Key published and unpublished reports, central to the LIVER FUNCTION -1

No	Authors/Year	Keyword	Materials / Methods	Human/Animal model	Biomarker
1	Idilman et al, 2020	genome-wide association studies (GWAS), nonalcoholic fatty liver disease, PNPLA3, steatohepatitis	European(Turkish)	NAFLD, Health	1. Baseline characteristics(ALT, AST, GGT etc) 2. Histological Assessments-Liver biopsy 3. PCR-DNA sequencing, 4. Statistical analysis
2	Pirola et al, 2015	Liver, Nonalcoholic Steatohepatitis	American	NAFLD, Health	1. serum miRNA profiling, 2. Independent validation of selected miRNA 3. Evaluation of liver expression of candidate miRNAs 4. Inflammation marker leucocyte count and CRP, sICAM-1, PAI-1, soluble CD40 ligand, CK-18
3	Yamada et al, 2013	Circulating microRNA, Cross-sectional study, Epidemiology, General people, Liver steatosis, NAFLD	Japanese	NAFLD, Health	1. Blood biochemistry 2. miRNA (miR-21, miR-34a, miR-122, miR-145 and miR-451
4	Yip et al, 2017	NAFLD, Epidemiological study, AUROC, machine learning	Chinese	NAFLD, Health	1. Baseline characteristics(ALT, AST, NA, K, creatinine, uric acid etc) 2. Statistical analysis
5	Drescher et al, 2019	algorithms; biomarkers; fibrosis; grading; imaging; nonalcoholic steatohepatitis; scores	-	NAFLD, NASH, fibrosis	Blood biomarker panels to identify inflammatory liver disease.
6	Kotronen et al, 2009	1H-MRS, AROC, BP, BMI, fasting plasma, fasting serum, hepatitis B virus, hepatitis C virus, NAFLD, PNPLA3, ROC, SNP	European	NAFLD, Health	1. Baseline characteristics(ALT, AST, blood counts, creatinine, Hepatitis B virus, hepatitis C virus serology, transferrin saturation etc) 2. Genotyping, 3. Diagnosis of the Metabolic Syndrome, 4. Statistical analysis
7	Lee et al, 2010	Body mass index, Fatty liver, Hepatic steatosis index, Screening	Korean	NAFLD, Health	1. Baseline characteristics(ALT, AST, BMI, SBP, DBP, TG, GGT etc) 2. Statistical analysis
8	Jeong et al, 2020	NAFLD; insulin resistance; metabolic risk factors; non-invasive diagnosis	Korean	NAFLD, Health	1. Baseline characteristics(BMI, SBP, DBP, TG, HDL, WC, AST, ALT etc) 2. Statistical analysis
9	Bedogni et al, 2006	FL, NAFLD, obesity, GGT, BMI	European	FL, Health	1. Baseline characteristics(ALT, AST, BMI, GGT etc), 2. Statistical analysis
10	Calori et al, 2011	Insulin resistance, FL, BMI, CVD	European	FL, Health	1. Baseline characteristics(TG, BMI, WC, GGT, HDL, insulin etc) 2. Statistical analysis

Key published and unpublished reports, central to the LIVER FUNCTION - 2

11	Kim et al, 2022	ALD, AST, ALT, GGT1, HNF1A, alcohol, PNPLA3, SNP	Korean	alcohol intake (non, light, high)	1. Baseline characteristics(ALT,AST, total bilirubin, blood urea nitrogen, serum creatinine, white blood cell counts etc) 2. PCR-DNA sequencing 3. Statistical analysis
12	Cermelli et al, 2011	blood, Case-Control Studies, Fatty Liver, Hepatitis C, MicroRNAs, Non-alcoholic Fatty Liver Disease	micro RNA miR-122, miR-34a, miR-16 and miR-21	cell - Huh7.5 cell / HCV virus human- chronic hepatitis C, NAFLD, Health	1. cell miR-122, miR-34a, miR-16 level 2. serum miR-122, miR-34a, miR-16 level
13	Pirola et al, 2013	DNA methylation, MT-ND6, NAFLD, epigenetics, mitochondria	MT-ND6 methylation	NAFLD, Health	1. MT-ND6 methylation, 2. Liver MT-ND6 mRNA expression 3. DNA (cytosine-5) methyltransferase 1
14	Hajri et al, 2021	DNA methylation, epigenetic, high-fat diet, non-alcoholic fatty liver disease (NAFLD)	C57BL6 mouse	C57BL6 mouse / with HFD, fat provided 60% energy, mainly as saturated fat (palm oil) or LFD diet provided 10% calories from fat	1. Triglycerides, cholesterol, free fatty acids, 2. TNF-α and interleukin-6 (IL-6) 3. expression of ppary, cd36, and 피의 4. Hepatocyte fatty acid uptake 5. Cell Viability, 6. DNA Methyltransferase Activity
15	Soto et al, 2024	MASLD; NAFLD; organoids; pathophysiology	-	MASLD	1. Risk Factors for MASLD, 2. Genetic Pathways Related to MASLD 3. The Future with Organoids, 4. Therapy
16	Thing et al, 2024	Acetate; Butyrate; Circulating SCFA; Cirrhosis; Metabolome; Microbiome; Non-alcoholic fatty liver disease; Non-alcoholic steatohepatitis; Propionate; Targeted metabolomics	European	MASLD, Health	1. gas chromatography-tandem mass spectrometry (GC-MS/MS) 2. linear regression
17	Yu et al, 2019	Advanced fibrosis, Glycated hemoglobin A1c, Non-alcoholic fatty liver disease, Obesity	Chinese	NAFLD, Health	HbA1c
18	Xie et al, 2022	HbA1c, NAFLD, NHANES, Steatosis, Transient elastography	American	non-diabetic NAFLD, Health	1. Baseline characteristics(HbA1c, ALT, AST, GGT, TG etc) 2. Multivariate regression analysis between HbA1c and the prevalence of NAFLD
19	Wei et al, 2020	cohort study, hyperuricemia, non-alcoholic fatty liver disease, risk factor, serum uric acid	Chinese	non history of chronic liver disease NAFLD, Health	1. Ultrasonography, 2. Baseline characteristics(ALT, AST, TG, HbA1c, uric acid etc) 3. Cox Regression Analysis of serum uric acid Levels for Incidence NAFLD
20	Dai et al, 2016	Body mass index, Gender, Homocysteine, Interaction, Non-alcoholic fatty liver disease	Chinese	NAFLD, Health	1. Baseline characteristics(ALT, TBIL, PLT, TG, creatinine, homocysteine etc) 2. Statistical analysis

Key published and unpublished reports, central to the SKIN AGING – 1

No	Authors/Year	Keyword	Materials / Methods	Human/Animal model	Biomarker
1	Zhang et al., 2024	Mulberry fruit extract, AGEs, Oxidative stress, Anti-glycation, Anti-skin aging	Mulberry fruit	[Senescence model] HaCaT cells / By fructose, MGO-BSA, KM mice / By D-galactose	1. Cell viability, 2. MDA activity, SOD activity 3. Cell apoptosis, 4. Moisture content, 히알루론산, Hydroxyproline(HYP) Content, AGEs, 5. Serum GSH-px, SOD, MDA
2	Lee et al., 2022	brown seaweeds; sargassum; skin aging; cosmeceutica	Sargassum spp	[Photoaging model] Male HR-1 strain hairless mice	1. Average length and depth(of wrinkle decreasing) 2. Epidermal thickness(inhibit increasing) 3. collagen bundle formation
3	Yoon et al., 2022	Cirsium japonicum flower extract; anti-glycation; skin aging; extracellular matrix; skin, elasticity; skin wrinkle	Cirsium japonicum flower extract	[Senescence: Glycation model] Human fibroblast cell / By BSA, glucose Female subjects	1. glucose glycation system(AGEs, CML, Carbonylated protein contents), 2. The breaking activity on crosslinks of collagen–AGEs 3. MMP-1 expression, 4. collagen lattices 5. Skin wrinkles, mean, max depth blggest wrinkle(inhibit increasing), total wrinkle area, total wrinkle volume, skin elasticity
4	Brown et al., 2023	Anti-aging; Bakuchiol; Photoaging; Retinal; Retinaldehyde; Retinoid; Skin aging; Vigna aconitifolia	Vigna aconitifolia, Bakuchiol, potent retinoid retinal	[Photoaging model] (3D) full-thickness in vitro skin model (FT skin)-normal human epidermal keratinocytes and normal human dermal fibroblasts / By UVB irradiation	1. mRNA expression of keratinocyte differentiation (i.e., CALML5, CASP14, KRT14, TP63), 2. mRNA expression of epidermal barrier function (i.e., CDSN, CLDN1, FLG, GRHL3, TGM1, DSG1) 3. mRNA expression of MMP9, 4. mRNA expression of Hydration (AQP3), 5. mRNA expression of immune, inflammation 6. In vitro skin irritation potentials, 7. Pro-collagen 1, total Collagen level
5	Nutho et al., 2023	lotus plant; skin-aging enzyme inhibition; molecular docking; molecular dynamics simulation	Nelumbo nucifera Gaertn.	Molecular Docking	1. Molecular Docking(collagenase, elastase, tyrosinase) 2. Enzyme inhibition(collagenase, elastase, tyrosinase)
6	Lee et al., 2020	caviar extract; DHA; adiponectin; adipocyte differentiation; skin aging; MMP	Caviar Extract, docosahexaenoic acid (DHA)	[Photoaging model] 3T3-L1 cell / By UVB irradiation	1. adipocyte differentiation 2. mRNA expression of PPAR-gamma, SREBP-1 alpha, C/EBP-alpha 3. mRNA expression of Adiponectin, MMP-1
7	Zheng et al., 2023	black tea extract, skin aging, anti-aging, biochemical index, tissue structure	black tea extract	[Senescence model] male KM mice / By D-galactose	1. Contents of HA, MDA, 2. SOD, CAT, GSH-Px activity 3. Total skin collagen content, 4. HE staining of aged skin tissue (increasing), 5. Type 1, 3 collagen (histology), 6. Moisture, HA content
8	Shin et al., 2015	AGE; fibrillin-1; glycation; human skin explants; Akebia quinata fruit extract	Akebia quinata fruit extract	[Senescence: Glycation model] Human fibroblast cell / By glycated BSA Human Skin Explants / by Methylglyoxal (MG)	1. AGEs, N-CML, 2. Intracellular ROS levels 3. Activity of SA-β-Gal, 4. Antiglycation Activity 5. fibrillin-1 under the dermal-epidermal junction

Key published and unpublished reports, central to the SKIN AGING – 2

9	Shin et al., 2019	Rosa gallica, Skin aging, Flavonoid Anti oxidative effect	Rosa gallica petal extracts	[Photoaging model] B16F10 melanoma cells, Human dermal fibroblast / By UV irradiation	1. mushroom tyrosinase activity 2. melanin production 3. protein expression of Tyrosinase
10	Wang et al., 2019	Skin aging, Cherry blossom extract Antioxidant, Anti-apoptosis, HaCaT cells	Cherry blossom extract	[Photoaging model] HaCaT cells / By UVB irradiation	1. Intracellular ROS levels 2. Activities of SOD, GSH-Px, content of MDA 3. Amount of CPD and 8-OHdG 4. Apoptotic cells 5. Protein, mRNA expression of Bcl-2, Bax, Cytochrome-c, Caspase-3
11	Kang et al., 2018	Antioxidant activity, Marigold methanol extract, MMP-1 mRNA, MMP-2 activity, Skin anti-aging effects, Type I procollagen synthesis	Marigold methanol extract	[Photoaging model] Human dermal fibroblasts / By UVA irradiation	1. Mushroom tyrosinase activity 2. Color difference meter (a value) 3. Melanin production 4. Protein expression of TYR, MMP-1
12	Jo et al., 2020	Vaccinium uliginosum; skin aging; UVB; winkles; mitogen-activated protein kinase (MAPK)	Vaccinium uliginosum extract	[Photoaging model] Hairless mice (SKH-1, 4-week-old male) / By UVB irradiation	1. Skin water holding capacity, TEWL, erythema value, 2. Inhibit increasing epidermal thickness 3. fects of an anthocyanin-enriched extract from Vaccinium uliginosum on 4. Total wrinkle area, number of wrinkles, mean wrinkle length, wrinkle depth, mean wrinkle depth (inhibit increasing) 5. Inhibit increasing epidermal thickness Collagen degradation (histological) 6. mRNA expression of MMP-2, MMP-3, MMP-9, TIMP1, TIMP2, COL1a1, HYAL, SOD1, CAT, GPx 7. Protein expression of MAPK pathway 8. IL-6, IL-12, TNF-alpha
13	Bacqueville et al., 2020	anti-aging therapy, clinical trial, inflammaging, senescence, skin model	combination containing bakuchiol (BK) and vanilla tahitensis extract (VTE) (serum form)	[Photoaging model] Human dermal fibroblasts / By UVA irradiation Ex vivo human skin / By UVA irradiation	1. Cellular Morphology, 2. IL-8, p16, 3. Dermal density(GAGs) 4. Efficacy Outcomes (in human) 5. Illustrative analysis of improvement of ptosis volume (in human), 6. Results of skin firmness 7. Full-face macrophotographs of radiance evaluation (in human)
14	Choi et al., 2017	Ulmus macrocarpa Hance extracts; human dermal fibroblasts; hairless mice; antioxidant; anti-aging	Ulmus macrocarpa Hance extracts	[Oxidative stress model] HDFs / by H_2O_2 [Photoaging model] Hairless mice	1. ROS generation, 2. SA-β-gal positive cells 3. Protein expression of SOD, CAT, GPx, GR, MAPK pathway 4. Inhibit increasing wrinkle length, number, depth, thickness

