A systematic review of randomized controlled trials assessing phytochemicals and natural ingredients for skin and hair care

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Table 1: Summary of randomized controlled trials (RCTs) conducted between 1997 and 2020 of plants, herbs, or isolated compounds used for skin care.

Skin care (*n* = 53)										
Author, year	**Country**	**Population (n)**	**Intervention (dose/method of application)**	**Comparison(s)**	**Outcome(s), p value**	**Method of testing**	**Duration**	**Scientific name of plant used**	**Part used**	**Dosage form**
Skin protection										
Gonzalez S et al., 1997	Spain	18–46-year-old males and females untreated or treated with oral psoralens (21)	Topical or oral *Polypodium leucotomos* (oral dose = 1080 mg)	Untreated control	1. Immediate pigment darkening (IPD): UV dose significantly increased ($p<0.01$) 2. Minimal erythema dose (MED): UV dose significantly increased ($p<0.01$) 3. Minimal melanogenic dose (MMD): no significant difference 4. Minimal phototoxic dose (MPD): UV dose significantly increased ($p<0.01$) 5. Langerhans cells examination: partial prevention of acute phototoxicity compared with untreated skin	1. Immediate pigment darkening (IPD) 2. Minimal erythema dose (MED) 3. Minimal melanogenic dose (MMD) 4. Minimal phototoxic dose (MPD) 5. Langerhans cells examination of psoralen-sensitized volunteers	3 days	*Polypodium eucotornos*	-	Capsules containing 120 mg *Polypodium eucotornos* or lotion containing 10, 25, and 50% *Polypodium eucotornos* extract (v/v)
Camouse M et al., 2008	USA	19–58-year-old males and females (90)	Topical green tea or topical white tea applied min	Placebo	Contact hypersensitivity (CHS): no significant effect ($p>0.05$)	Contact hypersensitivity (CHS) evaluated by the total millimetre increase in	2 days	*Camellia sinensis*	-	-

			prior to solar-simulated ultraviolet radiation (ssUVR) irradiation, as well as immediately after it			skin fold thickness (SFT)				
Rival D et al., 2009	France	Group A: 40–50-year-old females (20) Group B: 50–60-year-old females (40)	Group A: topical product containing 3% *Hibiscus abelmoschus* Group B: topical product containing 3% *Hibiscus abelmoschus* and topical product containing 3% vitamin C	Placebo	1. Skin elasticity: improved for both groups and both products 2. Skin firmness, texture, and density: improved for both groups and both products Fringe projection: significantly reduced compared to the placebo in group B for both products ($p<0.05$)	1. Skin elasticity measured on the cheek using a ballistometer 2. A visual and tactile evaluation of skin firmness, texture, and density performed by an expert clinician 3. Depth of the main wrinkle analyzed by fringe projection	6 weeks	*Hibiscus abelmoschus*	Seed	-
Bazin R et al., 2010	Germany	45–65-year-old Caucasian females (24)	Emulsion containing soy and jasmine applied twice daily	Placebo	Global signals detected in the dermis significantly higher ($p<0.05$)	Multilayers acquisitions using a multiphoton tomograph with subcellular resolution	12 weeks	-	-	Emulsion
Akhtar N et al., 2011	Pakistan	24–35-year-old healthy males and females (21)	W/O emulsions containing 3%	Placebo	Hydration and firmness of skin were significantly improved ($p<0.05$)	Mechanical parameters of the skin using noninvasive suction skin elasticity meter	8 weeks	*Calendula officinalis*	-	Cream

			Calendula officinalis			Cutometer 580 MPA				
Wineman E et al., 2012	Israel	Antiwrinkles effect: ≥45-year-old females (20) Skin hydration: 19–60-year-old females (10)	A cream containing complex of Dead Sea water and three Himalayan (Tibetan goji berries, moss lichen, and Himalayan raspberry) extracts applied once daily	Untreated control	Antiwrinkles effect: wrinkles depth significantly reduced ($p<0.05$) Skin hydration: significantly increased ($p<0.05$)	Antiwrinkles effect: the depth of one single wrinkle in the eye examined before and after application by PRIMOS optical 3D measuring device Skin hydration: electrical capacitance measured using capacitance meter (Corneometer CM 825)	Antiwrinkles effect: 4 weeks Skin hydration: 12 hours	-	Tibetan goji: berries Himalayan raspberry: root	Cream
Danby SG et al., 2013	UK	Cohort 1: males and females with an average age of 46 ± 5.7 years with previous atopic dermatitis (AD), no symptoms for 6 months (7) Cohort 2: males and females with an average age of 46 ± 5.7 years with/without previous AD, no symptoms for 6	Cohort 1: Six drops of olive oil applied to the forearm twice daily Cohort 2: six drops of olive oil or sunflower oil applied to the forearm twice daily	Untreated control	Cohort 1: 1. Transepidermal water loss (TEWL): significantly increased with tape stripping ($p<0.001$) 2. Cohesiveness of stratum corneum (SC): significantly decreased in volunteers with a history of AD ($p<0.05$) 3. SC hydration: no significant effect ($p>0.05$) 4. Erythema: higher Cohort 2: 1. TEWL: no significant effect 2. Cohesiveness of SC: no significant effect ($p>0.05$) 3. SC hydration: significantly	1. Skin-surface pH measured using pH meter (PH905) 2. Stratum corneum (SC) hydration measured using Corneometer (CM825) 3. Erythema measured using Mexameter (MX 18) 4. Transepidermal water loss (TEWL) measured using an AquaFlux AF200 5. Protein removed using tape stripping performed in conjunction with TEWL, then the	Cohort 1: 5 weeks Cohort 2: 4 weeks	*Olea europaea* *Helianthus annuus*	*Olea europaea*: fruit *Helianthus annuus*: seed	Oil

