, cetearyl alcohol, 2-octyldodecanol, benzyl alcohol, cyclomethicone, and cyclopentasiloxane.

[0025] In another example, the topical compositions comprise one or more preservatives selected from the group consisting of: tocopherol, diiodomethyl-p-tolylsulfone, 2-Bromo-2-nitropropane-1,3-diol, cis isomer 1-(3-chloroallyl)-3,5,7-triaza-1-azoniaadamantane chloride, glutaraldehyde, 4,4-dimethyl oxazolidine, 7-Ethylbicyclooxazolidine, methyl paraben, sorbic acid, Germaben II, rosemary extract, and EDTA.

[0026] In some examples, methods for decreasing skin damage and/or promoting the repair of damaged skin are provided. The method may comprise applying a composition (e.g., a topical composition) comprising any non-naturally occurring polypeptide described herein (e.g., a truncated and/or non-naturally occurring human elastin) to the skin of a subject. In some cases, the method increases the viability of the fibroblast cells or keratinocytes of the skin of the subject. In some cases, the application of the composition (e.g., a topical composition) increases the synthesis of tropoelastin by the fibroblast cells of the subject's skin. In some cases, the topical application of the composition (e.g., a topical composition) protects skin or keratinocytes against UV damage. In some cases, application of a composition (e.g., a topical composition) to the skin of a subject decreases thymine-thymine (TT) dimer formation.

[0027] In another example, a non-naturally occurring polypeptide (e.g., a truncated human elastin) is a recombinant polypeptide (e.g., produced by a host cell, e.g., by recombinant expression). The recombinant polypeptide may be a recombinant human elastin (e.g., a non-naturally occurring and/or truncated human elastin). In an example, the recombinant elastin is a full-length or truncated elastin. In one example, the recombinant polypeptide (e.g., a truncated human elastin) is truncated at the C-terminal end relative to a natural and/or full-length elastin, the N-terminal end relative to a natural and/or full-length elastin, internally truncated relative to a natural and/or full-length elastin, or truncated at both the C-terminal end and the N-terminal end of a natural and/or full-length elastin.

[0028] In some examples, a recombinant polypeptide (e.g., a non-naturally occurring and/or truncated human elastin) described herein may be between 10 and 700 amino acids in length, between 10 and 600 amino acids in length, between 10 and 500 amino acids in length, between 10 and 400 amino acids in length, between 10 and 300 amino acids in length, between 10 and 200 amino acids in length, between 10 and 100 amino acids in length, between 10 and 50 amino acids in length, between 50 and 800 amino acids in length, between 50 and 700 amino acids in

length, between 50 and 600 amino acids in length, between 50 and 500 amino acids in length, between 50 and 400 amino acids in length, between 50 and 300 amino acids in length, between 50 and 200 amino acids in length, or between 50 and 100 amino acids in length.

[0029] In another example, a recombinant polypeptide described herein (e.g., a non-naturally occurring and/or truncated human elastin) may have a molecular weight of between 1 kDa and 60 kDa, between 5 kDa and 55 kDa, between 5 kDa and 50 kDa, between 5 kDa and 45 kDa, between 5 kDa and 40 kDa, between 5 kDa and 35 kDa, between 5 kDa and 30 kDa, between 5 kDa and 25 kDa, between 5 kDa and 20 kDa, between 5 kDa and 15 kDa, between 5 kDa and 10 kDa, between 10 kDa and 40 kDa, between 10 kDa and 35 kDa, between 10 kDa and 30 kDa, between 10 kDa and 25 kDa, or between 10 kDa and 20 kDa.

[0030] In various examples, a recombinant host cell may comprise at least one copy of a heterologous nucleic acid sequence encoding a recombinant polypeptide described herein (e.g., a non-naturally occurring and/or truncated elastin). In some cases, a nucleic acid sequence encoding a recombinant polypeptide (e.g., a non-naturally occurring and/or truncated human elastin) may comprise a nucleic acid sequence selected from the group consisting of: SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, SEQ ID NO: 18, and a homolog thereof (e.g., having at least 80%, at least 85%, at least 90%, at least 95%, or at least 98% sequence identity thereto). In another example, a nucleic acid sequence encoding a recombinant polypeptide (e.g., a non-naturally occurring and/or truncated human elastin) may consist of a nucleic acid sequence selected from the group consisting of: SEQ ID NO: 4, SEQ ID NO: 6, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 16, SEQ ID NO: 18, and a homolog thereof (e.g., having at least 80%, at least 85%, at least 90%, at least 95%, or at least 98% sequence identity thereto).