Key published and unpublished reports, central to the SKIN AGING – 3

15	Mao et al., 2021	Rosemary extract; Human skin fibroblasts; UVA photoaging; ROS; p53 Protein	Rosmarinus officinalis extracts	[Photoaging model] Human dermal fibroblasts / By UVA irradiation	1. Proliferation activity 2. SA-β-gal positive cells 3. Morphological change 4. ROS, 5. Protein expression of p53, MMP-1, MMP-3
16	Puglia et al., 2013	skin, red orange, oral supplementation, anti-aging, solar lentigo	Red orange extracts	[Photoaging model] Subjects (skin types II ~ IV) / By UV irradiation	1. Erythema index 2. Mean values of solar spots, spotless skin sites
17	Yang et al., 2024	Corydalis heterocarpa; cellular senescence; anti-aging; autophagy; LRSAM1	Corydalis heterocarpa extracts	[Senescence model] HDFs / By replicative senescence (young, old)	1. SA-β-gal positive cells, 2. Protein expression of p53, p21, caveolin1, 3. The cell cylce distribution, 4. Autophagy, protein expression of LC3B, p62, 5. Lysomal activation, 6. Protein expression of LRSAM1, AMPK, mTOR, ULK1
18	Upatcha et al., 2023	Nanoencapsulation; cordy ceps extract; antioxidation;autophagy; skin regeneration	Cordyceps extract	[Oxidative stress model] HDFs / by H2O2	1. mRNA expression of Collagen and Elastin synthesis 2. mRNA expression of Antioxidant 3. ROS generation, 4. mRNA expression of Antophagy 5. Efficiency of wound healing
19	Chao et al., 2023	Poria cocos; aging; lanostane triterpenoids; Lipucan®; collagen; hyaluronic acid	P. cocos lanostane triterpenoids extract	[Senescence model] SD rats (10 weeks old) / By D-galactose	1. Skin papillary ridge, epidermis thickness, width (inhibit decreasing) 2. Protein expression of Collagen 1 3. Hyaluronic acid level
20	Lyu et al., 2022	Chenopodium formosanum; Djulis; ultraviolet radiation; advanced glycation end products; glycation stress; reactive oxygen species	Chenopodium formosanum	[Photoaging model] HDFs / by UVB irradiation	1. Antioxidant Activity, 2. ROS generation 3. Protein expression of Nrf2, Keap1, HO-1 4. Nuclear translocation of Nrf2 5. Protein expression of MMPs, TIMP, MAPK, pro-collagen 1 6. Protein expression of TGF-β, Smad3, RAGE 7. Collagen contents
21	Klinngam et al., 2022	Polymethoxyflavone, Kaempferia parviflora, Skin aging, Senescence, Ex vivo	Kaempferia parviflora	[Senescence model] HDFs / By replicative senescence (young, old) Aged ex vivo skin tissues (old subjects)	1. SA-β-gal positive cells, activity, 2. Gene expression of cellular senescence-related genes (CDKN1A, TP53, SIRT1..) 3. ROS level, 4. Protein expression of IL-6, STC-1, MMP1, Tropocollagen, 6. Staining of collagen type I, fibrillin-1, hyaluronic acid, Lamin B1, Lamin 5, 7. Epidermal thickness(inhibit decreasing, dermal-epidermal stability 8. SASP factors (GDF-15, IL-6, IL-8, MMP-1)
22	Shecori et al., 2024	hyperpigmentation; grapevine leaf extract; UV radiation; tyrosinase inhibition; sun protection factor (SPF); polyphenols; total phenolic content (TPC); skincare	grapevine leaf extract	no model	1. Pytochemical contents 2. SPF factors 3. PCA analysis 4. Tyrosinase Inhibitory Effect

Key published and unpublished reports, central to the SKIN AGING – 4

23	Kanlayavattanaku &Lourith, 2018	cosmeceuticals, hyperpigmentation, kojic acid, natural products, skin-whitening, topical agents	Plants and antioxidants	[Review article] - Photoaging: melatinocyte(B16F10 cells)	1. TYR, TRP-1, TRP-2, MC1R, MITF, EPK, a-MSH 2. Melanin contents, antimelanogenesis
24	Shariful Azam et al., 2018	cAMP, ERK, Hyperpigmentation, MITF, Sargaquinoic acid, Tyrosinase	Sargassum serratifolium	[Photoaging model] B16F10 cells	1. Melanin content, TYR activity 2. Protein expression of TYR, TYR1, TYR2, CREB, MITF, 3. Protein expression of cAMP, PKA 4. Molecular docking model (cAMP, PKA) 5. Protein expression of MAPK
25	Fukunaga et al., 2018	ceramide, food extract, melanogenesis, tyrosinase, tyrosinase-related protein-1 (TRP1), yeast	ceramides(Yeast, rice, maize)	[Photoaging model] B16F10 cells	1. Melanin content, TYR activity 2. Protein expression of TRP1
26	Kim et al., 2015	: Gaillardia aristata, Melanogenesis, Melanin, Tyrosinase, Skin-lightening effect	Gaillardia aristata	[Photoaging model] B16F10 cells	1. Melanin content, TYR activity 2. Protein expression of TYR activity, TYR, TRP-1, DCT, MITF 3. mRNA expression of TYR, TRP-1, DCT, MITF, 4. melanogenesis activity
27	Chan et al., 2018	Dendrobium tosaense; polyphenol; antioxidation; mushroom tyrosinase; B16F10; melanogenesis	Dendrobium tosaense extracts	[Photoaging model] B16F10 cells	1. Antioxidant activty 2. Mushroom tyrosinase inhibition activity, melanin content
28	Portillo-Esnaola et al., 2021	cyclobutane pyrimidine dimers; dark cyclobutene pyrimidine dimers; ultraviolet radiation;Polypodium leucotomos; photoprotection; melanocytes; skin cancer	Polypodium leucotomos	[Photoaging model] B16F10 cells / By UVA irradiation	1. CPD formation, positive cells 2. Nitric oxide, Superoxide, Peroxynitrite formation
29	Moreau et al., 2023	ROS scavenging; plant small RNA technology (PSRTM); aconitase; mitochondrial function	black tea extract	[Photoaging model] Keratinocytes, fibroblasts (From normal human skin sample) / By UVA, UVB irradiation	1. Aconitase activity, 2. Basal respiration, ATP synthesis, respiration rate, 3. Mitochondrial ROS 4. Relative quantification of CPDs 5. Relative quantification of MLH1 6. mRNA expression of MMP1, 7. Staining of procollagen 1, fibrilin-1
30	Makino et al., 2017	Antioxidant activity, Aesculus hippocastanum, cyclobutane pyrimidine dimers, DNA repair, horse chestnut seed	Aesculus hippocastanum extracts	[Photoaging model] NHDFs / By UVB irradiation	1. CPDs level 2. Antioxidant activity 3. Cell nuclei stained by 4´,6-diamidino-2-phenylindole
31	Vernhes et al., 2012	Plants, UV radiation, fibroblast, DNA repai	Phyllanthus orbicularis Kunth	[Photoaging model] XP4PA (DNA repair) / By UVB irradiation	1. Transmittance against the UV wavelength interval 2. Cell survial 3. Apotosis level 4. Improved DNA damage (CPD) removal

Key published and unpublished reports, central to the SKIN AGING – 5

32	Bolfa et al., 2013	Romanian propolis; Ultraviolet radiation; Inflammation; Apoptosis; Genotoxic lesions	Romanian propolis	[Photoaging model] Swiss mice (8 weeks old) / By UVB, UVA irradiation	1. MDA, 8-oxo-dG, GSH, NO levels and activation of GPx 2. IL-6, IL-12 levels, 3. Epidermal thickness (inhibit increasing), cell layers, Neutrophil infiltration–dermis 4. Sun burn cells, 5. Epidermal active caspase-3 6. TUNEL-positive cells 7. CPD formatin
33	Yang et al., 2013	skin fibroblasts; senescence; growth; cigarette smoke extract; senescence-associated β-galactosidase.	cigarette smoke extract	[Senescence model] HDFs / By cigarette smoke extracts	1. Fibroblast growth, proliferation, growth kinetics 2. SA β-gal activity, 3. Morphological changes 4. microvilli shedding, nucleolus degeneration, mitochondrial deformity 5. ROS production, SOD and GSH-Px activities
34	Bellu et al., 2022	stem cells; nanofibers; skin aging; cell senescence; 4D dynamic model; precision medicine; natural extracts; biophysics; cellular mechanisms	Myrtus communis	[Photoaging model] Human skin stem cells, Human skin fibroblast 1 / By UVB irradiation	1. Activity of SA-β-Gal 2. mRNA expression of p16, p19, Bmi1, TERT (senescence) 3. mRNA expression of Oct-4, Sox2, Nanog, HAS 4. Morphological changes
35	Kim et al., 2011	Centella asiatica – dermal fibroblasts – gene expression –hydrogen peroxide – senescence	Centella asiatica	[Senescence model] HDFs / By H2O2	1. SA β-gal activity 2. Protein expression of p53, p21, pRb, Rb 3. Expression profile of differentially expressed mRNAs 4. mRNA expression of FoxM1, E2F2,MCM2, GDF15, BHLHB2 (senescence), 5. DNA synthesis in UVA in H2O2-induced
36	Huang et al., 2011	cellular senescence; human placental extract; oxidative stress; dermal fibroblasts	human placental extract	[Senescence model] HDFs / By H2O2	1. Cumulative population doubling level, SAβ-gal activity, 2. mRNA expression of p16 3. ROS levels, 4. Gene expression of 'extracellular matrix organization', 'antioxidant' 5. Protein expression of anti-NRF2
37	Wo et al., 2022	Isatis tinctoria L.; senomorphics; replicative senescence; senescence-associated secretory phenotype (SASP); anti-aging; mTOR pathway	Isatis tinctoria L	[Senescence model] HDFs / By replicative senescence (young, old)	1. SA β-gal activity, 2. ROS generation 3. Protein expression of p53, p21, p16, 4. SASP expression(ILs, MMP-1), 5. Protein expression of SIRT1-mTOR-MAPK-NF-κB Signaling, 6. Staining of p65
38	Ortiz-Espín et al., 2017	Deschampsia antarctica, human fibroblasts, cellular senescence	Deschampsia antarctica extracts	[Senescence model] HDFs / By replicative senescence (young, pre, old), H2O2	1. Cell proliferation and viability , 2. mRNA expression of PCNA 3. SA β-gal activity 4. Protein expression of Sirt1, LmnA/C, Trx2
39	Gu et al., 2022	bamboo leaf flavonoids; nanoliposome; biopolymer conjugation; in vitro release; skin permeability; anti-senescence activity	bamboo leaf flavonoids	[Senescence model] C57BL/6J mice HaCaT cells / By AAPH	1. In vitro skin penetration of naked 2. Prolifration and inhibition of proliferation 3. SAHF formation, positive cells 4. Protein expression of p16, p21, K9M-H3

Key published and unpublished reports, central to the SKIN AGING – 6

40	Woo et al., 2021	Cellular senescence, SASP, cell cycle arrest, HDFs, Silybum marianum flower	Silybum marianum flower	[Senescence model] HDFs / By replicative senescence (young, old)	1. Morphology change, 2. Staining of γ-H2AX 3. mRNA expression of p16, p21, p53 4. SA-β-gal activity, 5. caspase-3/PARP pathway 6. senescent cells and cell proliferation 7. MMP-1, IL-6, Type-1 procollagen expression
41	Lee et al., 2022	Selaginella rossii; matrix metalloproteinases; amentoflavone; skin aging; anti-wrinkle	Selaginella rossii	[Senescence model] CCD-986sk fibroblasts, HaCaT / By UVB, AAPH	1. MMP-1, 2, 3, 9 expression 2. type I C-peptide (PIP), mRNA expression of COL1A1, COL1A2 3. ROS accumulation 4. Protein expression of MAPK
42	Hsu et al., 2020	Ajuga taiwanensis, fbroblasts, senescence	Ajuga taiwanensis	[Senescence model] HDFs / By replicative senescence (young, old)	1. Cell aging analysis (Cell cycle phase, SA-β-gal activity, ki-67, morphology), 2. Protein expression of p53 3. cell colony formation 4. Cell proliferation rate, ROS generation
43	Zhou et al., 2014	Tetrahydroxystilbene glucoside, dermal layer thickness, collagen fiber, insulin/IGF-1 signal pathway, Ca2+	Tetrahydroxystilbene glucoside	[Senescence model] Male Kunming mice aged 18 months / Old aged	1. Thickness of dermal layer (inhibit decreasing) 2. Collagen fiber content, 3. Elastic fiber content 4. Levels of insulin, IGF-1, and the receptors of insulin and IGF-1 5. Levels of Ca2+, P, in serum
44	He et al., 2024	(-)-α-Bisabolol, Cellular senescence, D-Galactose, SASP, Skin aging	(-)-α-bisabolo	[Senescence model] Human skin fibroblasts / by D-Galactose. BALB/c mice	1. Aging phenotype(SA-β-gal, SASP, MMPs, p16, p21) 2. TEWL, skin barrier index, 3. Mean epidermal area, Dermal thickness (inhibit increasing), brown area of dermis 4. SOD inhibition rate, contents of MDA and HYP 5. mRNA expression of elastin, collagen Ⅲ, MMP-2, and MMP-3
45	Hu et al., 2016	Laminaria polysaccharide, dermal thickness, MAPK, Aging	Laminaria polysaccharide	[Senescence model] female Kunming / By young, old age	1. Dermal thickness(inhibit decreasing) 2. Collagen, HYP content, type I collagen mRNA levels 3. Protein expression of MMP-1, TIMP-1, MAPK pathway 4. Antioxidant enzyme expression
46	Park et al., 2017	Intrinsic skin aging, Kaempferia parviflora Wall ex. Baker, cellular senescence, mitochondrial dysfunction	Kaempferia parviflora Wall ex. Baker extracts	[Senescence model] Human dermal fibroblasts (Hs68) / By H2O2 female hairless mice / By middle, young age	1. cell growth promotion and SA-β activity. 2. mRNA and protein expression of p53, p21, p16, pRb, E2F1, SIRT1, 3. Protein expression of PI3K/AKT pathway, mTOR and FoxO3a, 4. mRNA and protein expression of IL-6, IL-8, NF-kb, COX2 5. ATP, ROS level, 6. mRNA expression of PGC-1α, ERRα, NRF-1, and Tfam, 7. mtDNA expression 8. Wrinkle area, number, total length, wrinkle depth (inhibit increasing), 9. Skinfold thickness(inhibit decreasing) 10. Collagen content, 11. Gross elasticity