		months (12)			higher ($p<0.05$) 4. Erythema: no significant effect ($p>0.05$)	amount of protein that each disc immediately determined using infrared densitometry				
Ilnytska O et al., 2016	USA	18–65-year-old healthy females with bilateral moderate to severe dry skin on their lower legs (50)	Colloidal lotion containing oatmeal extract applied twice daily	Untreated control	1. Dry skin: significantly improved ($p<0.05$) 2. Skin barrier integrity and hydration: significantly improved ($p<0.05$)	1. Dry skin: visual evaluation and using Dermalab 2. Skin barrier integrity and hydration assessed by transepidermal water loss (TEWL) measurements and using Skicon 200 EX	5 weeks	*Avena sativa*	-	Lotion
Ray S et al., 2016	UK	40–68-year-old males (32)	Low-concentration or high concentration blackcurrant juice drink	Placebo	No significant difference ($p>0.05$)	1. Phototesting using a calibrated irradiation monochromator 2. Minimal erythema dose (MED)	6 weeks	-	-	Juice
Lee KE et al., 2016	South Korea	Females with an average age of 47.7 ± 4.8 years (20)	0.5% phenolic veratric acid cream	Placebo	1. Visual evaluation: showed improvement 2. Photometric evaluation: significantly improved ($p<0.01$) 3. Self-assessment: positive feedback	1. Visual evaluation 2. Photometric evaluation using Skin-Visiometer SV 600 3. Self-assessment	12-weeks	-	-	Cream
Wang Y et al., 2017	France	Females with an average age of 37.1 ± 10.6 years with dry and sensitive skin (20)	A cream containing Yunnan *Portulaca oleracea* extract, *Prinsepia utilis* oil,	A control cream containing *Carthamus tinctorius* extract and oil	1. Visual evaluation: a significant improvement 2. Self-assessment questionnaire: test cream was significantly favoured ($p<0.05$) of dryness, erythema, and roughness was observed	1. Visual evaluation including dryness, roughness, desquamation, and erythema 2. Self-assessment questionnaire 3. Transepidermal	4 weeks	*Portulaca oleracea* *Prinsepia utilis*	-	Cream

			beta-glucan, and sodium hyaluronate extracted from mushroom applied to 1 side of the face twice daily		compared to baseline ($p<0.05$). For skin desquamation, no significant difference was observed 3. Hydration index: significantly increased ($p<0.05$) 4. Skin texture parameter: roughness significantly declined, and smoothness significantly increased ($p<0.05$) 5. Skin barrier function (TEWL), sebum recovery (lipid index), wettability, color, and stinging test: no significant effect ($p>0.05$)	water loss assessment using Vapometer 4. Skin hydration assessment using Corneometer CM825 5. Lipid index assessment using Sebumeter SM 815 6. Skin texture assessment using Visioscan VC98 7. Skin-surface wettability 8. Skin color using Minolta 400 Chroma Meter 9. Skin sensitivity using a stinging test with 10% lactic acid				
Egoumenides L et al., 2018	France	19–50-year-old healthy Caucasian (93)	1. A melon concentrate capsule containing 20 mg superoxide dismutase 2. Cream containing 12 U superoxide dismutase per cm^2 of skin	Placebo	Minimal Erythema Dose (MED): significantly higher for both cream and capsule ($p<0.05$)	Minimal Erythema Dose (MED) using ORIEL solar simulator as a source of radiations	4 weeks	*Cucumis melo* L.	Skin and seeds	1. Hard capsule 2. Cream
Antiaging										
Martelli L et al., 2000	Italy	20–25-year-old healthy female (20)	A cream containing boswellic	Placebo	1.Skin hydration: no significant difference 2. Biomechanical properties:	1. Skin Hydration measured by electrical capacitance by	4 weeks	*Centella asiatica*		Cream

			acids, silybin, and *Centella asiatica* extracts		significantly increased ($p<0.02$) No adverse effects were reported	Coneometer 2. Biomechanical properties (extensibility and firmness) of the skin measured using suction device (Dermaflex)				
Bauza E et al., 2002	France	46–58-year-old females (10)	Cream with 5% date palm kernel extract on the eye area twice daily	Placebo	1. Skin microrelief evaluation: total surface of wrinkles was significantly reduced ($p<0.05$) 2. Clinical evaluation: 60% of participants showed improvement 3. Questionnaire: 50% of participants reported improvement	1. Skin microrelief evaluation: silicon replica analysis using a software 2. Clinical evaluation under a magnifying glass 3. Questionnaire	5 weeks	-	Kernel	Cream
Kim YH et al., 2008	Korea	35–53-year-old healthy females (20)	0.03% ziyuglycoside I cream	Placebo	1. Visual evaluation: intervention showed a nonsignificant difference between 4-8 weeks, significant results were observed after 12 weeks of treatment ($p<0.05$) 2. Photometric evaluation: mean depth of roughness showed a significant difference in 12 weeks ($p<0.05$)	1. Visual evaluation using photodamage score 2. Photometric evaluation using Skin-Visiometer SV 600	12-weeks	*Sanguisorba officinalis*	Root	Cream
Kim YH et al., 2010	Spain	34-49-year-old healthy females (25)	0.2% *P. strobilacea* extract	Placebo	1. Visual evaluation: intervention showed a nonsignificant difference between 4-8 weeks, significant results were observed after 12 weeks of treatment ($p<0.05$)	1. Visual evaluation 2. Photometric evaluation 3. Image analysis using Skin-Visiometer SV 600	12-weeks	*Platycarya strobilacea*	Fruit	Cream