[0031] In another example, a recombinant polypeptide described herein may include one or more of the group consisting of: a secretion tag, a histidine tag, a fluorescent protein tag, and a protease cleavage site. In some cases, the secretion tag is DsbA, PelB, OmpA, TolB, MalE, lpp, TorA, Hy1A, DegP, or a hybrid secretion tag that comprises a portion of one secretion tag fused to a portion of a second secretion tag. In a specific example, the secretion tag is DsbA.

[0032] The polynucleotides encoding the polypeptides described herein (e.g., non-naturally occurring and/or truncated elastin), and vectors comprising the polynucleotides, can be used to transform host cells which may then express the recombinant polypeptides (e.g., non-naturally occurring and/or truncated human elastin).

[0033] In another example, host cells that have been engineered (e.g., recombinant host cells) to express the disclosed recombinant polypeptides (e.g., non-naturally occurring and/or truncated

elastin) are provided. Host cells can be any host cell including bacterial cells, yeast cells, fungal cells, insect cells, mammalian cells, plant cells, and any other cells used to express exogenous polynucleotides. In a specific example, the host cell is *Escherichia coli*. In specific examples, the host cell is capable of secreting the recombinant polypeptide extracellularly (e.g., into a culture medium).

[0034] In another example, a method of producing a polypeptide described herein is provided (e.g., a recombinant polypeptide such as, e.g., a non-naturally occurring elastin and/or a truncated elastin). The method comprises the steps of inoculating a culture medium with a recombinant host cell comprising at least one copy of a heterologous nucleic acid sequence encoding a polypeptide described herein (e.g., a non-naturally occurring and/or truncated elastin), cultivating the host cell (e.g., culturing the host cell in the culture medium) whereby the host cell secretes the recombinant polypeptide extracellularly (e.g., into the culture medium), and isolating the recombinant polypeptide (e.g., from the host cell and/or the culture medium).

[0035] In another example, provided herein are methods for decreasing the production of inflammatory cytokines in a skin cell. In one example, the skin cell is a keratinocyte or a fibroblast. The method comprises applying a polypeptide described herein (e.g., a non-naturally occurring and/or truncated elastin, e.g., in a topical formulation) to a skin cell or to skin of a subject. In some instances, the production of inflammatory cytokines (e.g., TNFα, IL-1α, IL-1β, IL-3, IL-6, IL-7, IL-8, IL-10, IL-18, and IL-1RA) are decreased.

[0036] In another example, a method for decreasing skin damage or promoting the repair of damaged skin is provided. The method may comprise applying a composition (e.g., a composition formulated for topical application) comprising a non-naturally occurring polypeptide described herein (e.g., a truncated elastin) to the skin of a subject. In some cases, the method increases the viability of the fibroblast cells or keratinocytes of the skin of the subject. In some cases, the application of the composition increases the synthesis of tropoelastin by the fibroblast cells or keratinocytes of the subject's skin. In some cases, the topical application of the composition protects skin, fibroblasts, or keratinocytes against UV damage. In some cases, thymine-thymine (TT) dimer formation is decreased by topical application of the compositions provided herein.

[0037] In another example, provided herein are methods of protecting skin cells against the effect of exposure to urban dust. In some cases, the method comprises applying a non-naturally occurring polypeptide described herein (e.g., a truncated elastin) to a skin cell or to skin of a subject. In some cases, the exposure of the skin cell or the skin of the subject to the non-

naturally occurring polypeptide increases the viability of the skin cell after exposure to urban dust. The skin cell may be a keratinocyte or a fibroblast.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] The novel features of the invention are set forth with particularity in the appended claims. A better understanding of the features and advantages of the present invention will be obtained by reference to the following detailed description that sets forth illustrative embodiments, in which the principles of the invention are utilized, and the accompanying drawings of which:

[0039] FIG. 1 shows a photograph of a protein gel. Lane 1 is the size marker. Lanes 2 and 3 show that the 23 kDa truncated human elastin of Example 10 runs on the gel at the expected molecular weight. Lane 4 is blank with no proteins loaded. Lanes 5 and 6 show that the 13 kDa truncated human elastin of Example 11 runs on the gel at the expected molecular weight.