Key published and unpublished reports, central to the SKIN AGING – 7

47	Song et al., 2012	hairless mice; Mangifera indica; skin aging; ultraviolet B	Mangifera indica L	[Photoaging model] HR-1 hairless mice / By UVB irradiation	1. Features of the dorsal skin, 2. Mean length of skin wrinkle, 3. Epidermal thickness(inhibit increasing), 4. Staining of collagen fiber
48	Chen et al., 2017	Anti-skin-aging, EGCG, d-galactose, Oxidative stress, EGFR pathway	Epigallocatechin gallate(EGCG)	[Senescence model] male, Kunming mice / by D-Galactose.	1. Epidermal, dermal thickness(inhibit decreasing) 2. Staining of collagenin 3. H2O2, MDA levels, 4. Activites of SOD, CAT, GSH, GSH-px 5. Protein expression of p21, EGFR, JAK-2, STAT-5, Bax, BCl-2
49	Lee et al., 2023	food; inner beauty; panax; skin aging; ultraviolet rays	ginseng sprouts	[Photoaging model] hairless mice / By UVB irradiation	1. Epidermal thickness(inhibit increasing), dermal collagen density 2. Skin barrier(TEWL, Moisture, Roughness) 3. Skin elasticity, content of procollagen type 1 C-peptide(PIP)
50	Goto et al., 2012	Proteoglycans, glycosaminoglycan (GAG), UVB, skin aging, salmon nasal cartilage	salmon nasal cartilage extracts	[Photoaging model] hairless mice / By UVB irradiation	1. Erythema values, TEWL 2. Hydration levels 3. Skin sections of dorsal skin 4. Epidermal and dermal thickness(inhibit increasing) 5. TNF-alpha, IL-1β, IL-6
51	Gu et al., 2023	skin aging, photoaging, ultraviolet B, Schizonepeta tenuifolia, mitogen-activated protein kinase (MAPK), advanced glycation end products (AGEs)	Schizonepeta tenuifolia	[Photoaging model] HR-1 hairless mice / By UVB irradiation	1. Body weight and liver toxicity serum biomarkers 2. Wrinkle area, total wrinkle length, wrinkle depth(inhibit increasing), 3. Skin, epidermal thickness(inhibit increasing) 4. Protein expression of MMP1, MMP3, MMP9, pro-COL1A1, TIMP1, 5. Protein expression of HAS1,2,3, Filaggrin, collagen-1, HYAL-1,2, 6. Skin moisture, hyaluronan 7. Protein expression of MAPKs and nuclear factor-kapp 8, AGEs accumulations, Protein expression of AGE, RAGE
52	Carpenter et al., 2023	glucosinolate, isothiocyanate, nitrile, UVB, photoprotective, chemopreventive, 3D skin equivalent, MMPs (Min. 5–Max. 8)	(Limnanthes alba) glucosinolate derivatives	[Photoaging model] keratinocytes (HPEKs) and 3D human skin / By UVB irradiation	1. Staning of human skin equivalent sections 2. Epidermal sunburned cell counts, epidermal thickness(inhibit increasing), 3. Epidermal of CPDs + cells 4. Protein expression of p-H2A.X, epidermal PCNA+ cells 5. Protein expression of MMP-1, MMP-3
53	Calvo-Castro et al., 2013	Blackberry juice, NHEK cell, Apoptosis, Caspases 9	Ultrafiltered blackberry juice	[Photoaging model] NHEK cell / By UVB irradiation	1. Apoptosis level(PARP, caspases 3, 6, 8 and 9) 2. Protein expression of 8-oxodG, p53, p-p53 (Ser15), 3. CPD
54	Mary Britto et al., 2017	UV radiation, Apigenin, DNA damage, Apoptosis, Cyclobutane pyrimidine dimer	Apigenin	[Photoaging model] HDFa cell / By UVB irradiation	1. Sun protection factor 1. CPDs formaton, 3. mRNA expression of XPC, TFIIH, ERCC1 4. Protein expression of XPC, XPB, XPG, XPF, Bcl-2, Bax, Caspase-3 3. Apoptosis rate

Key published and unpublished reports, central to the SKIN AGING – 8

55	Shin et al., 2013	veratric acid, photoprotection, anti-inflammation	veratric acid (VA, 3,4-dimethoxybenzoic acid)	[Photoaging model] HaCaT Cell / By UVB irradiation	1. DNA dammage, CPD positive cell number 2. p-p53, γ-H2AX positive cell 3. Percentage of cells in the subG1, G1, S, G2/M phase 4. Apotosis rate, 5. PARP, capase-3, 8, 9, Bcl-xL 6. Protein expression of COX-2, PGE2, IL-6 7. Induction percentage of eythema
56	Katiyar et al., 2010	Green tea polyphenols, contact hypersensitivity, nucleotide excision repair	Green tea polyphenols	[Photoaging model] Human fibroblasts / By XPA-deficient, UVB irradiation C3H/HeN mice / XPA-deficient	1. Ear skin thickness (inhibit increasing) 2. CPD positive cells 3. mRNA expression of XPA, XPC, RPA1, DDB1, DDB2 4. Genomic DNA of XPA+/+, XPA−/−
57	Minoretti et al., 2023	protein carbonylation, cyclobutane pyrimidine dimers, dna, ultraviolet radiation, actinic keratosis	Fotoker, Eryfotona AK NMSC Fluid, Heliocare 360 MD AK 100+, Actixicam, Kerà K1, Kerà K2, Vehicle	[Photoaging model] Subjects of Fitzpatrick skin types II–III / By UVB irradiation	1. Actinic keratosis (CPDs) 2. Protein carbonylation
58	Delinasios et al., 2017	vitamin E, UVAI, keratinocytes, ultraviolet radiation	Vitamin E	[Photoaging model] keratinocytes / By UVAI irradiation	1. Intracellular of GSH, 2. DNA damage (% tail DNA) (Oxdised purines, CPD), 3. Production of oxidising species 4. Emission spectrum of the "UVA spot" 5. Pectroradiometric distribution of the emission spectrum
59	Sugimoto et al., 2009	ultraviolet, ascorbic acid-2-O-phosphate, p53, pyrimidine dimer, (6-4)photoproducts	Ascorbic acid (Asc), Asc2-O-phosphate (Asc2P), Dehydro-Asc, Asc-2-O-α-glucoside (Asc2G).	[Photoaging model] keratinocyte, Human skin fibroblasts cell / By UVA irradiation	1. Formation of CPD, 6-4PP 2. DNA damage (6-4PP) 2. Gene expression of p53, MDM2
60	Song et al., 2019	Grape skin; UV irradiation, NHEK cells; cyclobutane pyrimidine dimers; pyrimidine (6-4) pyrimidine photoproduct	Grape skin extract	[Photoaging model] NHEK cells / By UV irradiation	1. Amounts of CPDs, 6-4 PP 2. Protein expression of Bax, Bcl-2, Cytochrome c 3. polyphenol content
61	Wang et al., 2017	Skin aging Cherry blossom extract Antioxidant Anti-apoptosis HaCaT cells	Cherry blossom extract (Prunus Yedoensis)	[Photoaging model] Keratinocyte / By UVB irradiation	1. Activites of SOD, GSH-Px, MDA 2. Amounts of CPD, 8-OHdG, 3. Apoptosis cells 4. Protein, mRNA expression of Bck-2, Bax, cytochrome-c, caspase-3
62	Padmaja Divya et al., 2015	Blackberry extract; Ultraviolet radiation; Inflammation; COX-2; NF-κB	Blackberry extract	[Photoaging model] hairless mice / By UVB irradiation	1. Skin thickness (inhibit increasing) 2. Intracellular ROS, 3. 8-oxodG, CPD 4. Protein expression of COX-2, TNF-α, IL-6 5. Protein expression of ERK1/2, p38, JNK, MKK4
63	Uchino et al., 2020	Erlotinib · Dry skin · Stratum corneum · Cholesterol sulfate · Ceramide · Hydroxy free fatty acid	Erlotinib	Human stratum corneum	1. Intercellular lipud analysis (Ceramide, Free fatty acid) 2. Chages in Skin rash, dry skin grades, 3. Composition of stratum corneum lipid, 4. Ratio of CER, FFA (protein concentration) 5. Level of CS (cholesterol sulfate)

Key published and unpublished reports, central to the SKIN AGING – 9

64	kim et al., 2013	Curdrania tricuspidata, antioxidant, photoaging, MMPs, wrinkle	Curdrania tricuspidata leave extract	[Photoaging model] hairless mice / By UVB irradiation	1. Wrinkle formation on the back 2. Histological observation of Skin tissue 3. Activites of SOD, GPx 4. mRNA expression of MMP-1, 3, 9
65	Kim et al., 2012	Lespedeza cuneata, skin aging, antioxidant activity, hairless mouse	Lespedeza cuneata extract	[Photoaging model] hairless mice / By UVB irradiation	1. Erythema index, lipid capacity, moisture capacity 2. xanthine oxidas (XO), SOD 및 CA 3. GSH, TBARS
66	Park et al., 2018	mugwort (Artemisia vulgaris), ascorbic acid, antiwrinkle, UVB, skin aging	mugwort (Artemisia vulgaris)	[Photoaging model] hairless mouse / By UVB irradiation	1. Skin thickness (inhibit increasing) 2. Ra (arithmetric average roughness), Rt (skin roughness) 3. Rq (root mean square roughness), Rz (average roughness) 4. collagen formation 5. MMP-1
67	Lee el al., 2019	photoaging, fibroblast, collagen, Acanthopanax cortex shoots	Acanthopanacis cortex extract	[Photoaging model] Hs68 cell / By UVB irradiation	1. ROS generation 2. MMP-1, MMP-3, collagen production
68	Park et al., 2024	Perilla frutescens, Galactose, Cellular senescence	Perilla Leaf Extract	[Senescence model] C2C12 / By D-Galactose.	1. Protein expression of PCNA 2. Apotosis cells 3. Activities of CAT, GSH-Px, T-AOC, SOD, MDA 4. ROS generation / mitocondrial dysfunction 5. Loss of MMP, 6. γH2AX, SA-β-gal activity 7. Protein expression of IL-6, IL-18, p16, p53, p21 8. Protein expression of NF-κB and IκBα, Lamin B
69	Kim et al., 2004	skin, parsley extract, cpllagen, aging, PGE2	Parsley extract	[Senescence model] hairless mouse / By replicative senescence (Old-40 weeks) Fibroblast cell [Photoaging model] HaCaT cell / By UVB irradiation	[Senescence model] 1. Production of total collagen, type 1 procollagen 1. Skin thickness (inhibit decrease) [Photoaging model] 1. type I procollagen , MMP-1 2. Inhibition of PGE2 3. Inhibition of TNF-α, IL-1α,
70	Lee et al., 2017	Mori Folium, wrinkle formation, collagen, Advanced glycation end product	Mori Folium	[Glycation model] Sprague-Dawley (SD) rat / By streptozotocin	1. Contents of AGEs in serum, skin tissue 2. Protein expression of RAGE, CML, CEL 3. Protein expression of MMP-1, COL1A2, IL-6
71	Lee et al., 2006	NOS, SOD, Old-rat, testosterone, erectile dysfunction	KH-304	[Senescence model] Rat / By replicative senescence (Old- 21 months)	1. Protein expression of eNOS, nNOS, Caveolin1,3, SOD/Mn 2. blood testosteron 3. SOD activity
72	Berkers et al., 2018 [skin lipid 1]	Ceramides . lipid organization . skin barrier repair . topical formulation	Ceramides	[Skin moisture] ex vivo / Human stratum corneum cultured	1. Epidermer thickness 2. CER, CER EOS, CER NS, FAm TG(Triglyceride) 3. TEWL

Key published and unpublished reports, central to the SKIN AGING – 10

73	Berkers et al., 2019 [skin lipid 2]	Fourier-transform infrared spectroscopy, skin barrier repair, inflammatory	-	[Skin moisture] in vivo (Healty subjects male 18~29 years), ex vivo / Human stratum corneum	1. CER subclass 2. MCL (Mean chain length) 3. C34 CER, MuCER (Mono-unsaturated CERs) 4. CH2 symmetric stretching vibrations
74	Mack Correa et al., 2013 [skin lipid 3]	oleic acid, skin barrier, skin lipids, stratum corneum	Oleic acid, Glyceryl trioleate (GT)	[Skin moisture] ex vivo / Human stratum corneum (surgical abdominal)	1. Skin depth 2. TEWL 3. SC region 4. Interactions of OA or GT with model SC lipids in monolayers 5. ΔGex 6. CD2 stretching region demonstrating OA-d penetration into skin
75	Røpke et al., 2017 [skin lipid 4]	Skin lipids, Stratum corneum, Glucocorticoids, Skin atrophy, Skin barrier	clobetasol proprionate (CP), betamethasone diproprionate (BDP)	[Skin moisture] in vivo / Human stratum corneum	1. Epidermal thickness by OCT 2. stratum corneum thickness by CSLM 3. Full skin thickness by ultrasound 4. TEWL, 5. CER (ceramides), TAG (triacylglycerols), Cho (cholesterols), SFA (saturated fatty acids) UFA(unsaturated fatty acids) 6. TG level, 7. Levels of saturated and unsaturated fatty acids 8. Levels of CER subclass
76	Nip et al., 2024 [skin lipid 5]	barrier repair, ex vivo skin, fatty acid-containing formulations, intercellular lipid lamellae, lamellar bodies, repair, skin barrier	-	[Skin moisture] ex vivo / Human stratum corneum	1. Ki-67 potsitivel cells, 2. Epidermal area and image 3. Number of Stratum Corneum layers 4. intercellular lipid lamellae length 5. Number of intact Lamellar Bodies (iLB) 6. Lamellar bodies (LB) extrusion process
77	Rissmann et al., 2009 [skin lipid 6]	Lipid organization , Skin barrier perturbation, Murine model	Acetone	[Skin moisture] in vivo / hairless mouse	1. TEWL 2. Photomicrographs, number of SC layers 3. lipid composition and organization
78	Wang et al., 2023	Vanilla pompona, Orchidaceae, Vanilloideae, bioactive compounds, cosmeceutical, senescence, skin fibroblasts	Vanilla pompona leaves	[Senescence model] NHDF-Ad(Normal Human Dermal Fibroblasts), / By replicative senescence (young, old) [photoaging model] NHDF-Ad(Normal Human Dermal Fibroblasts), HaCaT cell (Keratinocyte) / By UVB, UVA	1. Inhibiton of Elastase, 2. Protein production (Collagen, HA, Elastin) 3. lipid composition and organization 4. SA-β activity and image 5. Cell viability 6. mRNA expression of TGF-βR1-2, Smad2-3-7, Elastin, FBN1-2, LOX, LOXL, MMP-1, TIMP-1

Key published and unpublished reports, central to the AMD – 1

No	Study title/Author/Year	Keyword	Materials / Methods	Human/Animal model	Biomarker
1	Suppressive E ect of Arctium lappa L. Leaves on Retinal Damage against A2E-Induced ARPE-19 Cells and Mice	Arctium lappa L. leaves; age-related macular degeneration; A2E accumulation; A2E-induced cell death; apoptosis	extract of ALleaves (ALE)	ARPE-19 cells / By A2E BALB/c mice / By white light	1. Cell viability, 2. Relative of A2E level 3. Cell apotosis 4. H&E staining 5. Stained region in ONL layer
2	Effect of Photooxidation of A2E, a Lipofuscin in the Retina, induced by Smartphone Light Against the Photooxidation by Blue Light Blocking Lenses	Age-related macular degeneration (AMD), Lipofuscin in retina, A2E and iso-A2E, Blue light blocking tinted lens, Blue light blocking coated lens	스마트 폰 빛 조사	스마트폰에서 발생하는 빛 조사 전후의 형광색소물질의 양 & 다양한 청광차단 안경렌즈를 사용하였을 때의 차이를 형광색소물질의 흡광도를 통하여 확인	1. 스마트폰으로 유발되는 A2E와 iso-A2E의 광산화 효과 2. A2E와 iso-A2E의 항광산화에 미치는 청광차단렌즈의 효과 3. 시간에 따른 청광차단렌즈의 항광산화 효과
3	Macular Pigment Optical Density and Photoreceptor Outer Segment Length as Predisease Biomarkers for Age-Related Macular Degeneration	macular pigment; photoreceptor; age-related macular degeneration; retina; medical checkup; biomarker	Not applicable	Thirty AMD fellow eyes of 30 late AMD patients (22 men; mean age, 68.2 1.8 years; range 50–85 years) and 30 eyes of control patients	1. Macular pigment optical density (MPOD) and photoreceptor outer segment (PROS) length 2. Correlation between macular pigment optical density (MPOD) and photoreceptor outer segment (PROS) length 3. Scatter diagramofmacularpigmentopticaldensity(MPOD)andphotoreceptorout ersegment (PROS) length 4. Representative optical coherence tomography (OCT) images of control and age-related macular degeneration (AMD)-fellow eyes
4	Positive Association between Macular Pigment Optical Density and Glomerular Filtration Rate: A Cross-Sectional Study	macular pigment optical density; estimated glomerular filtration rate; age-related macular degeneration	Not applicable	137 patients aged 60 years or older were diagnosed with grade 2 or higher-grade nuclear opacifications based on the Lens Opacities Classification System III	1. Study design flow diagram 2. Simple linear analysis between MPOD and eGFR
5	Protective effects of Vaccinium Uliginosum L. fractions and its compounds on dry age-related macular degeneration	Vaccinium uliginosum L., age-related macular degeneration(AMD), A2E, blue light exposure, HP20 resin	Vaccinium uliginosum L. (V.U)	ARPE-19 cells/ By blue light BALB/c mice/ By blue light	1. Representative HPLC chromatogram (330 nm) of fruit extract of Vaccinium uliginosum L. and UV spectra 2. V.U extract (VE) and 70% EtOH (FE) and fraction of HP20 resin (FH) on A2E oxidation and A2E-laden ARPE-19 cell death from blue light induced damage 3. Effect of V.U single compound on A2E-oxidation and A2E-laden ARPE-19 cell death from blue light induced damage 4. ONL thickness & Nuclei of ONL