					2. Photometric evaluation: average difference in roughness showed a significant difference in 12 weeks ($p<0.05$)					
Kanlayavattanakul M et al., 2016	Thailand	25–50-year-old healthy males and females (24)	Cream containing 0.1 or 0.2% rice panicle extract applied twice daily	Placebo	Skin hydration: significantly improved ($p<0.05$) Skin lightening: significantly improved ($p<0.001$) Skin firming: significantly increased ($p<0.05$) Skin wrinkle: significantly reduced ($p<0.05$)	Clinical evaluation using Corneometer® CM 825, Cutometer® MPA 580, Mexameter® MX 18 and Visioscan® VC 98	12 weeks	*Oryza sativa cv. indica*	Rice panicle	Cream
Yoshida H et al., 2018	Japan	34–56-year-old healthy females (21)	A gel containing 20 mg/mL of *G. thunbergii* extract	Placebo	Skin wrinkle scores: significantly reduced ($p<0.05$) Skin hydration: significantly improved ($p<0.05$) No side effects reported	1. The antiwrinkle efficacy evaluated by visual scoring by a dermatologist, 3D skin replica images obtained from the eye corner using Silflo® and the 3D image analyzer PRIMOS system. 2. Skin elasticity measured using the Cutometer DUAL MPA580 w	8 weeks	*Geranium thunbergii*	Leaves	Gel
Roh S. et al., 2018	Korea	40–50-year-old healthy females (46)	SHYBE extract included: 0.0385% liquorice extract, 0.0765% *Angelica gigas* extract,	Placebo	1. Skin hydration: significantly increased at week 4 ($p<0.05$) 2. Skin elasticity: significantly increased at week 4 ($p<0.05$) 3. Dermal thickness and density: significantly increased at week 4 ($p<0.05$) 4. Self-assessment: no	1. Skin hydration evaluation using Corneometer® CM 825 2. Skin elasticity evaluated using Cutometer® MPA580 3. Dermal thickness and density evaluation	8 weeks	Licorice: *Glycyrrhiza glabra*, *Angelica gigas*, *Peach: Prunus persica*, *Ophiopog*	*Glycyrrhiza glabra*: root, *Angelica gigas:* root, *Prunus persica:*	Cream

			0.0765% peach extract, 0.0765% *Ophiopogon japonicus* extract, 0.0765% *Paeonia suffruticosa* extract, 0.0765% *Atractylodes japonica* extract, 0.1290% *Poria cocos*, 0.1290%*Rehmannia chinensis* extract, 0.0385% *Cimicifuga simplex* extract, 0.0765% *Asparagus cochinchinensis* extract (0.0765%), 0.0385% safflower extract, 0.0385% *Scutellaria baicalensis* extract (0.0385%),		significant differences 5. Safety assessment: No adverse events were reported	Dermascan® C 4. Self-assessment using a questionnaire 5. Safety assessment by a dermatology specialist		*on japonicus, Paeonia suffruticosa, Atractylodes japonica, Poria cocos, Rehmannia chinensis, Cimicifuga simplex, Asparagus cochinchinensis, Scutellaria baicalensis, Astragalus membranaceus, Safflower: Carthamus tinctorius*	kernel, *Ophiopogon japonicus:* root, *Paeonia suffruticosa:* root, *Atractylodes japonica:* rhizome, *Poria cocos:* sclerotium, *Rehmannia chinensis:* root, *Cimicifuga simplex:* root, *Asparagus cochinchinensis:* root, *Carthamus tinctorius:* flower, *Scutellar*	

			and 0.1290% *Astragalus membranaceus* extract						*ia baicalensis:* root, and *Astragalus membranaceus* root	
Goldberg DJ et al., 2019	USA	Efficacy and tolerability study: 40–65-year-old healthy females (39) Hydration study and transepidermal water loss study: 18–65-year-old males and females (24) Test in oily skin: 30–65-year-old healthy females (31) Noncomedogenic study: 18–55-year-old females with combination or oily	Night facial serum (NFS) containing melatonin, bakuchiol, and ascorbyl tetraisopalmitate applied daily	Untreated control	Efficacy and tolerability study: 1. Wrinkle roughness: significantly decreases ($p<0.05$) 2. Skin firmness: skin deformation volume and depth decreased significantly ($p<0.05$) 3. Pigmintation: Significant decrease in pigmentation in comparison with baseline ($p<0.05$) Hydration study and transepidermal water loss study: 1. Hydration kinetics: significantly improved ($p<0.05$) 2. Transepidermal water loss (TEWL): significantly improved until after 6 hours of application only ($p<0.01$) Test in oily skin 1. Sebum secretion:	Efficacy and tolerability study: 1. Wrinkles assessment using Dermatop 2. Firmness assessment using Dynaskin 3. Pigmentation assessment using A CM-700d Spectrocolorimeter 4. Subject questionnaire Hydration study and transepidermal water loss study: 1. Hydration kinetics using a Corneometer CM825 probe connected to a Cutometer dual MPA 580 2. Transepidermal water loss (TEWL) using a Tewameter®	Efficacy and tolerability study: 13 weeks Hydration study and transepidermal water loss study: 12 hours Test in oily skin: 28 days Noncomedogenesis study: 28 days	*Psoralea corylifolia* to obtain bakuchiol	Seeds	Serum