[0040] FIG. 2 depicts an SDS-PAGE protein gel showing high purity and homogeneity of a recombinantly produced polypeptide (comprising a non-naturally occurring truncated elastin amino acid sequence) described herein.

[0041] FIG. 3 depicts secretion levels of pro-collagen type I C-peptide after treatment of fibroblasts with an exemplary polypeptide (comprising a non-naturally occurring truncated elastin amino acid sequence) provided herein.

[0042] FIG. 4 depicts the anti-oxidative capacity of an exemplary polypeptide (comprising a non-naturally occurring truncated elastin amino acid sequence) provided herein.

[0043] FIG. 5 depicts expression levels of mRNA of various anti-oxidant genes after treatment of keratinocytes with an exemplary polypeptide (comprising a non-naturally occurring truncated elastin amino acid sequence) provided herein.

[0044] FIG. 6 depicts expression levels of mRNA of various pro-apoptotic genes after treatment of keratinocytes with an exemplary polypeptide (comprising a non-naturally occurring truncated elastin amino acid sequence) provided herein.

DESCRIPTION

[0045] In the following description, certain specific details are set forth in order to provide a thorough understanding of various embodiments of the disclosure. However, one skilled in the art will understand that the disclosure may be practiced without these details.

[0046] As used herein the term "about" generally refers to ± 10 %.

[0047] The term "consisting of" means "including and limited to". In general, a disclosure of "comprising" includes a disclosure of "consisting of".

CLAIMS

WHAT IS CLAIMED IS:

1. A non-naturally occurring polypeptide comprising the amino acid sequence of SEQ ID NO: 20 with an N-terminal truncation of from 50 to 100 amino acids and a C-terminal truncation of from 50 to 600 amino acids, wherein the non-naturally occurring polypeptide comprises an amino acid sequence having at least 80% sequence identity to SEQ ID NO: 19 or a truncate thereof that is at least 100 amino acids in length.

2. The non-naturally occurring polypeptide of claim 1, wherein the non-naturally occurring polypeptide comprises an amino acid sequence having at least 85% sequence identity to SEQ ID NO: 19 or a truncate thereof that is at least 100 amino acids in length.

3. The non-naturally occurring polypeptide of claim 1 or 2, wherein the non-naturally occurring polypeptide comprises an amino acid sequence having at least 90% sequence identity to SEQ ID NO: 19 or a truncate thereof that is at least 100 amino acids in length.

4. The non-naturally occurring polypeptide of any one of claims 1-3, wherein the non-naturally occurring polypeptide comprises an amino acid sequence having at least 95% sequence identity to SEQ ID NO: 19 or a truncate thereof that is at least 100 amino acids in length.

5. The non-naturally occurring polypeptide of any one of claims 1-4, wherein the non-naturally occurring polypeptide comprises SEQ ID NO: 19 or a truncate thereof that is at least 100 amino acids in length.

6. The non-naturally occurring polypeptide of claim 1, wherein the non-naturally occurring polypeptide consists of an amino acid sequence having at least 80% sequence identity to SEQ ID NO: 19 or a truncate thereof that is at least 100 amino acids in length.

7. The non-naturally occurring polypeptide of claim 1, wherein the non-naturally occurring polypeptide consists of SEQ ID NO: 19 or a truncate thereof that is at least 100 amino acids in length.

8. The non-naturally occurring polypeptide of claim 1, wherein the non-naturally occurring polypeptide consists of an amino acid sequence having at least 80% sequence identity to SEQ ID NO: 19.

9. The non-naturally occurring polypeptide of claim 1, wherein the non-naturally occurring polypeptide consists of SEQ ID NO: 19.

10. A composition comprising from 0.001% to 30% w/w of the non-naturally occurring polypeptide of any one of claims 1-9.

11. The composition of claim 10, wherein the composition exhibits one or more properties selected from the group consisting of: stimulates growth of fibroblast cells, increases viability of fibroblast cells or keratinocyte cells, stimulates synthesis of tropoelastin, stimulates synthesis of procollagen, stimulates expression of one or more anti-oxidant gene, reduces expression of one or more pro-apoptotic gene, decreases production of one or more inflammatory cytokines, decreases formation of thymine-thymine (TT) dimer, and any combination thereof.