Key published and unpublished reports, central to the AMD – 2

6	Prunella vulgaris var. L extract protects blue light induced RPE cell death in vitro and in vivo	Prunella vulgaris var. L, age-related macular degeneration (AMD), A2E, blue light exposure, oxidative stress, inflammation	Prunella vulagris (P.V) extract	ARPE-19 cells/ By blue light BALB/c mice(5weeks)/ By blue light	1. Inhibitory effect of P.V extract on A2E oxidation in cell free system from BL, 2. cell viability, 3. P.V extract inhibits A2E accumulation 4. P.V extract inhibits BL induced apoptosis in ARPE-19 cells 5. P.V extract activates Nrf-2/HO-1 signaling pathway and inhibits BL induced inflammation in ARPE-19 cells 6. HNE staining, thickness, protein expression(NF-kB p65 and IkB alpha), mRNA expression(TNF-alpha, MCP-1, MMP-2, MMP-9, VEGF-alpha, IL-1beta and IL-6)
7	들쭉추출물의 노인성 황반변성증에 관한 예방효과 A2E 축적된 ARPE-19세포와 C57BL/6 mice의 망막에서 광 손상에 대한 들쭉추출물의 보호효능	Age-related macular degeneration (AMD), Vaccinium uliginosum L., A2E, ARPE-19 cells, Blue light	Vaccinium uligisosum L.	ARPE-19 cells/ By UV A C57BL/6 Male, mice (11months)/ By blue light	1. antioxidant effect of V.U, 2. cell viability 3. Inhibitory effects of A2E accumulation in V.U extract 4. H&E staining, 5. Nuclei of ONL per 100um, Thickness of ONL 6. Transmission electron microscopic analysis of lipofuscin
8	레스베라트롤 및 그 유도체를 이용한 노인성 황반변성증에 대한 보호 효과	Age-related macular degeneration (AMD) Resveratrol, Antioxidant Anti-inflammatory, Retinal pigment epithelium	레스베라트롤 및 레스베라트롤 배당체	ARPE-19 cells / By 청색광 (430nm)	1. cell viability 2. Inhibitory action of RES and PIC against A2E photooxidation 3. Protective effect of RES and PIC against A2E accumulation induced damage on ARPE-19 cells 4. Protective effects of RES and its glycones against blue light induced photo damage on ARPE-19 cells
9	Protective effects of Panax ginseng berry extract on blue light-induced retinal damage in ARPE-19 cells and mouse retina	Panax ginseng berry Age-related macular degeneration Blue light exposure A2E ARPE-19 cells	ginseng berry extract (GBE)	ARPE-19 cells / By blue light (430nm) Balb/c mice (5weeks) / Blue light (430nm)	1. GBE inhibits cell death induced by A2E treatment and blue light exposure in ARPE-19 cells 2. GBE activates SIRT1/PGC-1a signaling pathway and inhibits BL induced inflammatory response in A2E-laden ARPE-19 cells 3. GBE inhibits apoptosis and restores the inhibition of autophagic flux induced by BL exposure in A2E-laden ARPE-19 cells 4. GBE protects BL induced retinal degeneration in retina (ONL Thickness) 5. GBE activates SIRT1/PGC-1a signaling pathway and inhibits BL induced inflammatory response in retina (gene expression(SIRT1, PGC-1a, TNF-a, IL-1b) western blot(SIRT1, PGC-1a, NF-kB, Lamin B1)

Key published and unpublished reports, central to the AMD – 3

10	Protective Effects of Spirulina maxima against Blue Light-Induced Retinal Damages in A2E-Laden ARPE-19 Cells and Balb/c Mice	Spirulina maxima; age-related macular degeneration; A2E; blue light; inflammation; oxidative stress	Spirulina maxima (S. maxima)	ARPE-19 cells / By blue light (430nm) Balb/c mice (5weeks) / Blue light (430nm)	1. S.maxima inhibited celldeath caused by A2E treatment and BLexposure 2. S.maxima regulated the inflammatory response caused by BL in A2E-laden ARPE-19 cells (western blot: NF-kb, Lamin B, iKb-b) 3. S.maximaRegulatedtheApoptosisCausedbyBLinA2E-LadenARPE-19Cells (PARP, caspase 3) 4. S. maxima protected photoreceptor degeneration caused by BL in retina (H&E staining, ONL Thickness) 5. S. maxima regulated the inflammation and apoptosis caused by BL in retina (TNF-, CXCL-2, MCP-1, MMP-2, MMP-9, VEGF-A, IL-1 , and IL-6)
11	Long-term blue light exposure impairs mitochondrial dynamics in the retina in light-induced retinal degeneration in vivo and in vitro	Dry age-related macular degeneration RPE cells Blue light Oxidative stress Mitochondrial dynamics	Not applicable	C57BL/6 mice (6month) / blue light (800lx)	1. Effects of long-term blue light exposure on the retina in C57BL/6 mice (HE staining, Thickness, TUNEL) 2. Alterations in mitochondrial structure and dynamics-related markers in mice exposed to blue light (DRP1, OPA1, OMA1) 3. Cytotoxicity Induced by Blue Light in ARPE-19 Cells (cell viability) 4. ROS Generation in ARPE-19 Cells Exposed to Blue Light 5. Mitochondrial dynamics were destroyed by blue light in ARPE-19 cells (OPA1, Bcl-2, BAX)
12	초기 황반변성 환자에서 들쭉 추출물의 효과	Age-related macular degeneration (AMD), Vaccinium uliginosum L., A2E (N-retinyl-N-retinylidene ethanolamine) ARPE-19 cells, Blue light	들쭉나무(Vaccinium uliginosum)	초기 황반변성은 AREDS 그룹의 분류에 의한 early AMD (AREDS category 2) & intermediated AMD (AREDS category 3)에 해당하는 환자	1. Retinal thickness between RPE and IS/OS junction was measured at the fovea. RPE and IS/OS thickness and foveal thickns 2. Survey questions of subjective symptoms 3. Analysis of the rate of change in study group and control group
13	In Vivo Multimodal Imaging of Drusenoid Lesions in Rhesus Macaques	Drusenoid lesions, Rhesus macaques, Age-related macular degeneration (AMD) Multimodal imaging, Spectral domain optical coherence tomography (SD-OCT)	Not applicable	rhesus macaques (Macaca mulatta)(>19years)	1. Grading and quantification of drusenoid lesions in rhesus macaques from fundus photographs 2. Multimodal imaging of soft drusen in rhesus macaques 3. Multimodal imaging of hard punctate lesions in rhesus macaques 4. Image segmentation and thickness measurement of retinal and choroidal layers in rhesus macaques
14	Drusen, choroidal neovascularization, and retinal pigment epithelium dysfunction in SOD1-deficient mice: A model of age-related macular degeneration	animal model; superoxide dismutase	Not applicable	Sod1 -/- C57BL/6 mice / By light	1. Senescent Sod1 -/- mice showing drusen 2. Degenerated 깨 Eand thickened Bruch's membrane in Sod1 -/- mice 3. CNVs in Sod1 / mice 4. Expression of SOD1, SOD2, and SOD3 in the eyes of Sod1 -/- mice 5. Oxidatively damaged RPE and its disrupted b-catenin-mediated integrity in Sod1 -/- mice

Key published and unpublished reports, central to the AMD - 4

15	REV-ERBα regulates age-related and oxidative stress-induced degeneration in retinal pigment epithelium via NRF2	Retinal pigment epithelium Aging Age-related macular degeneration REV-ERBα Oxidative damage NRF2	SR9009	WT and Rev-erbα -/- mice (12month)	1. REV-ERBα declines in aging RPE and sub-retinal deposits increase in Rev-erbα -/- mice 2. RPE degeneration in Rev-erbα -/- eyes (BrM thickness) 3. REV-ERBα deficiency decreases RPE phagocytic activity 4. Rev-erbα -/- eyes are more sensitive to chemical-induced oxidative stress injury 5. REV-ERBα agonist protects against chemical (NaIO3)-induced RPE damage 6. REV-ERB α regulates NRF2(Nfe2l2) transcription and the expression of its downstream target antioxidant genes in RPE cells 7. RPE-specific knockout of REV-ERBα in mice shows similar ocular pathologies as Rev-erbα -/- mice
16	Retinal pigment epithelium-specific CLIC4 mutant is a mouse model of dry age-related macular degeneration	Age-related macular degeneration (AMD), Retinal pigment epithelium (RPE), CLIC4 (Chloride intracellular channel 4) Drusen, Lipid metabolism	Not applicable	C57BL/6 J mice (Clic4 f/f mice16 and Best1-Cre+/− mice)	1. RPEΔClic4 mice developed age-related vision loss 2. RPEΔClic4 mice progressively develop histopathological features resembling intermediate and advanced AMD 3. Young RPEΔClic4 mice had altered epithelial cell features and increased RPE dropout 4. CLIC4 deficiency causes transcriptomic reprograming and pathway changes in RPE cells 5. RPEΔClic4 mice have aberrant and age-related lipids, lipoproteins, and protein depositions at sub-RPE/BrM 6. RPE lipid transport, BrM lipid deposition & disease summary for RPEΔClic4 mice
17	Relationship Between Drusen Height and OCT Biomarkers of Atrophy in Non-Neovascular AMD	AMD, atrophy, OCT, druse, drusen	Not applicable	155 patients with drusen associated with intermediate AMD	1. Drusen Characteristics Across All Eyes 2. Optical coherence tomography (OCT) B-scans from seven separate cases and one control case of macular drusen 3. Frequency and Location of OCT Biomarkers of Atrophy Within the Same Eye 4. Relationship Between Height and Diameter of Drusen
18	Drusen Volume as a Predictor of Disease Progression in Patients With Late Age-Related Macular Degeneration in the Fellow Eye	macular degeneration, geographic atrophy, wet macular degeneration, retinal drusen, choroidal neovascularization, optical coherence tomography, drusen volume	Not applicable	89 patients who had neovascular AMD in only one eye	1. baseline drusen volumes for eyes that developed late AMD at 1 year 2. baseline drusen volumes for eyes that developed late AMD at 2 year 3. Central OCT scans of a fellow eye at baseline, month 12, and month 24 of follow-up

Key published and unpublished reports, central to the AMD - 5

19	Drusen volume development over time and its relevance to the course of age-related macular degeneration	Age-related macular degeneration (AMD) Drusen volume, Optical coherence tomography (OCT) Disease progression, Retina	Not applicable	109 patients presenting early and intermediate age-related macular degeneration (AMD)	1. Calculating the drusen volume growth model 2. Bland–Altman plot showing the agreement between the drusen volume measurements 3. Development of drusen volume of all eyes during study period
20	Association of Visual Function Measures with Drusen Volume in Early Stages of Age-Related Macular Degeneration	Automatic segmentation of drusen, drusen volume, age-related macular degeneration, contrast sensitivity	Not applicable	A total of 100 eyes (16 eyes with early AMD, 62 eyes with intermediate AMD, and 22 eyes from healthy controls)	1. Sociodemographic and Clinical Characteristics of the Participants 2. Relationship Between Drusen Volume and Visual Function Tests
21	Observational Study in Drusen Patients with Epiretinal Membrane after Vitrectomy and Membrane Peeling	Central foveal thickness, Drusen, Drusen size, Epiretinal membrane, Vitrectomy	Not applicable	드루젠과 함께 황반전막이 있는 환자 20안과 드루젠이 없는 황반전막이 있는 환자 25안	1. Baseline characteristics 2. Pattern of BCVA (logMAR) at preoperative and in the postoperative period, in both subgroups 3. Mean change of central foveal thickness
22	Extramacular Drusen and Progression of Age-related Macular Degeneration (AMD); Age-related Eye Disease Study 2 Report 30	Age-related macular degeneration (AMD) Extramacular drusen Disease progression, Age-Related Eye Disease Study 2 (AREDS2) Geographic atrophy	Not applicable	4168 eyes (2998 participants) with intermediate AMD in one or both eyes	1. Field 2 macula centered fundus photograph with macular grid overlay 2. Extramacular drusen were not associated with risk of progression to late AMD 3. Characteristics of Extramacular Drusen
23	건강검진 자료를 이용한 나이관련황반변성의 위험인자 분석	Age-related macular degeneration, Check-up, Fundus photography, Risk factor	Not applicable	104 patients with early-phase, 75 patients with intermediate-phase, and 4 patients with late-phase AMD	1. Comparison of baseline characteristics between 4 groups with normal, early AMD, intermediate AMD, late AMD 2. Comparison of average values between normal and AMD groups after propensity score matching for age and sex 3. Logistic regression analysis of factors which showed meaningful relationships with AMD
24	Are macular drusen in midlife a marker of accelerated biological ageing?	Macular drusen, Leukocyte telomere length, DNA methylation age acceleration, Epigenetic clock, Retinal vessel caliber	Not applicable	1037 participants	1. Fundus photographs showing macular drusen (right eye) and without drusen (left eye) 2. Pace of ageing of participants with drusen (N = 165) and without drusen (N = 669) 3. Pace of ageing of participants with no drusen (N = 669), with drusen in one eye (N = 61), and with drusen in both eyes (N = 104)