		facial skin with comeDones (33)			significantly decreased (p< 0.01) Noncomedogenesis study: 1. 85% of subjects had fewer comeDones after 28 days of treatment	TM 300 Test in oily skin: 1. Forehead sebaceous secretion measured using the Sebumeter SM 815 2. Subject questionnaire Noncomedogenesis study: 1. Clinical examination 2. Self-assessment				
Zeng X et al., 2019	China	35–60-year-old females with bilateral visible static crow's feet (20)	Formulation containing 2% *Zanthoxylum bungeanum* maxim extract	Placebo	1. Skin roughness: no significant difference (p>0.05) 2. Skin hydration: no significant difference (p>0.05) 3. Skin elasticity: no significant difference (p>0.05) 4. Subjective assessments: IGA score significantly decreased 5. Participants' self-assessment: 90% reported some improvement	1. Objective assessments of pictures taken using VISIA®. Crow's feet were measured by Primospico, a three-dimensional system for measuring skin roughness quantitatively 2. Skin hydration measured using Corneometer® CM825 3. Skin elasticity measured using Cutometer® MPA580 4. Subjective assessments: Investigator's global assessment (IGA) of the severity of the	4 weeks	*Zanthoxylum bungeanum* maxim	Fruit	-

						crow's feet recorded using a scale from 0 to 6 5. Participants' self-assessment of efficacy graded as worse, no improvement, some improvement, moderate improvement, and excellent improvement				
Im AR et al., 2020	Korea	40–59-year old Soyang- (SY-) type females (21)	Cream including 0.3 % *C. teeta* and *T. rosthornii* extract applied to the area around the eyes twice daily	Placebo	1. Visual assessment of skin wrinkles: skin damage was significantly restored ($p<0.05$) 2. Evaluation of skin wrinkle parameters using replica images: significantly decreased ($p<0.05$) 3. Questionnaire evaluation by participants: no significant difference ($p>0.05$) 4. Skin safety evaluation: no adverse dermatological events were observed	1. Visual assessment of skin wrinkles under specific lighting conditions 2. Evaluation of skin wrinkle parameters using replica images analyzed using Visioline VL650 3. Questionnaire evaluation by participants 4. Skin safety evaluation performed by assessing skin irritation through an interview and by medical examination	12 weeks	*Coptis teeta* *Trichosanthes rosthornii*	*Coptis teeta*: rhizome *Trichosanthes rosthornii*: seed	Cream
Melasma/hyperpigmentation treatment and skin whitening										
Altaei T et al., 2012	Iraq	28–55-year-old males and females with melasma (96)	A cream containing 0.1% or 0.2% silymarin applied twice	No treatment and Placebo	1. Skin pigment evaluation (MASI): significantly improved ($p<0.05$) 2. Physician global assessment (PGA):	1. Skin pigment evaluation by melasma area and severity index (MASI) 2. Physician global	4 weeks	*Silybum marianum*	-	Cream

			daily		significantly improved ($p<0.05$) 3. Assessment of overall treatment: significantly satisfied ($p<0.05$)	assessment (PGA) 3. Assessment of overall treatment using a scale from 0 to 10				
Shin DH et al., 2013	Korea	21–53-year-old participants (25)	Lotion with 0.05% S. flavescens extract applied twice daily	Placebo	Significantly whitening by device and visual assessment ($p<0.05$)	1. Visual assessment by dermatologists 2. Whitening effects measured using a chromameter CR-400	8 weeks	*Sophora flavescens*	root	Lotion
White GM et al., 2013	USA	Hispanic females with moderate-to-severe facial melasma (40)	Oral *Polypodium leucotomos* extract three times daily	Placebo	1. Melasma Area Severity Index (MASI): No significant difference ($p= 0.14$) 2. Assessment of melasma-related quality of life (MelasQOL): No significant difference ($p = 0.62$)	1. Melasma Area Severity Index (MASI) 2. Assessment of melasma-related quality of life (MelasQOL)	12 weeks	*Polypodium leucotomos*	-	-
Mendoza CG et al., 2014	Philippines	18–60-year-old males and females with epidermal and mixed melasma (45)	3% *Rumex occidentalis* cream applied twice daily	4% hydroquinone cream and placebo	1. Melasma Area Severity Index (MASI): significantly improved compared with baseline ($p<0.05$) 2. Skin pigmentation and Mexameter MX18 readings: significantly improved compared with baseline ($p<0.05$)	1. Melasma Area Severity Index (MASI) 2. Skin pigmentation: using Mexameter MX18	8 weeks	*Rumex occidentalis*	-	Cream
Morag M et al., 2015	Poland	26–55-year-old females with melasma and lentigo solaris (102)	A cream with the aqueous extract from leaf of five-leaf serratula containing 2.51% of arbutin applied twice	Placebo	Average level of melanin: significantly improved for patients with melasma ($p<0.05$)	1. Skin discoloration and measuring the average level of melanin: video dermatoscope DermoGenius (LINOS) and a probe Mexameter MX18 2. Dermatoscopic	8 weeks	*Serratula quinquefolia*	Leaves	Cream with aqueous extract