12. The composition of claim 10 or 11, wherein the composition is formulated for topical application.

13. The composition of claim 12, wherein the composition comprises a topical carrier, a preservative, or both.

14. The composition of claim 13, wherein the topical carrier is selected from the group consisting of: water, oil glycereth-8 esters, glycerin, coconut alkanes, hydroxyethyl acrylate/sodium acryloyldimethyl taurate copolymer, pentylene glycol, disodium ethylenediaminetetraacetic acid (EDTA), caprylyl glycol, chlorphenesin, phenoxyethanol, liposome, biodegradable microcapsule, lotion, spray, aerosol, dusting powder, biodegradable polymer, mineral oil, triglyceride oil, silicone oil, glycerin, glycerin monostearate, alcohols, emulsifying agents, liquid petroleum, white petrolatum, propylene glycol, polyoxyethylene, polyoxypropylene, wax, sorbitan monostearate, polysorbate, cetyl ester wax, cetearyl alcohol, 2-octyldodecanol, benzyl alcohol, cyclomethicone, cyclopentasiloxane, and any combination thereof.

15. The composition of claim 13 or 14, wherein the preservative is selected from the group consisting of: tocopherol, diiodomethyl-p-tolylsulfone, 2-bromo-2-nitropropane-1,3-diol, cis isomer 1-(3-chloroallyl)-3,5,7-triaza-1-azoniaadamantane chloride, glutaraldehyde, 4,4- dimethyl oxazolidine, 7-ethylbicyclooxazolidine, methyl paraben, sorbic acid, rosemary extract, EDTA, and any combination thereof.

16. The composition of any one of claims 10-15, wherein the composition is a cosmetic.

17. The composition of any one of claims 10-16, wherein the composition is formulated for a personal care product for application to skin.

18. The composition of claim 17, wherein the personal care product is selected from the group consisting of: a mask, a skin cleaner, 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 moisturizer, a facial serum, a facial mask, a body mask, a facial toner, a facial mist, an eye cream, an eye treatment, and an exfoliator formula.

19. The composition of any one of claims 10-16, wherein the composition is formulated for a personal care product for application to hair.

20. The composition of claim 19, wherein the personal care product is selected from the group consisting of: a hair shampoo, a hair conditioner, a hair serum, a scalp serum, a hair mist, and a hair spray.

21. The composition of any one of claims 10-20, wherein the composition comprises from 0.001% to 5% w/w of the non-naturally occurring polypeptide.

22. A method of providing a cosmetic benefit to the skin of a subject, the method comprising: applying the composition of any one of claims 10-18 or 21 to the skin of the subject, thereby providing the cosmetic benefit to the skin of the subject.

23. The method of claim 22, wherein the cosmetic benefit is an improvement in appearance of the skin of the subject, protection of the skin of the subject, or both.

24. The method of claim 23, wherein the improvement in appearance of the skin of the subject is selected from the group consisting of: an increase in firmness of the skin, an increase in elasticity of the skin, an increase in hydration of the skin, an increase in tactile texture of the skin, an increase in visual texture of the skin, and any combination thereof.

25. The method of claim 23 or 24, wherein the protection of the skin of the subject is selected from the group consisting of: a decrease in skin damage, a promotion of repair of damaged skin, protection of the skin against ultraviolet (UV) damage, an increase in viability of skin cells, protection of skin cells from effects of urban dust exposure, and any combination thereof.

26. A polynucleotide comprising a nucleic acid sequence encoding a non-naturally occurring polypeptide of any one of claims 1-9.

27. The polynucleotide of claim 26, wherein the polynucleotide is contained within a vector.

28. The polynucleotide of claim 26 or 27, wherein the polynucleotide further comprises a nucleic acid sequence encoding one or more of a secretion tag, a histidine tag, and a protease cleavage site.

29. The polynucleotide of any one of claims 26-28, wherein the nucleic acid sequence encoding the non-naturally occurring polypeptide is codon-optimized for expression in a host cell.

30. A recombinant cell comprising at least one copy of a heterologous nucleic acid sequence encoding the non-naturally occurring polypeptide of any one of claims 1-9.

31. The recombinant cell of claim 30, wherein the recombinant cell is a microbial cell.

32. The recombinant cell of claim 31, wherein the microbial cell is a bacterial cell.