Key published and unpublished reports, central to the AMD – 6

25	스펙트럼 영역 빛간섭단층촬영 결과에 영향을 주는 다양한 인자 분석	스펙트럼 영역 빛간섭단층촬영 (Spectral domain optical coherence tomography, SD-OCT) 황반 두께 (Macular thickness) 망막신경섬유층 두께 (Retinal nerve fiber layer thickness)	Not applicable	최대 교정시력 0.6 이상으로 세극등과 안저 검사상 이상이 없는 196명	1. Baseline characteristics of subjects 2. ETDRS subfields within standard 1-, 3-, and 6-mm-diameter concentric circles at the right used for reporting retinal thickness 3. Macular subfield thicknesses and retinal nerve fiber layer thicknesses stratified by sex, 4. Macular subfield thicknesses and retinal nerve fiber layer thicknesses stratified by laterality 5. Correlations between OCT measurements and age, spherical equivalent, and signal strength
26	Evaluation of retinal pigment epithelium changes in serous pigment epithelial detachment in age-related macular degeneration	Age-related macular degeneration (AMD) Retinal pigment epithelium (RPE) Pigment epithelial detachment (PED) Multi-contrast optical coherence tomography RPE-melanin OCT	Not applicable	26 eyes of 21 Japanese patients with serous PEDs due to AMD (13 men, 8 women; age range, 55–83 years; mean age, 72.1 years)	1. Multimodal imaging of serous PED in the right eye of a 78-year-old man 2. Multimodal imaging of serous PED in the right eye of a 70-year-old man 3. Scatterplots of RPE70 areas or area ratios and morphometric PED parameters with statistically significant correlations
27	Natural History of Drusenoid Pigment Epithelial Detachment in Age-Related Macular Degeneration: AREDS Report Number 28	Age-related macular degeneration (AMD) Drusenoid pigment epithelial detachment (DPED) Natural history Age-Related Eye Disease Study (AREDS) Disease progression	Not applicable	4757 participants enrolled in the Age-Related Eye Disease Study (AREDS), 255 were identified as having DPED in at least one eye and having 5 or more years of follow-up after the initial detection of the DPED	1. Progression of study eyes with drusenoid pigment epithelial detachments (DPED) to advanced forms of age-related macular degeneration (AMD) 2. Natural history of fundus changes in eyes with drusenoid pigment epithelial detachments (DPEDs) not progressing to advanced forms of age-related macular degeneration (AMD) by 5 years (n = 163) 3. Fundus changes occurring in the left eye of a 73 year-old woman with a drusenoid pigment epithelial detachment (DPED) at baseline 4. Change in best corrected visual acuity over time in eyes with drusenoid pigment epithelial detachments (DPED)
28	Activated Retinal Pigment Epithelium, an Optical Coherence Tomography Biomarker for Progression in Age-Related Macular Degeneration	retinal pigment epithelium, age-related macular degeneration, optical coherence tomography, drusen, hyperreflective foci, transdifferentiation, apoptosis, migration, Mie scattering, electron microscopy, stereology	Not applicable	142 maculas (53 advanced AMD, 13 GA eyes from 12 donors and 40 neovascular AMD eyes from 40 donors; 29 early AMD; 60 age-matched control eyes)	1. Fifteen phenotypes of retinal pigment epithelial cell morphology in advanced age-related macular degeneration 2. Retinal pigment epithelium phenotypes in spectral-domain optical coherence tomography 3. Progression of RPE phenotypes in the transition to geographic atrophy 4. Correlations between ex vivo SDOCT and high-resolution histology in drusenoid pigment epithelium detachment 5. Histologically defined RPE features are visible in vivo 6. RPE morphology and the life cycle of drusenoid pigment epithelial detachment (DPED)

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29	Therapeutic Efficacy of a Novel Acetylated Tetrapeptide in Animal Models of Age-Related Macular Degeneration	acetylated tetrapeptide (Ac-RLYE); neovascular age-related macular degeneration; resis tance; retinal neovascularization; laser-induced CNV model; VEGF; VEGFR-2	Not applicable	Six-week-old male C57BL/6J mice / By 532nm	1. The effects of the intravitreal administration of RLYE, the modified RLYE variants [R(D)LYE and Ac-RLYE], and aflibercept on the area of choroidal neovascularization (CNV) in laser-induced CNV mouse models 2. The effects of the intravitreal administration of RLYE and Ac-RLYE on inhibition of retinal vascular leakage in streptozotocin (STZ) induced diabetic mouse models 3. The effects of the intravitreal administration of Ac-RLYE and aflibercept on inhibition of choroidal neovascularization (CNV) rat models 4. The effects of the intravitreal administration of Ac-RLYE and ranibizumab on inhibition of choroidal neovascularization (CNV) in laser-induced CNV rabbit models 5. The effects of the intravitreal administration of Ac-RLYE and ranibizumab on inhibition of choroidal neovascularization (CNV) in laser-induced CNV minipig models 6. The effects of the intravitreal administration of Ac-RLYE, ranibizumab, and aflibercept on inhibition of choroidal neovascularization (CNV) in laser-induced CNV rabbit models
30	Wnt5a/β-catenin-mediated epithelial-mesenchymal transition: a key driver of subretinal fibrosis in neovascular age-related macular degeneration	Neovascular age-related macular degeneration, Subretinal fibrosis, Retinal pigment epithelium, Epithelial mesenchymal transition, Wnt5a/β-catenin	FH535 (a β-catenin inhibitor) Box5 (a Wnt5a inhibitor)	ARPE-19 cells 7-week-old male C57BL/6J mice / By 532nm	1. Safety assessment of intravitreal administration of FH535 in C57 mice 2. The effects of FH535 on subretinal fibrosis, EMT and CNV in laser-induced CNV mice 3. The impact of intravitreal administration of FH535 or Box5 on Wnt-signaling, EMT and subretinal fibrosis in laser-induced CNV mice 4. The influence of TGFβ1 on the Wnt-signaling molecules in ARPE-19 cells 5. The impact of FH535 co-incubation on the EMT and migratory capacity of ARPE-19 cells treated with TGFβ1 6. The impact of Box5 (a Wnt5a antagonist) on the expression profiles of EMT- and Wnt signaling-related molecules, as well as its influence on the migratory capacity in TGFβ1-treated ARPE-19 cells
35	Kim et al., 2011	Centella asiatica – dermal fibroblasts – gene expression –hydrogen peroxide – senescence	Centella asiatica	[Senescence model] HDFs / By H2O2	1. SA β-gal activity 2. Protein expression of p53, p21, pRb, Rb 3. Expression profile of differentially expressed mRNAs 4. mRNA expression of FoxM1, E2F2,MCM2, GDF15, BHLHB2 (senescence) 5. DNA synthesis in UVA in H2O2-induced

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36	Huang et al., 2011	cellular senescence; human placental extract; oxidative stress; dermal fibroblasts	human placental extract	[Senescence model] HDFs / By H2O2	1. Cumulative population doubling level, SAβ-gal activity, 2. mRNA expression of p16 3. ROS levels 4. Gene expression of 'extracellular matrix organization', 'antioxidant' 5. Protein expression of anti-NRF2
37	Wo et al., 2022	Isatis tinctoria L.; senomorphics; replicative senescence; senescence-associated secretory phenotype (SASP); anti-aging; mTOR pathway	Isatis tinctoria L	[Senescence model] HDFs / By replicative senescence (young, old)	1. SA β-gal activity 2. ROS generation 3. Protein expression of p53, p21, p16 4. SASP expression(ILs, MMP-1) 5. Protein expression of SIRT1-mTOR-MAPK-NF-κB Signaling 6. Staining of p65
38	Ortiz-Espín et al., 2017	Deschampsia antarctica, human fibroblasts, cellular senescence	Deschampsia antarctica extracts	[Senescence model] HDFs / By replicative senescence (young, pre, old), H2O2	1. Cell proliferation and viability 2. mRNA expression of PCNA 3. SA β-gal activity 4. Protein expression of Sirt1, LmnA/C, Trx2
39	Gu et al., 2022	bamboo leaf flavonoids; nanoliposome; biopolymer conjugation; in vitro release; skin permeability; anti-senescence activity	bamboo leaf flavonoids	[Senescence model] Skin tissue of C57BL/6J mice HaCaT cells / By AAPH	1. In vitro skin penetration of naked 2. Prolifration and inhibition of proliferation 3. SAHF formation, positive cells 4. Protein expression of p16, p21, K9M-H3
40	Woo et al., 2021	Cellular senescence, SASP, cell cycle arrest, HDFs, Silybum marianum flower	Silybum marianum flower	[Senescence model] HDFs / By replicative senescence (young, old)	1. Morphology change 2. Staining of γ-H2AX 3. mRNA expression of p16, p21, p53 4. SA-β-gal activity 5. caspase-3/PARP pathway 6. senescent cells and cell proliferation 7. MMP-1, IL-6, Type-1 procollagen expression
41	Lee et al., 2022	Selaginella rossii; matrix metalloproteinases; amentoflavone; skin aging; anti-wrinkle	Selaginella rossii	[Senescence model] CCD-986sk fibroblasts, HaCaT / By UVB, AAPH	1. MMP-1, 2, 3, 9 expression 2. type I C-peptide (PIP), mRNA expression of COL1A1, COL1A2 3. ROS accumulation 4. Protein expression of MAPK
42	Hsu et al., 2020	Ajuga taiwanensis, fbroblasts, senescence	Ajuga taiwanensis	[Senescence model] HDFs / By replicative senescence (young, old)	1. Cell aging analysis (Cell cycle phase, SA-β-gal activity, ki-67, morphology) 2. Protein expression of p53 3. cell colony formation 4. Cell proliferation rate, ROS generation

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43	Zhou et al., 2014	Tetrahydroxystilbene glucoside, dermal layer thickness, collagen fiber, insulin/IGF-1 signal pathway, Ca2+	Tetrahydroxystilbene glucoside	[Senescence model] Male Kunming mice aged 18 months / Old aged	1. Thickness of dermal layer (inhibit decreasing) 2. Collagen fiber content 3. Elastic fiber content 4. Levels of insulin, IGF-1, and the receptors of insulin and IGF-1 5. Levels of Ca2+, P, in serum
44	He et al., 2024	(-)-α-Bisabolol, Cellular senescence, D-Galactose, SASP, Skin aging	(-)-α-bisabolo	[Senescence model] Human skin fibroblasts / by D-Galactose. BALB/c mice	1. Aging phenotype(SA-β-gal, SASP, MMPs, p16, p21) 2. TWEL, skin barrier index 3. Mean epidermal area, Dermal thickness (inhibit increasing), brown area of dermis, 4. SOD inhibition rate, contents of MDA and HYP 5. mRNA expression of elastin, collagen Ⅲ, MMP-2, and MMP-3
45	Hu et al., 2016	Laminaria polysaccharide, dermal thickness, MAPK, Aging	Laminaria polysaccharide	[Senescence model] female Kunming / By young, old age	1. Dermal thickness(inhibit decreasing) 2. Collagen, HYP content, type I collagen mRNA levels 3. Protein expression of MMP-1, TIMP-1, MAPK pathway 4. Antioxidant enzyme expression
46	Park et al., 2017	Intrinsic skin aging, Kaempferia parviflora Wall ex. Baker, cellular senescence, mitochondrial dysfunction	Kaempferia parviflora Wall ex. Baker extracts	[Senescence model] Human dermal fibroblasts (Hs68) / By H2O2 female hairless mice / By middle, young age	1. cell growth promotion and SA-β activity. 2. mRNA and protein expression of p53, p21, p16, pRb, E2F1, SIRT1 3. Protein expression of PI3K/AKT pathway, mTOR and FoxO3a 4. mRNA and protein expression of IL-6, IL-8, NF-kb, COX2 5. ATP, ROS level, 6. mRNA expression of PGC-1α, ERRα, NRF-1, and Tfam, 7. mtDNA expression 8. Wrinkle area, number, total length, wrinkle depth (inhibit increasing) 9. Skinfold thickness(inhibit decreasing) 10. Collagen content, 11. Gross elasticity
47	Song et al., 2012	hairless mice; Mangifera indica; skin aging; ultraviolet B	Mangifera indica L	[Photoaging model] HR-1 hairless mice / By UVB irradiation	1. Features of the dorsal skin, 2. Mean length of skin wrinkle 3. Epidermal thickness(inhibit increasing) 4. Staining of collagen fiber
48	Chen et al., 2017	Anti-skin-aging, EGCG, d-galactose, Oxidative stress, EGFR pathway	Epigallocatechin gallate(EGCG)	[Senescence model] male, Kunming mice / by D-Galactose.	1. Epidermal, dermal thickness(inhibit decreasing) 2. Staining of collagenin 3. H2O2, MDA levels 4. Activites of SOD, CAT, GSH, GSH-px 5. Protein expression of p21, EGFR, JAK-2, STAT-5, Bax, BCI-2
49	Lee et al., 2023	food; inner beauty; panax; skin aging; ultraviolet rays	ginseng sprouts	[Photoaging model] hairless mice / By UVB irradiation	1. Epidermal thickness(inhibit increasing), dermal collagen density 2. Skin barrier(TEWL, Moisture, Roughness) 3. Skin elasticity, content of procollagen type 1 C-peptide(PIP)

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50	Goto et al., 2012	Proteoglycans, glycosaminoglycan (GAG), UVB, skin aging, salmon nasal cartilage	salmon nasal cartilage extracts	[Photoaging model] hairless mice / By UVB irradiation	1. Erythema values, TWEL 2. Hydration levels 3. Skin sections of dorsal skin 4. Epidermal and dermal thickness(inhibit increasing) 5. TNF-alpha, IL-1β, IL-6
51	Gu et al., 2023	skin aging, photoaging, ultraviolet B, Schizonepeta tenuifolia, mitogen-activated protein kinase (MAPK), advanced glycation end products (AGEs)	Schizonepeta tenuifolia	[Photoaging model] HR-1 hairless mice / By UVB irradiation	1. Body weight and liver toxicity serum biomarkers 2. Wrinkle area, total wrinkle length, wrinkle depth(inhibit increasing) 3. Skin, epidermal thickness(inhibit increasing) 4. Protein expression of MMP1, MMP3, MMP9, pro-COL1A1, TIMP1 5. Protein expression of HAS1,2,3, Filaggrin, collagen-1, HYAL-1,2 6. Skin moisture, hyaluronan 7. Protein expression of MAPKs and nuclear factor-kapp 8, AGEs accumulations, Protein expression of AGE, RAGE
52	Carpenter et al., 2023	glucosinolate, isothiocyanate, nitrile, UVB, photoprotective, chemopreventive, 3D skin equivalent, MMPs (Min. 5–Max. 8)	(Limnanthes alba) glucosinolate derivatives	[Photoaging model] keratinocytes (HPEKs) and 3D human skin / By UVB irradiation	1. Staning of human skin equivalent sections 2. Epidermal sunburned cell counts, epidermal thickness(inhibit increasing) 3. Epidermal of CPDs + cells 4. Protein expression of p-H2A.X, epidermal PCNA+ cells 5. Protein expression of MMP-1, MMP-3
53	Calvo-Castro et al., 2013	Blackberry juice, NHEK cell, Apoptosis, Caspases 9	Ultrafiltered blackberry juice	[Photoaging model] NHEK cell / By UVB irradiation	1. Apoptosis level(PARP, caspases 3, 6, 8 and 9) 2. Protein expression of 8-oxodG, p53, p-p53 (Ser15) 3. CPD
54	Mary Britto et al., 2017	UV radiation, Apigenin, DNA damage, Apoptosis, Cyclobutane pyrimidine dimer	Apigenin	[Photoaging model] HDFa cell / By UVB irradiation	1. CPD 2. XPC, XPB, XPG and XPF, Bcl-2, Bax, Caspase-3 3. Apoptosis
55	Shin et al., 2013	veratric acid, photoprotection, anti-inflammation	veratric acid (VA, 3,4-dimethoxybenzoic acid)	[Photoaging model] HaCaT Cell cell / By UVB irradiation	1. CPD 2. p-p53, γ-H2AX expression 3. subG1, S, G1, G2M 4. PARP, capase-3, 8, 9, Bcl-xL 5. COX-2, PGE2, IL-6 6. Skin recovery
56	Katiyar et al., 2010	Green tea polyphenols, contact hypersensitivity, nucleotide excision repair	Green tea polyphenols	[Photoaging model] Human fibroblasts / By UVB irradiation	1. Ear skin thickness 2. CPD 3. mRNA expression of XPA, XPC, RPA1, DDB1, DDB2 4. XPA+/+, XPA−/−