			daily			examination: probe Mexameter MX18				
Lee HK et al., 2018	Korea	20–30-year-old females (40)	A cream with 2% (wt %) *Poria cocos* Wolf extracts applied once daily in the morning	Placebo	Skin brightness increased significantly ($p<0.05$)	Visual evaluation 2. Skin tone improvement measured using a Spectrophotometer CR 2600D	4 weeks	*Poria cocos* Wolf	-	Cream
Zhang MS et al., 2019	China	25–50-year-old males and females with melasma (90)	A cream containing herbal mixture (*China camellia* (1%), Sanchi (0.5%), *Prinsepia utili*s oil (0.5%), and *Portulaca oleracea* (1%))	Arbutin cream and placebo	1. Melasma area and severity index (MASI) score: significantly improved after 12 weeks ($p<0.05$) 2. Melanin index (MI): significantly decreased after 12 weeks ($p<0.05$) 3. Erythema index (EI): significantly decreased after 12 weeks ($p<0.05$) 4. The density of inflammatory cells: significantly decreased after 12 weeks ($p <0.05$) 5. The subjective satisfaction scores: "very satisfied" increased from 13.3% at week 4 to 33.3% at week 12	1. Melasma area and severity index (MASI) score, melanin index (MI), erythema index (EI), using Mexameter and photographed using VISIA 2. Assessment of density of inflammatory cells using a reflectance confocal microscopy 3. The subjective satisfaction scores: The volunteers evaluated their satisfaction with the following criteria: 0 = not satisfied, 1 = partially satisfied, 2 = satisfied, or 3 = very satisfied	12 weeks	*China camellia*, *Sanchi*, *Prinsepia utilis*, and *Portulaca oleracea*	-	Cream
Tsuchiya T et al., 2020	Japan	30–59-years-old females (100)	200 ml beverage containing 200 mg of	Placebo	1. Sunspot scores: significantly reduced ($p<0.05$) 2. Melanin index value: significantly reduced ($p<0.05$)	1. Sunspot score diagnosed by a dermatologist 2. Melanin index value	12 weeks	*Vitis vinifera*	Fruit	Beverage

			red wine oligomeric procyanidins once daily		3. Water content of the stratum corneum: significantly increased ($p<0.05$) 4. Skin viscoelasticity: no significant difference ($p>0.05$) 5. Wrinkle depth, and visual analog scale (VAS) questionnaire: no significant difference ($p>0.05$)	in sunspots, and skin color using a CIE 1976 lightness 3.Water content of the stratum corneum 4. Skin viscoelasticity 5. Wrinkle depth, and visual analog scale (VAS) questionnaire				
Bagatin JT et al., 2020	Brazil	32–49-year-old females with center-facial melasma (42)	Topical formulation containing the olive extract and oral placebo or Topical vehicle formulation and oral capsule containing the olive extract	Placebo	1. Modified Melasma Area and Severity Index (mMASI): no significant difference ($p>0.05$) 2. Melanin index: no significant difference ($p>0.05$)	1. Modified Melasma Area and Severity Index (mMASI) score (20) evaluated based on high resolution images and luminosity using VisioFace 1000D equipment 2. Melanin index evaluated using a spectrophotometer Mexameter	12 weeks	*Olea europaea*	Fruit	Topical: - Oral: capsule
Antihirsutism										
Javidnia K et al., 2003	Iran	16–53-year-old females with mild-to-moderate forms of idiopathic hirsutism localized to the face (45)	Creams containing 1% or 2% of Fennel extract applied twice daily	Placebo	Hair diameter from the facial area: significantly reduced using fennel extract ($p<0.05$)	Hair diameter measurement from the facial area	12 weeks	*Foeniculum vulgare*	Seeds	Cream

Vicente RA et al., 2009	Brazil	>18-year-old females with excess terminal hair (54)	A cream containing 6.0% of *Stryphnodendron adstringens* extract	Placebo	Significant improvement ($p<0.05$)	Clinical examination	26 weeks	*Stryphnodendron adstringens*	Bark	Cream
Sargazi A et al. 2016	Iran	18–24-year-old females (60)	Eucerin as a basal cream mixed with 1%, 2%, and 5% of alfalfa extract applied twice daily	Placebo	Hair growth length and hair diameters; significantly reduced ($p<0.05$)	Hair growth length and hair diameters measured using a caliper with 0.02-micrometer sensitivity	12 weeks	*Medicago sativa* L.	Leaves	Cream
Srivilai J et al., 2016	Thailand	18–23-year-old females (60)	A lotion containing 1 or 5% w/w essential oil of *C. aeruginosa*	Placebo	1. Safety pretesting (hydration, irritation, etc.): There was very little erythema and no edema 2. Hair growth: significantly diminished ($p<0.05$) 3. Hair density: insignificant effect ($P>0.05$) 4. Skin brightening: insignificant effect ($p>0.05$) 5. Participant questionnaire: generally positive	1. Transepidermal water loss (TEWL) assessment using a Tewameter®TM300 2. Skin hydration assessment using a Corneometer®CM825 3. Hair growth and hair density: images recorded by a video imager, hair lengths, and numbers were measured using a computer software 4. Melanin measurement using a Mexameter®MX18 5. Skin irritation and skin flaking, or scaling assessed by a practicing	12 weeks	*Curcuma aeruginosa*	Rhizomes	Lotion

						dermatologist 6. Participant questionnaire				
Srivilai J et al., 2018	Thailand	20–52-year-old females (30)	A lotion containing 5% sesquiterpene-Enriched Extract of *Curcuma aeruginosa* applied twice daily	Placebo	1. Hair growth: delayed response, retarded hair growth was observed after week 7 2. 2. Participant questionnaire: overall satisfaction ($p<0.05$)	1. Hair growth and length: images recorded by a video imager, hair lengths, and numbers were measured using a computer software 2. Participant questionnaire	13 weeks	*Curcuma aeruginosa*	Rhizomes	-
Moisturizer										
Filipović M et al., 2016	Serbia	Healthy females (76) 1. Phase I: average age = 21.15 ± 2.05 (52) 2. Phase II: on sodium lauryl sulfate- (SLS-) irritated skin, average age = 29.9± 8.9 (24)	Alpine Rose stem cells (ARSC), olive oil squalene, and a natural alkyl polyglucoside cream: Formula 1: 0.4% of ARSC Formula 2: 1% of squalene Formula 3: Commercially available with 0.4% of ARSC Formula 4:	Untreated control on the forearm	Phase I: 1. Electrical capacitance (EC): significant change with formula 2 and 3 ($p<0.05$) 2. Transepidermal water loss (TEWL): significantly decreased with formula 2 ($p<0.05$) Phase II: 1. Electrical capacitance (EC): significantly increased with formula 1, 2, and 5 ($p<0.05$) 2. Transepidermal water loss (TEWL): significantly decreased with all tested creams ($p<0.05$) 3. Erythema index (EI): significantly increased with formula 1, 4, and 5 ($p<0.05$)	1. Electrical capacitance (EC) using Corneometer® CM825 2. Transepidermal water loss (TEWL) using Tewameter® TM210 3. Erythema index (EI) using Mexameter® MX18 4. Skin elasticity using Cutometer® MPA580	Phase I: 21 days Phase II: 6 days	*Rhododendron ferrugineum*	Stem cells	Cream

			1% of squalene + 0.4% of ARSC Formula 5: 6% of squalene + 0.4% of ARSC Formula 6: Placebo							
Milani M et al., 2017	Italy	Healthy females with an average age of 40 years (20)	A fluid containing *C. asiatica* meristem cell culture	Untreated control	1. Skin hydration: significantly increased ($p<0.05$) 2. Transepidermal water loss assessed (TEWL): significantly decreased ($p<0.05$)	1. Skin hydration evaluated using a Corneometer 2. Transepidermal water loss (TEWL) evaluated using a Vapometer device	1 day	*Centella asiatica*	Leaves	Fluid
Kanlayavattanakul M et al., 2017	Thailand	23–39-year-old healthy males and females (24)	A gel containing 0.5% Malva nut polysaccharide (0.5%) or a formulation containing 0.2% polysaccharides, tamarind, and algae	Placebo	1. Safety assessment: no irritation observed 2. Skin hydration: Malva nut gel was shown to hydrate the skin more effectively than tamarind and base gels ($p<0.05$)	1. Safety assessment by a single application closed patch test 2. Skin hydration monitored by using Corneometer®CM 825	75-180 min	*Scaphium scaphigerum*	Seeds	Gel
Asada K et al., 2019	Japan	21–54-year-old males and females (47)	A hot water extract of *Curcuma longa* taken	Placebo tablets contained safflower	1. Water content of the skin surface: significantly increased ($p>0.05$) 2. Transepidermal water loss	1. Water content of the skin surface measured with a Skicon-200EX	8-weeks	*Curcuma longa*	Rhizomes	Tablets

			daily or a hot water extract + curcumin	color and kaoliang color to match the color of the other tablets	(TEWL): no significant difference ($p>0.05$) 3. Minimal erythema dose (MED): no significant difference ($p>0.05$)	2. Transepidermal water loss (TEWL) measured using a Vapo Scan ASVT100RS 3. Minimal erythema dose (MED) performed using a solar simulator 601-300 2.5 UV Multiport				
Anti-inflammatory										
Zhang YQ et al, 2014	China	18–65-year-old males and females (40)	A cream containing 3% cherry blossom extract applied twice daily to forearm with induced irritation using occlusive application of 3% sodium lauryl sulfate (SLS) for 24 hours	Placebo	1. Visual erythema scores: significantly decreased from the third day ($p<0.05$) 2. Erythema value: significantly decreased from the fifth day ($p<0.05$)	1. Visual erythema scores were evaluated by dermatologist 2. Erythema value measurement using Mexameter MX18	9 days	*Prunus yedoensis*	Flowers	Cream
Boonchai W et al., 2017	Thailand	15–72-year-old males and females with mild-to-moderate facial dermatitis (80)	A cream containing 4-t-butylcyclohexanol and licochalcone	0.02% triamcinolone	1. Physician's assessment: significantly improved ($p<0.05$) 2. Skin hydration: significantly increased ($p<0.05$)	1. Physician's assessment and redness score using a Eucerin redness rating card 2. Skin hydration and	4 weeks	*Glycyrrhiza inflata*	-	Cream