57	Minoretti et al., 2023	protein carbonylation, cyclobutane pyrimidine dimers, dna, ultraviolet radiation, actinic keratosis	Fotoker, Eryfotona AK NMSC Fluid, Heliocare 360 MD AK 100+, Actixicam, Kerà K1, Kerà K2, Vehicle	[Photoaging model] ? / By UVB irradiation	1. CPD 2. PC
58	Delinasios et al., 2017	vitamin E, UVAI, keratinocytes, ultraviolet radiation	Vitamin E	[Photoaging model] keratinocytes / By UVAI irradiation	1. GSH 2. CPD
59	Sugimoto et al., 2009	ultraviolet, ascorbic acid-2-O-phosphate, p53, pyrimidine dimer, (6-4)photoproducts	Ascorbic acid (Asc), Asc2-O-phosphate (Asc2P), Dehydro-Asc, Asc-2-O-α-glucoside (Asc2G).	[Photoaging model] Fibro2Y cell / By UVAI irradiation	1. CPD, 6-4PP 2. p53, MDM2
60	Song et al., 2019	Grape skin; UV irradiation, NHEK cells; cyclobutane pyrimidine dimers; pyrimidine (6-4) pyrimidine photoproduct	Grape skin extract	[Photoaging model] NHEK cells/ By UV irradiation	1. CPDs, 6-4 PP 2. Bax, Bcl-2, Cytochrome c 3. polyphenol content
61	Wang et al., 2017	Skin aging Cherry blossom extract Antioxidant Anti-apoptosis HaCaT cells	Cherry blossom extract (Prunus Yedoensis)	[Photoaging model] Keratinocyte/ By UVB irradiation	1. SOD, GSH-Px, MDA 2. CPD, 8-OHdG 3. V-FITC, apoptosis 4. Bck-2, Bax, cytochrome-c, caspase-3
62	Padmaja Divya et al., 2015	Blackberry extract; Ultraviolet radiation; Inflammation; COX-2; NF-κB	Blackberry extract	[Photoaging model] hairless mice/ By UVB irradiation	1. Skin thickness 2. 8-oxodG, CPD 3. Protein expressions of COX-2, TNF-α, IL-6 4. Protein expression of ERK1/2, p38, JNK, MKK4
63	Uchino et al., 2020	Erlotinib · Dry skin · Stratum corneum · Cholesterol sulfate · Ceramide · Hydroxy free fatty acid	Erlotinib	stratum corneum	1. CER, FFA 2. CS (cholesterol sulfate)

Key published and unpublished reports, central to the Periodontitis – 1

No	Study title	Keyword	Materials / Methods	Human/Animal model	Biomarker
1	조성훈 외 4인, 백서 치아 발거후 잔존 치주인대가 발치와의 치조골 재건에 미치는 영향, 1995	치주인대, 골 형성, 치주인대세포, 결합조직, 염증 없이 손상된 치주조직	약제 [β-aminopropionitrile (0.4%)+증류수]	생후 4주된 체중 약 90g 내외의 웅성 백서 20마리의 상악 좌,우측 제1대구치 - 대조군(10마리): 치주인대 제거, 수분 섭취 - 실험군(10마리): 발치시 치주인대를 균일한 넓이로 잔존, 치아의 발거전 5일동안은 수분을 [β-aminopropionitrile (0.4%)+증류수]로 섭취시킴	1. 결합조직의 밀도, 콜라겐 합성능 2. 치주인대세포의 증식, 이주, 분화 속도 3. 치유양상속도 4. 골질의 치밀도, 골 형성량
2	나성윤 외 4인, 행인 추출물이 고포도당 상태의 치은섬유아세포 및 치주인대세포에 미치는 영향, 2000	행인 추출물, 치주인대세포, 치은섬유아세포의 활성	생합성 약물의 일종 [살구나무씨(행인) 추출물]	전신건강, 임상적으로 염증이 없는 성인 치주조직에서 초기 배양한 치은섬유아세포와 치주인대세포 교정치료를 목적으로 내원한 환자로부터 제1소구치 발치시 건강한 치은조직을 채취 > 세척 >조직편을 약 1 mm3의 크기로 세절 > 배양접시에 10~15조각 씩 고르게 분포 > 치은섬유아세포, 치주인대세포 각각 배양 - 대조군: 행인추출물 투여 x - 실험군: 10% FBS와 100 unit/ml penicillin, 100 μg/ ml streptomycin, 0.5 μg/ml amphotericin -B가 포함된 DMEM으로 구성된 배양액에 포도당을 400 mg/dℓ의 농도로 투여한 군 - 실험 제1군: 행인추출물을 1 μg/mℓ의 농도로 투여한 군 - 실험 제2군: 행인추출물을 10 μg/mℓ의 농도로 투여한 군	1. 치은섬유아세포의 세포수 2. 치주인대세포의 세포수 3. 단백질함량 4. Alkaline phosphatase 활성도
3	조병도, 외 4인, 혈소판유래성장인자와 상피성장인자가 치주인대세포와 골수세포의 성상에 미치는 영향, 1996	혈소판유래성장인자, 상피성장인자, 치주인대세포, 골수세포	혈소판유래성장인자, 상피성장인자	치주인대세포 (생후 1년 6개월 이상된 약 10~12kg 체중의 순종 웅성 비글견 4마리의 제2,3,4 소구치) - 대조군: 성장인자 투여하지 않은 배양세포 - 실험 제1군: 혈소판유래성장인자 (PDGF) 10 ng/mℓ의 농도로 투여한 군 - 실험 제2군: 상피성인자(EGF) 10 ng/mℓ의 농도로 투여한 군	1. 세포 증식율 2. 단백질 합성능 3. Alkaline phosphatase 활성도
4	권영혁 외 1인, 혈소판유래성장인자-BB가 골간질세포와 치주인대세포의 성상에 미치는 연구, 1996	혈소판유래성장인자, 골간질세포, 치주인대세포, 조직치유, 세포이동	혈소판유래성장인자	치주인대세포 (생후 4주된 체중 약 100g 내외의 웅성 백서 10마리의 상악 제1대구치) - 대조군: 성장인자 투여하지 않은 군 - 실험군: 혈소판유래성장인자 (PDGF)를 투여한 군	1. 세포증식속도 2. Alkaline phosphatase 활성도 3. 단백질 합성능 4. 석회화 결절 수
5	최종우 외 5인, 혈소판유래 및 상피성장인자가 치주조직재생에 미치는 영향, 1997	혈소판유래성장인자, 상피성장인자, 치주조직 재생과정, 경조직 치유, 연조직 치유, 세포이동, 세포 증식	혈소판유래성장인자, 상피성장인자	치주인대세포 (생후 1년 6개월 이상된 약 14~16kg 체중의 순종 웅성 비글견 6마리의 좌우측 하악 제 1,2,3,4 소구치) - 대조군: PDGF-BB 적용 - 실험군: PDGF-BB와 EGF 적용	1. 골형성 2. 골성강직 3. 골의 재생속도 4. 골의 성숙도

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6	송영보 외 5인, Aralia cortex와 Phellodendron cortex의 혼합추출물이 치주조직세포 활성에 미치는 영향, 1999	두릅나무, 황백피, 치주조직세포 활성, 치은섬유아세포, 치주인대세포	두릅나무(Aralia cortex)와 황백피(Phellodendron cortex)의 혼합추출물 (P55A)	치은섬유아세포와 치주인대세포 (4-7 passage) (교정치료를 목적으로 내원한 환자의 제1소구치) - 대조군: 일반적인 배양 조건에서 배양한 세포 - 실험 제1군: P55A를 0.1㎍/㎖의 농도로 투여한 군 - 실험 제2군: P55A를 1㎍/㎖의 농도로 투여한 군 - 실험 제3군: P55A를 10㎍/㎖의 농도로 투여한 군	1. 치주인대세포의 세포수 2. 단백질함량 3. Alkaline phosphatase 활성도
7	김선희 외 4인, Chitosan이 치주인대, 두개관 및 치은섬유아세포의 성상에 미치는 영향, 1998	Chitosan, 천연물, 치주질환, 치주조직 재생, 치주인대세포, 두개관세포, 치은섬유아세포	Chitosan(1-4, 2-amino-2-deoxy-β-D-glucan) chitosan 분말을 200µg/㎖의 농도로 0.2% acetic acid 용액에 용해	치주인대세포 (4-7세대) (교정치료를 목적으로 발거한 제1소구치의 치근 중앙 1/3에서 치주인대 조직 채취) - 대조군: chitosan이 포함되지 않은 배지에서 배양한 세포군 - 실험군: 배양액 1㎖ 당 40µg의 chitosan이 포함된 배지에서 배양한 세포군	1. 치주인대세포의 세포증식율 2. 단백질 합성능 3. Alkaline phosphatase 활성도 4. 석회화 결절 수
8	이상구 외 2인, 치근면 구연산 도포가 치주인대세포의 부착과 전개에 미치는 영향, 1993	구연산, 치주인대세포 부착, 치주염, 치주조직 재생	구연산	치주인대세포 (교정치료를 목적으로 내원한 환자의 제1소구치) - 대조군: 배지에 약제를 첨가하지 않은 군 - 실험 제1군: 중증 치주염에 의해 발거한 치앙들 중 치근면활택술만 시행한 치아 (치근면활택군) - 실험 제2군: 치근면활택술 후 구연산 처리한 치아 (구연산 처리군)	1. 치근표면 형태 2. 세포부착양상속도 3. 증식세포수
9	강승훈 외 2인, 미노사이클린이 치주인대세포의 부착과 전개에 미치는 효과, 1991	미노사이클린, 치주인대세포 부착, 치주염, 치주조직 재생	미노사이클린	치주인대세포 (교정치료를 목적으로 내원한 환자의 제1소구치) - 대조군: 교정치료를 목적으로 발거한 정상 제1소구치 - 실험 제1군: 치은섬유아세포의 부착과 절개를 촉진한 미노사이클린군 - 실험 제2군: 섬유아세포의 부착촉진물질로 알려진 fibronectin군 - 실험 제3군: 미노사이클린의 세균에 대한 단백질합성 억제역할로서의 약리작용이 동일한 에리스로마이신군 - 실험 제4군: 미노사이클린의 chelation 작용과 동일한 효과를 가진 ethylene glycol-bis-N,N,N',N'-tetraacetic acid (EGTA) 군	1. 세포부착양상 2. 세포부착비율 (부착수 측정) 3. 세포전개양상
10	김천종 외 3인, 八味地黃丸 및 五倍子 추출물이 뼈모유사세포와 치주인대섬유모세포의 증식, Alkaline Phosphatase의 활성 및 단백질 합성능에 미치는 影響, 2003	팔미지황환, 오배자, 뼈모유사세포, 치주인대섬유모세포, ALP, 단백질 합성능	팔미지황환(八味地黃丸), 오배자(五倍子) 추출물	치주섬유모세포 (6-8세대) (교정치료를 목적으로 발거한 제1소구치의 치근 중앙 1/3에서 치주인대 조직 채취) - 대조군: 배지에 한약제를 첨가하지 않은 군 - 실험 제1군: 팔미지황환(0.10%) 처리 - 실험 제2군: 팔미지황환(0.25%) 처리 - 실험 제3군: 팔미지황환(0.50%) 처리 - 실험 제4군: 오배자(0.10%) 처리 - 실험 제5군: 오배자(0.25%) 처리 - 실험 제6군: 오배자(0.50%) 처리	1. 세포활성도 2. Alkaline phosphatase 활성도 3. 단백질 합성능

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11	Hyang-Yu Kim et al., Enhancing effects of myricetin on the osteogenic differentiation of human periodontal ligament stem cells via BMP-2/Smad and ERK/JNK/p38 mitogen-activated protein, 2018 kinase signaling pathway	Osteogenesis, Myricetin, Bone morphogenetic protein/Smad, Mitogen-activated protein kinases, Human periodontal ligament stem cells	myricetin	hPDLSC (4~7 passage) - 대조군: 미리세틴(0 μM) 처리 - 실험 제1군: 미리세틴(0.01 μM) 처리 - 실험 제2군: 미리세틴(0.1 μM) 처리 - 실험 제3군: 미리세틴(1 μM) 처리 - 실험 제4군: 미리세틴(5 μM) 처리 - 실험 제5군: 미리세틴(10 μM) 처리 - 실험 제6군: 미리세틴(20 μM) 처리	1. Cell proliferation 2. Alkaline phosphatase (ALP) activity 3. mineral deposition 4. Runx2 5. Osterix 6. Fra-1 7. FosB 8. Osteocalcin 9. Osteopontin 10. Collagen type- Ⅰ 11. GSK-3β 12. BMP(bone morphogenetic protein) 13. MAPK(mitogen-activated protein kinase) 14. Wnt/β-catenin 15. Smad –1/5/9 16. extracellular signal-regulated kinases (ERK)1/2 17. c-Jun N-terminal protein kinase (JNK)
12	Emmanuel Souza et al., Maresin-1 and Resolvin E1 Promote Regenerative Properties of Periodontal Ligament Stem Cells Under Inflammatory Conditions, 2020	Maresin-1 (MaR1), Resolvin E1 (RvE1), Inflammation, Regeneration, Periodontal ligament stem cells (hPDLSCs), Phosphoproteomics	Maresin-1 (MaR1), Resolvin E1 (RvE1)	hPDLSC (치주염, 치석 또는 충치가 없는 전신적으로 건강한 환자 3명(연령 24~25세)에게서 매복된 인간 제3대구치의 치근 중앙 1/3에서 치주인대 조직 채취) - 대조군: no treat - 실험 제1군: MaR1 (10 nM) 처리 - 실험 제2군: RvE1 (10 nM) 처리 - 실험 제3군: MaR1(10 nM) + RvE1(10 nM) 처리 - 실험 제4군: IL-1β 단독(10 ng/mL) 처리 - 실험 제5군: IL-1β(10 ng/mL) + MaR1(10 nM) 처리 - 실험 제6군: IL-1β(10 ng/mL) + RvE1(10 nM) 처리 - 실험 제7군: TNF-α (10 ng/mL) 처리 - 실험 제8군: TNF-α(10 ng/mL) + MaR1(10 nM) 처리 - 실험 제9군: TNF-α(10 ng/mL) + RvE1(10 nM) 처리 - 실험 제10군: IL-1β(10ng/mL) + TNF-α(10ng/mL) 처리 - 실험 제11군: IL-1β(10ng/mL) + TNF-α(10ng/mL) + MaR1(10nM) + RvE1(10nM) 처리	1. CD11b, CD44, CD45, CD73, CD90, CD105, human leukocyte antigens (CDHLA-ABC) 2. Oct-4 3. Sox-2 4. CD45, 11b, CD44, CD73, CD90, CD105, HLA, ABC 5. 상처 치유, 세포 이동 6. Cell Viability 7. Apoptosis 8. α-SMA 9. Tenomodulin 10. Periostin 11. 칼슘 침전물의 수 12. Alkaline Phosphatase