			applied twice daily		3. Patients evaluation of sensory symptoms: significantly decreased ($p<0.05$)	TEWL measured using a Corneometer CM825 and a Tewameter TM300 3. Patients evaluation of sensory symptoms for itching, pain, burning sensation, tingling, and redness using 10 cm visual analog scale				
Seiwerth J et al., 2019	Germany	Healthy males and females (42)	Cream with gentian, liquorice, and willow extract	1% hydrocortisone acetate	Ultraviolet (UV)-erythema test: significantly reduced compared with vehicle only ($P<0.05$)	Ultraviolet (UV)-erythema test using a Mexameter	48 hours	Gentian: *Gentiana lutea* liquorice: *Glycyrrhiza glabra* Willow: *Salix daphnoides*	*Gentiana lutea*: root *Glycyrrhiza glabra*: root *Salix daphnoides*: bark	Cream
Acne treatment										
Lee HE et al., 2011	South Korea	15–41-year-old males and females with mild-to-moderate acne (97)	APDDR-0901 (0.03% retinol, 0.7% rose extract, and 0.05% hexamidine diisethionate), daily in the evening	0.1% adapalene gel	1. Median percent change in lesion count: significantly improved from baseline ($p<0.05$) 2. Acne grade: significantly improved from baseline ($p<0.05$) 3. Physician-assessed global improvement: 84% achieved a significant response 4. Patient self-assessment: 77% reported improvement -Adverse effects including	1. Median percent change in lesion count 2. Acne grade 3. Physician-assessed global improvement 4. Patient self-assessment	12 weeks	-	-	-

					pricking were reported					
Weber N et al., 2018	Germany	21–49-year-old males and females with oily skin (21)	A cleanser containing coco-Glucoside, *Simmondsia chinensis* oil, *Gentiana lutea* extract, *Mentha arvensis* oil, *Humulus lupulus* extract, *Leptospermum scoparium* oil, *Salix daphnoides* extract, *Helianthus annuus* oil, Pectin, Xanthan gum	Face cleanser with sodium laureth sulfate	1. Skin sebum: significantly reduced only on day 17 after the application 2. Good skin tolerability 3. Self-assessment: participants reported pleasant skin sensation	1. Skin sebum measurement using Sebumeter 2. Skin erythema measurement using a Mexameter 3. Self-assessment	8 weeks	*Simmondsia chinensis Gentiana lutea Mentha arvensis Humulus lupulus Leptospermum scoparium Salix daphnoides Helianthus annuus*	*Simmondsia chinensis*: seed *Gentiana lutea*: roots *Leptospermum scoparium*: branch/leaf *Salix daphnoides*: bark *Helianthus annuus*: seed	-
Foot care										
Mandawgade SD et al., 2008	India	Healthy males and females suffering from different foot ailments (6)	A cream containing mango butter and olein fraction, fortified with vitamin E acetate (1%w/w)	Untreated Control	1. Assessment of functional attributes: complete repair of cracked skin in all the volunteers. Antiseptic, healing, soothing, and cooling actions were predominant in most of the clinical subjects 2. Assessment of aesthetic attributes: Excellent emolliency, rebuilt protective skin barrier and replenished moisture, and improve	1. Assessment of functional attributes: reduction in amplitude of cracked heels, pain, and bleeding through the cracks, degree of healing, skin reconstruction, soothing, skin rehydration, and antiseptic against the growth of resident	8 weeks	-	Fruit kernels	Cream

					smoothness. Had good appearance, spreadability, skin feel, smoothness, and absorption ($p<0.05$)	microorganisms 2. Assessment of aesthetic attributes: appearance, spreadability, skin feel, smoothness, and absorption				
Akhtar N et al., 2016	Pakistan	25–35-year-old healthy males (13)	An emulsion containing 4 % *Ziziphus mauritiana* extract	Placebo	Erythema: significantly decreased in both groups ($p<0.05$) Melanin content: significantly decreased ($p<0.05$) Skin moisture: significantly increased ($p>0.05$) Skin elasticity: significantly increased ($p<0.05$) Sebum content: significantly increased ($p<0.05$)	Melanin content, skin erythema, skin elasticity, sebum content, and skin moisture were evaluated using Mexameter, Corneometer, Visioscan, and Sebumeter MPA 5	8 weeks	*Ziziphus mauritiana*	Leaves	Emulsion
Rosacea										
Braithwaite I et al., 2015	New Zealand	Males and females aged 16 or over with a doctor's diagnosis of rosacea on the face (138)	Cream containing medical-grade Kanuka honey with 10% glycerine applied twice daily	Cetomacrogol cream	1. Baseline assessments (the IGA-RSS): significantly improved ($p<0.05$) 2. Participant-rated rosacea severity visual analog score (VAS-S) on a 100 mm scale: significantly improved ($p<0.001$) 3. Participant-rated dermatology quality of life index (DLQI): no significant difference ($p>0.05$)	1. Baseline assessments (the IGA-RSS) 2. Participant-rated rosacea severity visual analog score (VAS-S) on a 100 mm scale 3. Participant-rated dermatology quality of life index (DLQI)	8 weeks	-	-	Cream
Stretch marks prevention										
Soltanipour F, 2014	Iran	20–30-year-old nulliparous females with	1 cm^3 of olive oil applied twice daily	Saj cream (a commercial product	Striae severity: no significant effects on development and severity of striae gravidarum	Striae severity assessed using the Davey method	The subjects were	*Olea europaea*	Fruit	Oil