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13	Yunji Wang et al., Low-intensity pulsed ultrasound promotes periodontal ligament stem cell migration through TWIST1-mediated SDF-1 expression, 2018	Low-intensity pulsed ultrasound, Periodontal ligament stem cells (PDLSCs), Stromal cell-derived factor-1 (SDF-1), C-X-C motif chemokine receptor 4 (CXCR4), TWIST1 (twist family bHLH transcription factor 1)	LIPUS	건강한 소구치 (교정 목적 환자 5명(12~18세)의 치주 인대를 뿌리 표면의 중앙 1/3)로부터 PDLSC를 분리 1. LIPUS 처리 강도 비교: 대조군: LIPUS 미처리 실험 제1군: 30 mW/cm2 강도의 LIPUS 처리 (30분/일) 실험 제2군: 60 mW/cm2 강도의 LIPUS 처리 (30분/일) 실험 제3군: 90 mW/cm2 강도의 LIPUS 처리 (30분/일) 2. SDF-1 및 TWIST1 발현: 대조군: 미처리 PDLSCs 실험 제1군: AMD3100 (CXCR4 억제제) 처리 실험 제2군: LIPUS 처리 실험 제3군: LIPUS + AMD3100 병용 처리 3. 상처 치유 검정(이동 너비, 세포수): 대조군: 미처리 PDLSCs 실험 제1군: AMD3100 (CXCR4 억제제) 처리 실험 제2군: SDF-1 처리 실험 제3군: LIPUS 처리 - 실험 제4군: LIPUS + AMD3100 병용 처리 4. TWIST1 기능 실험: 대조군: 미처리 실험 제1군: scramble siRNA 처리 - 실험 제2군: TWIST1 812 siRNA 처리 실험 제3군: TWIST1 973 siRNA 처리 실험 제4군: TWIST1 1577 siRNA 처리 5. 세포 이동 실험: 대조군1: 미처리 PDLSCs 대조군2: LIPUS 처리 실험 제1군: scramble 처리 실험 제2군: scramble + LIPUS 병용 처리 실험 제3군: TWIST1 siRNA 처리 실험 제4군: TWIST1 siRNA + LIPUS 병용 처리	1. TWIST1 (Twist Family bHLH Transcription Factor 1) 2. SDF-1 (Stromal Cell-Derived Factor 1) 3. CXCR4 (C-X-C Motif Chemokine Receptor 4) 4. 줄기세포 양성 표지자 (CD73, CD146, STRO-1) 5. 줄기세포 음성 표지자 (CD34) 6. 상처 면적의 변화 7. 이동한 세포 수, 이동 너비 (Migration width(Pixel))
14	김지숙 외 5인, 백서의 치주인대세포와 두개관세포의 혼합배양이 석회화과정에 미치는 영향, 1997	염증 없이 손상된 치주조직, 치주인대세포, 두개관세포, 석회화, 치조골	x	두개관세포, 치주인대세포 (3-5세대) (생후 4주된 체중 약 100g 내외의 웅성 백서의 상악 좌,우측 제1대구치) - 실험 제1군: 두개관세포만 배양하는 군 - 실험 제2군: 두개관세포 70%, 치주인대세포 30%로 혼합한 군 - 실험 제3군: 두개관세포 50%, 치주인대세포 50%로 혼합한 군 - 실험 제4군: 두개관세포 30%, 치주인대세포 70%로 혼합한 군 - 실험 제5군: 치주인대세포만 배양하는 군	1. 세포증식율 2. 총단백질량 3. Alkaline phosphatase 활성도 4. 석회화 결절 수

15	인영미 외 3인, 치주인대세포와 치은 섬유아세포의 혼합배양이 석회화 결절형성에 미치는 영향, 1996	치주인대세포, 치은 섬유아세포, 석회화 결절, 부착조직 재생 과정	x	치주인대세포 (5-7세대) (교정치료를 목적으로 발거한 제1소구치의 치근 중앙 1/3에서 치주인대 조직 채취) - 실험 제1군: 치주인대세포만 배양하는 군 - 실험 제2군: 치주인대세포 70%, 치은 섬유아세포 30%로 혼합한 군 - 실험 제3군: 치주인대세포 50%, 치은 섬유아세포 50%로 혼합한 군 - 실험 제4군: 치주인대세포 30%, 치은 섬유아세포 70%로 혼합한 군 - 실험 제5군: 치은 섬유아세포만 배양하는 군	1. 세포증식율 2. Alkaline phosphatase 활성도 3. 석회화 결절 수
16	Attaporn Prueksakorn et al., The preservative effect of Thai propolis extract on the viability of human periodontal ligament cells, 2016	Thai propolis extract, periodontal ligament cell,	Thai propolis extract	Human PDL cell culture 96 closed-root-apex premolars without caries, root canal treatment and periodontal disease, planned for tooth extraction due to orthodontic purposes, were collected from 96 patients (18-24 years old) control group: no treat experimental group: propolis extract treat	1. 세포수 (Trypan blue dye exclusion assay) 2. 세포 독성 (AlamarBlue® cytotoxic assay) 3. 세포 증식 (BrdU cell proliferation assay)
17	Ghasempour, Maryam, et al., In vitro viability of human periodontal ligament cells in green tea extract, 2015	Green tea extract, periodontal ligament cell, cell viability	Green tea extract	Human PDL cell culture from 54 human teeth with closed apices negative control group: water treat positive control group: Hank's balanced salt solution (HBSS) treat experimental group: Green tea extract treat	1. Cell viability
18	Fahimeh Adeli et al., Comparative in vitro study of the effectiveness of Green tea extract and common storage media on periodontal ligament fibroblast viability, 2016	Green tea extract, periodontal ligament cell, cell viability	Green tea extract	Periodontal ligament cells obtained from freshly extracted healthy impacted third molars (무균 수술로 발치한 맹출되지 않은 제3대구치에서 파생됨) control group: no treat experimental group: green tea extract treat	1. Cell viability

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19	Se Eun Kim et al., Efficacy of horse chestnut leaf extract ALH-L1005 as a matrix metalloproteinase inhibitor in ligature-induced periodontitis in canine model, 2016	dog, doxycycline, horse chestnut leaf extract, matrix metalloproteinase, periodontal disease	ALH-L1005 (horse chestnut leaf extract) (밤나무 잎 추출물)	16마리의 약 1.5세 비글견 16마리의 약 1.5세 비글견의 오른쪽 상악 PM4의 협측 치은 가장자리에서 치은 조직 샘플 negative control group(n = 14): 위약 positive control group(n = 14): doxycycline 10 mg/kg/day experimental group 1(n = 22): ALH-L1005 100 mg/kg/day (LT) experimental group 2(n = 20): ALH-L1005 200 mg/kg/day (HT)	1. MMP-2 (in vitro) 2. MMP-9 (in vitro) 3. MMP-13 (in vitro) 4. 치태 지수(PI) (in vivo) 5 치은 지수(GI) (in vivo) 6. 치주낭 깊이(PPD) (in vivo) 7. 임상적 부착 수준(CAL) (in vivo) 8. 탐침 시 출혈(BOP) (in vivo)
20	Yueyue Wang et al., Effect of Eucommia water extract on gingivitis and periodontitis in experimental rats, 2022	Periodontitis, Porphyromonas gingivalis(P. gingivalis), Eucommia ulmoides Oliv., Alveolar bone resorption, Oxidative stress, Inflammatory factors	Water extracts of Eucommia (두충나무의 물 추출물)	치은 조직 (44 male SD rats (90 g-110 g)의 제2대구치) 치은염 모델 - control group: the control group treated with normal saline for 14 days (14일 동안 생리식염수로 처리한 대조군) - experimental group: the treatment group subjected to topical smear and intragastric administration of 800 mg/kg Eucommia water extracts once a day for 14 days (14일 동안 하루 한 번 800mg/kg의 두충수 추출물을 국소 도말하고 위 내 투여) 치주염 모델 치은 조직 (24 SD rats의 제2대구치) 치주염 유도: 결찰, P. gingivalis 박테리아 접종 - control group: 28일 동안 생리식염수 처리 - experimental group: 국소 도말과 800mg/kg의 두충수 추출물을 28일 동안 하루에 한 번 위 내 투여	1. superoxide dismutase superoxide dismutase (SOD) (치은염, 치주염) 2. catalase (CAT) (치은염, 치주염 3. 치조골 흡수 (치주염) 4. 상악 제2 치주 조직의 변화 (치주염) 5. Interleukin 1 β(IL-1β) 6. Interferon-gamma(IFN-γ) serum
21	A. A. Kompiang Martini et al., Administration of 50% propolis ethanolic extract increases the number of gingivitis fibroblast in H2O2-induced rats, 2019	Gingivitis, fibroblasts, propolis ethanolic extract (EEP)	propolis ethanolic extract (EEP, 프로폴리스 에탄올 추출물)	32 male white rats (180-220 g, good general health status > 35% H2O2 유도) - control group (16마리): 3x5분 동안 연속으로 면 브러시를 사용하여 50% EEP를 도포 - experimental group (16마리): 연속된 며칠 동안 가장 3x5분만 뿌림	1. 섬유아세포의 수 2. 호중구와 대식세포와 같은 염증 세포의 수
22	Eiba G. Eltay et al., Punica granatum peel extract as adjunct irrigation to nonsurgical treatment of chronic gingivitis, 2021	Chronic gingivitis, Interleukin-1β, Nonsurgical periodontal treatment, Pomegranate peel extract, Oral irrigator, Phytotherapy	Punica granatum peel extract (PGPE, 석류 껍질 추출물)	18~60세의 만성 치은염 환자 31명 (최소 20개의 치아, 지난 3년 동안 항균 치료나 비타민 보충제를 복용하지 않았으며, 임신 중이 아니었고 경구 피임약을 사용하지 않았음) The control group: received distilled water (placebo) irrigation following the same protocol for group A The experimental group: received 5% PGPE irrigation via Waterpik irrigator (Waterpik® model WP-360, Inc USA) following NST	1. 치태 지수 (PI) 2. 치은 지수(GI) 3. periodontal probe (PPD) 4. GCF IL-1β

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23	Nyoman Wirata et al., Decrease in the number of Streptococcus mutans and Staphylococcus aureus bacterial colonies after administration of sentul fruit peel extract gel (Sandoricum koetjape) in gingivitis model of white Wistar rats, 2023	gel, extract, sentul peel (Sandoricum koetjape), bacteria, Streptococcos mutans, Staphylococcus aureus	sentul fruit peel extract gel (Sandoricum koetjape)	healthy male Wistar white rat의 치은 (건강한 수컷 Wistar 흰 쥐 30마리, 180-200 g (adult male rat weight), aged 2-3 months) - negative control group: no treat (K-) - positive control group: 센툴 과일 껍질 추출물의 나노 젤을 투여하지 않고 황색포도상구균 및 S. 뮤탄스 박테리아의 침투만 투여 (K+) - experimental group 1: 0.6% 센툴 과일 껍질 나노 젤을 투여 - experimental group 2: 1.2% 센툴 과일 껍질 나노 젤을 투여 - experimental group 3: 1.8% 센툴 과일 껍질 나노 젤을 투여 - experimental group 4: 2.4% 센툴 과일 껍질 나노 젤을 투여	1. 치은열구액(Gingival Crevicular Fluid, GCF) 내에 존재하는 미생물 군집의 수(CFU/mL)
24	M González Begné et al., Clinical effect of a Mexican Sanguinaria extract (Polygonum aviculare L.) on gingivitis, 2001	Sanguinaria, Mouth-rinse, Gingivitis, Dental plaque, Prevention, Oral hygiene, Flavonoids	natural Mexican Sanguinaria extract (Polygonum aviculare L.)	치은염을 앓고 있는 멕시코 남자 60명 (18~25세) 대조군: 위약 용액 사용 실험 제1군: Sanguinaria의 뿌리 추출물 기반 구강 세정제 사용 실험 제2군: Sanguinaria의 줄기 추출물 기반 구강 세정제 사용 실험 제3군: Sanguinaria의 잎,꽃 추출물 기반 구강 세정제 사용	1. 치태 지수 (PI) 2. 치은 지수(GI) 3. 항균 효과 4. 항염증 효과 5. Plaque and Gingivitis Reduction Over Time (7일, 11일, 14일째 치태 및 치은염 감소 정도) 6. 참여자 치아 수 (실험 시작 시 최소 24개의 자연 치아를 보유한 참가자)
25	Robert A. DiSilvestro et al., Pomegranate extract mouth rinsing effects on saliva measures relevant to gingivitis risk, 2009	pomegranate, flavonoids, gingivitis, salivary, bacterial, antioxidant	Pomegranate Extract (석류 추출물)	(19-25세) 건강한 비흡연 청년 남성(16명), 비임신 여성(16명) 대조군(남8, 여8): 위약(옥수수 머핀 믹스)으로 구강을 헹구기 실험군(남8, 여8): 석류 추출물을 헹구기 구강 문제가 없거나 경미한 치은염 (치과 의사 확인) 플라보노이드나 다른 폴리페놀이 함유된 보충제를 정기적으로 섭취하지 않음 녹차나 콩 제품과 같이 폴리페놀이 많이 함유된 식품을 일주일에 2회 이상 섭취하지도 않음 타액 분비를 방해하는 약물(예: 항히스타민제, 항콜린제, 특정 이뇨제, 특정 고혈압 약물, 근육 경련 약물, 특정 충혈 완화제, 특정 항우울제)을 복용하지 않음 구강 내 장치를 사용하지 않음 최근에 항생제를 사용한 적이 없음 주요 염증 또는 산화 스트레스를 유발할 수 있는 질병(예: 당뇨병, 암, 관절염, 크론병 등) 없음	1. 타액 내 총 단백질 함량 2. aspartate aminotransferase (AST)의 타액 내 활성 3. 자당 분해 효소인 alpha-glucosidase (AG)의 타액 내 활성 4. 항산화 효소인 ceruloplasmin 활성 (처리 전후 수준) 5. 타액의 자유 라디칼 제거 능력의 척도 (= 총 항산화 상태)

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26	Gonzalez-Serrano, J. et al., Short-term efficacy of a gel containing propolis extract, nanovitamin C and nanovitamin E on peri-implant mucositis: A double-blind, randomized, clinical trial, 2021	Peri-implant mucositis (PM), Propolis extract, Nanovitamin C and Nanovitamin E, Bleeding on probing (BOP), Tannerella forsythia	gel containing propolis extract, nanovitamin C and nanovitamin E	n=46 - PM(탐침 시 출혈(BOP)과 방사선적 골 손실이 없는 상태에서의 농양)으로 진단된 하나 이상의 임플란트를 가진 환자 - 방사선적 골 손실(임플란트 주위염), 치료되지 않은 치주염, 나머지 치열의 심각한 치은 염증(BOP > 30%), 연구 결과를 바꿀 수 있는 전신 질환 또는 상태(당뇨병, 면역 억제, 감염성 질환, 류마티스 질환, 비스포스포네이트 치료 병력, 방사선 요법, 화학 요법 등)가 있는 경우는 제외 - 2개월 이내에 국소, 전신 항생제를 복용한 환자 제외 - 임신 또는 모유 수유 중인 여성 제외 - 젤 성분에 알레르기가 있는 환자 제외 [Human] 대조군: 위약 성분 함유한 겔을 치약으로 사용한 군 실험군: 2% 프로폴리스 추출물, 0.2% 비타민 C, 0.2% 비타민 E를 함유한 겔을 치약으로 사용한 군 [ex vivo] 가장 깊은 임플란트 주머니에서 멸균 종이 팁으로 샘플링	[Human] 1. 치태 지수 (PI) 2. 탐침 시 출혈 (BOP) 3. Modified Bleeding Index (mBI) 4. 치주낭 깊이 (PD) 5. Mucosal Redness (MR) 6. Keratinized Tissue Width (KT) [ex vivo] 1. 총 혐기성 세균 수 2. 표적 미생물 당 평균 수 * 표적 미생물 = 치주 병원균 (Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis, Prevotella intermedia, Tannerella forsythia, Parvimonas micra, Fusobacterium nucleatum, Campylobacter rectus, Eikenella corrodens, Capnocytophaga sp., Actinomyces odontolyticus)
27	Kaori Takahashi et al., Therapeutic effect of aged garlic extract on gingivitis in dogs, 2023	aged garlic extract, dog, oral health, oral hygiene, dental homecare, gingival index, halitosis, salivary cathelicidin	aged garlic extract (AGE)	비글견 10마리(수컷 4마리, 암컷 6마리, 나이 2~9세, 체중 9.8~11.8kg, 임상적으로 건강) 대조군(수컷 2마리, 암컷 3마리): 8주 동안 매일 한 번 42.9mg/kg 위약을 뿌린 건조 사료 250g를 먹인 대조군 (나이 4.6±1.2세, 체중 10.76±0.41kg, 평균 잇몸 지수 0.57±0.10) 실험군(수컷 2마리, 암컷 3마리): 8주 동안 매일 한 번 건조 AGE 추출물 18mg/kg을 뿌린 건조 사료 250g를 먹인 투여군 (나이 3.8±0.8세, 체중 10.76±0.35kg, 평균 잇몸 지수 0.53±0.13) 물은 자유롭게 제공 먹이를 준 후, 모든 개가 사료를 완전히 먹었는지 확인	1. 치은 지수 (Gingival Index, GI) 2. 체중 3. 공기 중 휘발성 유황 화합물 (VSC) 수준 4. 티올(유황 화합물) 수치 5. C-반응성 단백질 (C-reactive protein, CRP) 6. 혈청 아밀로이드 A (Serum Amyloid A, SAA) 7. 치주병원균 효소 활성 8. 침샘 IgA 9. 카텔리시딘 항균 펩타이드 (Cathelicidin Antimicrobial Peptide, CAMP)

28	Firdaus Robiatul et al., Inhibitory Effect of Lemongrass Extract (Cymbopogon Citratus) in Supragingival Plaque Bacterial Growth for Gingivitis Patient A Research Study, 2022	Gingivitis; Human and Health; Lemongrass; Minimum Inhibitory Concentration (MIC); Supragingival Plaque Bacteria	레몬그라스 추출물(Cymbopogon Citratus)	치은염 환자의 치은상부 플라그 박테리아 양성 대조군: (시험관 1) 치은염 환자의 치은상부 플라그 박테리아 현탁액만 있음 실험 제1군: (시험관 2) 100% 레몬그라스 추출물 10ml + 치은상부 플라그 박테리아 현탁액 1ml 실험 제2군: (시험관 3) 50% 레몬그라스 추출물 + 치은상부 플라그 박테리아 현탁액 1ml +BHIB 배지 5ml 실험 제3군: (시험관 4) 25% 레몬그라스 추출물 + 치은상부 플라그 박테리아 현탁액 1ml +BHIB 배지 5ml 실험 제4군: (시험관 5) 12.5% 레몬그라스 추출물 + 치은상부 플라그 박테리아 현탁액 1ml +BHIB 배지 5ml 실험 제5군: (시험관 6) 6.25% 레몬그라스 추출물 + 치은상부 플라그 박테리아 현탁액 1ml +BHIB 배지 5ml 실험 제6군: (시험관 7) 3.125% 레몬그라스 추출물 + 치은상부 플라그 박테리아 현탁액 1ml +BHIB 배지 5ml 실험 제7군: (시험관 8) 1.56% 레몬그라스 추출물 + 치은상부 플라그 박테리아 현탁액 1ml +BHIB 배지 5ml 실험 제8군: (시험관 9) 0.78% 레몬그라스 추출물 + 치은상부 플라그 박테리아 현탁액 1ml +BHIB 배지 5ml 음성 대조군: (시험관 10) BHIB(Broth Heart Infusion Base) 배지 10ml	1. 박테리아 성장 (흡광도, OD) 2. 살아있는 박테리아의 비율 (흡광도 백분율, %A)
29	Clinical and microbiologic effects of commercially available gel and powder AR Pradeep et al., containing Acacia arabica on gingivitis, 2012	Acacia arabica, Gingivitis, Anti-plaque agent, Chlorhexidine, Plaque index	아카시아 아라비카(Acacia arabica)	120명의 치아가 있는 대상자(남성 60명, 여성 60명, 평균 연령 27.37세) - 만성 전반성 치은염으로 진단받고, 25~40세 - 최소 20개의 자연치아를 가지고 있음 - 치주 치료의 병력이 없음 - 지난 6개월 동안 항생제나 항염제를 사용한 적이 없음 - 치은 지수 14 >1, 치주낭 탐침 깊이 ≤3mm, 임상적 부착 손실 = 0의 임상적 기준을 충족 - 방사선적 골 손실 없음 - 제형 성분에 대한 알레르기가 있는 대상자 제외 - 혈액학적 장애 또는 기타 전신 질환이 있는 대상자 제외 - 임신 및 수유 중인 여성 제외 - 교정 치료를 받고 있는 대상자 제외 - 흡연 습관이 있는 대상자 제외 대조군: 위약이 포함된 젤 실험 제1군: 아카시아 아라비카 + 기타 허브 성분이 포함된 젤	[Human] 1. 치태 지수 (PI) 2. 치은 지수(GI) 3. 탐침 깊이 (PD) [ex vivo] 1. Plaque Bacterial Counts - 연쇄상구균(Streptococcus) 종: Streptococcus sanguis, Streptococcus mitis, Streptococcus intermedius, Streptococcus oralis - 방선균(Actinomyces) 종: Actinomyces viscosus, Actinomyces naeslundii

30	Stela Peycheva et al., Effect of Bulgarian propolis on the oral microflora in adolescents with plaque-induced gingivitis, 2018	Bulgarian propolis, Candida albicans, Oral pathogens, Plaque-induced gingivitis, Prevotella spp., Streptococcus spp.	Bulgarian propolis	중등도의 치은염이 있는 70명 (12~18세) 충치 병변을 치료하고, 불량한 치과 보철물을 교정하고, 치석이 있는 경우 제거함 - 신체적, 정신적으로 건강한 청소년 (영구치열 포함) - 중등도 치태 유발 치은염 진단(GI = 1.1~1.9) - 치열 교정 기구를 사용한 치료 받은 사람 제외 - 턱과 치아의 심각한 변형 있는 사람 제외 - 심각한 치태 유발 치은염 있는 사람 제외 - 흡연자 제외 대조군(35명): [제공된 치약]으로 하루 두 번 2.5~3분 동안 양치 실험군(35명): [제공된 치약+Propolin 10방울(불가리아 프로폴리스 포함됨)]으로 하루 두 번 2.5~3분 동안 양치 [ex vivo] 하악 중절치의 치은 가장자리 근처의 건조된 전정 치아 표면에서 치태 샘플을 채취함	[Human] (임상 바이오마커) 1. 치태 지수 (PI) 2. 치은 지수(GI) [ex vivo] (미생물학적 바이오마커) 1. 호기성 박테리아 - Streptococcus spp. (S. viridans group (excl. S. mutans), S. mutans 포함) - Neisseria spp. - Candida spp. (C. albicans 포함) 및 형태학적 특징 2. 혐기성 박테리아 - Bifidobacterium spp. - Fusobacterium varium - Gr (-) cocci - Gr (-) rods (excl. Porphyromonas) - Gr (+) rods - Porphyromonas asaccharolyticus - Prevotella bivia - Prevotella intermedia - Prevotella melaninogenica - S. intermedius 3. Actinomyces spp.

31	José González-Serrano et al., Efficacy and safety of a bioadhesive gel containing propolis extract, 2022 nanovitamin C and nanovitamin E on desquamative gingivitis: a double-blind, randomized, clinical trial, 2022	Desquamative gingivitis, Oral lichen planus, Mucous membrane pemphigoid, Propolis, Antioxidants	gel-containing propolis extract, nanovitamin C, and nanovitamin E	22명의 환자(18세 이상) - 임상적으로 DGDG(erythema, epithelial desquamation, atrophy, painful erosions, or ulceration of the free and/or attached gingiva)로 진단된 환자 - MMP의 임상적 및 조직학적 진단을 받은 환자 - 플라그 유발 치은염의 임상적 진단 또는 탐침 깊이(PD) ≤ 5mm로 치주 유지 관리를 받는 환자 - 연구 결과에 영향을 줄 수 있는 전신 질환 또는 상태(통제되지 않는 당뇨병, 면역 억제, 감염성 질환, 류마티스 질환, 비스포스포네이트 치료 병력, 방사선 요법, 화학 요법, 면역 요법) 진단을 받은 환자 제외 - 사이클로스포린, 칼슘 통로 차단제, 페니토인과 같은 잇몸 비대와 관련된 약물을 사용한 활성 약물 복용 환자 제외 - 지난 4주 또는 8주 이내에 전신 코르티코스테로이드로 국소 코르티코스테로이드 치료를 받은 환자 제외 - 지난 3개월 이내에 국소 및/또는 전신 항생제 및/또는 항염제를 사용한 치료를 받은 환자 제외 - 임신 또는 모유 수유하는 사람 제외 - 흡연자 제외 - 항플라그 또는 항치은염 구강 세척제를 사용하는 환자 제외 - 테스트된 젤의 구성 요소에 대한 알레르기 병력이 있는 환자 제외 실험군(n =11): 프로폴리스 추출물 2%, 비타민 C 0.2%, 비타민 E 0.2% 함유된 젤 + 부드러운 칫솔 대조군(n =11): 유효성분 없이 색소만 첨가된 위약 젤 + 부드러운 칫솔 4주 동안 하루에 3번 지정된 젤을 치약 + 수정된 Bass 칫솔질 기술로 양치	1. DGCS 점수 (Desquamative Gingivitis Clinical Score) 2. 탐침 깊이 (PD) 3. 탐침 시 출혈 (BOP) 4. 치태 지수 (PI) 5. 시각적 상사 척도 (VAS) 6. 구강 건강 영향 프로필 (OHIP-14) 설문지

Key published and unpublished reports, central to the Periodontitis – 12

32	Johanna Weber et al., Randomized controlled clinical trial on the efficacy of a novel antimicrobial chewing gum in reducing plaque and gingivitis in adolescent orthodontic patients, 2024	Chewing gum, Essential oil, Plaque accumulation, Gingivitis, Orthodontic treatment	계피, 레몬, 페퍼민트와 같은 에센셜 오일과 추출물을 함유한 항균 껌	고정식 또는 이동식 기구로 치열교정 치료를 받는 11~22세 52명 전체 구강 API > 40%로 나타난 바와 같이 불충분한 구강 위생 상태 당뇨병, 종양 질환, 류마티스 관절염, 두 가지 껌의 성분 중 하나 이상에 대한 알려진 알레르기 또는 불내증, 지난 3개월 이내에 항생제를 사용한 경우는 제외 대조군(26명): 시중에서 판매하는 츄잉껌 시험군(26명): 계피, 레몬, 페퍼민트와 같은 에센셜 오일과 추출물을 함유한 항균 껌 환자는 10일 동안 하루 4회, 15분씩 이 껌을 씹음	[객관적 임상 지표] 1. API (Approximal Plaque Index) 2. PBI (Papilla Bleeding Index) [주관적 설문 지표] 1. COHIP-G19
33	Jayant Prakash et al., Effect of Punica granatum Extract Gel on Gingival Crevicular Fluid Levels of Interleukin-1β, Interleukin-8 and CCL28 Levels: Randomised Controlled Clinical Trial, 2017	Chlorhexidine, Cytokine, Gingivitis, Oral health, Oral hygiene, Ornidazole	석류 추출물, 클로르헥시딘, 오르니다졸	전신적으로 건강한 80명 (18-35세) - 탐침 깊이(Probing Depth) ≤ 3mm, Gingival Index (GI) ≥ 1.95, Plaque Index (PI) ≥ 1.95 - 최소 20개의 자연치아 보유 - 최근 6개월 이내 항생제 또는 항염증제 복용자 제외 - 최근 6개월 이내 치주 치료 또는 구강 청소(스케일링 등) 병력이 있는 자 제외 - 구강 연조직 병변(Oral Soft Tissue Pathology) 존재하는 자 제외 - 담배 흡연자 및 구강 자극제(씹는 담배 등) 사용자 제외 - 심각한 우식 치아, 완전 금관(Full Crown), 교정 장치가 부착된 치아, 보철물 지지치아, 또는 제3대구치(사랑니)는 치아 수에 포함되지 않음 - 임신 또는 수유 중인 여성 제외 음성 대조군: 활성 성분이 없는 위약 겔(PG) 양성 대조군1: 클로르헥시딘(CHX)을 함유한 겔 (각 그램에는 클로르헥시딘 글루코네이트 1% w/w에 해당하는 클로르헥시딘 함유) 양성 대조군2: 오르니다졸과 클로르헥시딘(CHX ORD)을 함유한 겔 (각 gm은 오르니다졸(10mg) 및 클로르헥시딘 글루코네이트 용액 IP 0.25% w/w 함유) 실험군: 10% 석류 추출물 젤 (PEG)	[임상적 치주 바이오마커] 1. 치은 지수(GI) 2. 치태 지수 (PI) 3. 탐침 시 출혈 (BOP) 4. Probing Depth (PD) [염증 및 면역 바이오마커] 1. Interleukin-1β (IL-1β) 2. Interleukin-8 (IL-8) 3. Chemokine (C-C motif) Ligand 28 (CCL28) [주관적 평가 바이오마커] 1. 부작용 평가 설문지 (통증, 화끈거림, 가려움, 구강 건조, 맛 변화, 치아 변색, 쓴맛)