		gestational age of 18–20 weeks (150)	on the skin of abdomen gently without massage	containing lanolin, stearin, triethanolamine, almond oil, and bizovax glycerin amidine) Control (no intervention)	(p= 0.43)		followed until gestational week of 38-40			
Scars reduction										
Hosnuter M et al., 2007	Turkey	Males and females with hypertrophic and keloid scars and an average age of 40.3 ± 9.6 (72)	Group 1: topical onion extract only Group 2: silicone gel sheet only Group 3 (n=20): combined onion extract and silicone gel sheet	Groups compared with each other	1. Clinical evaluation: A) A significant difference in the color parameter between groups 1 and 2 and in the height parameter between the groups 1 and 3 ($p<0.01$ and $p<0.05$ respectively) B) A significant reduction in scar erythema in group 1 compared with group 2 ($p<0.05$) C) TA significant reduction in scar height in group 3 compared with group 1 ($p<0.05$) 2. Patient assessment: A) No significant difference in hardness, itching, and pain between all groups ($p>0.05$) B) A significant improvement in scar color, hardness, and pain in group 1, and a significant improvement scar color, hardness, height, and	1. Clinical evaluation by one plastic surgeon 2. Patients' assessment of scar color, scar height, scar hardness, itching, and pain 3. A global assessment of the clinical course of scar development evaluated using a therapeutic index (TI)	25 weeks	*Allium cepa*	-	Gel

					itching groups 2 and 3 3. Evaluation of the therapeutic index (TI): The total TI of group 3 was better than the others					
Multiple effects										
Muhammad KW et al., 2015	Pakistan	25–35-year-old males (11)	W/O emulsion containing 4% w/w tamarind extract applied twice daily	Placebo	1. Skin sebum contents: significantly decreased with respect to time ($p \leq 0.05$) 2. Skin melanin contents: significant regular decline in skin melanin values with respect to time ($p \leq 0.05$)	1. Skin sebum contents using a Sebumeter MPA5 2. Skin melanin contents using a Mexameter MPA5	12 weeks	*Tamarindus indica*	Seeds	Emulsion
Matsuyama A et al., 2018	Japan	35–59-year-old females with mild skin problems (20)	A capsule containing 150 mg Sakura Extract-P (cherry blossom) taken once daily	Placebo	1. Advanced glycation end products (AGEs) and skin parameters: significantly decreased 2. Skin moisture: significantly decreased in both groups ($p<0.01$) 3. Transepidermal water loss (TEWL): significantly increased 4. VISIA and skin replica parameters: the number of facial spots and reddish areas decreased significantly. Skin texture and the number of pores did not change significantly. UV-reactive spots increased significantly. The other parameters showed no changes. 5. Questionnaire results: no significant differences	1. Advanced glycation end products (AGEs) measured using an AGE reader 2. Skin moisture measured using a Corneometer 3. Transepidermal water loss (TEWL) measured using a Tewameter 4. Skin elasticity measured using a Cutometer 5. Skin replica analyzed using a reflective 3-dimensional replica analysis system 6. Facial condition assessed by a face image analyzer (VISIA Evolution)	8 weeks	*Prunus serrulata*	Flowers	Capsule

						7. Evaluation of spots, wrinkles, texture, pores, ultraviolet (UV) reactive spots, brown spots, reddish areas, and porphyrin using an image captured with a VISIA Evolution 8. Questionnaires regarding skin condition				
Ahmad HI et al. 2020	Pakistan	Healthy males (13)	An emulsion containing *S. indicus* extract applied twice daily	Placebo	1. Assessment of skin erythema and melanin level: significant decrease in erythema index and melanin level ($p \leq 0.05$) 2. Assessment of skin hydration level: significantly increased ($p \leq 0.05$) 3. Assessment of skin elasticity: significantly increased ($p \leq 0.05$) 4. Assessment of skin sebum level: significantly decreased ($p \leq 0.05$) 5. Surface evaluation of living skin: significant decrease of both large and small pores ($p \leq 0.05$)	1. Assessment of skin erythema and melanin level measured using Mexameter® 2. Assessment of skin hydration level using Corneometer® 3. Assessment of skin elasticity using Elastometer® 4. Assessment of skin sebum level using Sebumeter® 5. Surface evaluation of living skin assessed using VisioFace® and investigation of the number of large and small pores, area of skin spots, and wrinkles using images	12 weeks	*Sphaeranthus indicus*	Flowers	Emulsion