

Electronic Supplementary Information

Lignin: a nature-inspired sun blocker for broad-spectrum sunscreens

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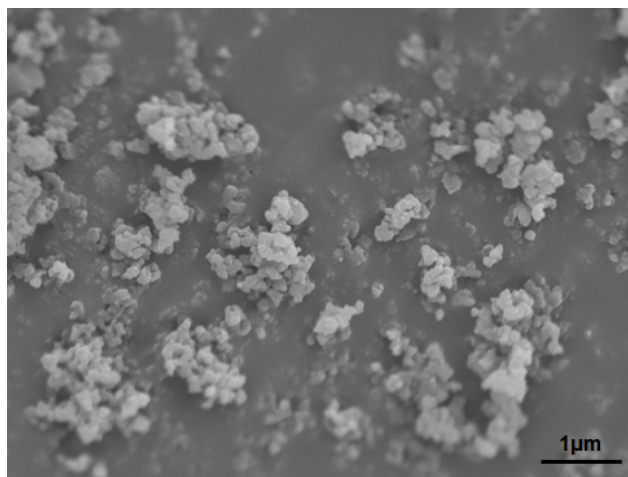


Fig. S1 Typical SEM image of alkali lignin. SEM image was obtained by using a JEOL JSM-7000F electron microscope (JEOL, Peabody, MA, USA) with an accelerating voltage of 5 kV. The SEM sample was prepared by spraying dry alkali lignin on the conductive adhesive directly. Gold was sprayed prior to characterization.

Table S1 Active and inactive ingredients of purchased sunscreen lotions and pure creams

Lotions & Creams	Active ingredients	Inactive ingredients
SPF15-L	Octinoxate 7.5%, Avobenzone 4%.	AQUA , C12-15 Alkyl benzoate, Phenethyl benzoate, Sorbitol, Stearic acid, Sorbitan oleate, Benzyl alcohol, Isopropyl myristate, Glyceryl stearate SE, Hydrogenated soybean oil, VP/Eicosene copolymer, Triethanolamine, Imidazolidinyl urea, Methylparaben, Dimethicone, Simmondsia chinensis (jojoba) Seed oil, Aloe barbadensis leaf extract, Tocopherol, Propylparaben, Acrylates/C10-30 Alkyl acrylate crosspolymer, Carbomer, Disodium EDTA, Parfum.
SPF30-L	Homosalate 10%, Octisalate 5%, Avobenzone 2%, Octocrylene 2%, Oxybenzone 2%.	AQUA , Sorbitol, Sorbitan isostearate, Polyglyceryl-3 distearate, Triethanolamine, Vp/Eicosene copolymer, Stearic acid, Benzyl alcohol, Dimethicone, Barium sulfate, Methylparaben, Carbomer, Aloe barbadensis Leaf extract, Propylparaben, Tocopherol, Simmondsia chinensis (jojoba) seed oil, Disodium EDTA, Octadecene/MA copolymer, Parfum.
SPF50-L	Homosalate 13%, Octisalate 5%, Avobenzone 3%, Octocrylene 7%, Oxybenzone 4%.	AQUA , Sorbitol, Stearic acid, Triethanolamine, Aluminum starch octenylsuccinate, Benzyl alcohol, Sorbitan isostearate, VP/Eicosene copolymer, Dimethicone, Polyglyceryl-3 distearate, Methylparaben, Carbomer, Parfum, Propylparaben, Tocopherol, Disodium EDTA.
SPF15-B	Homosalate 10%, Octisalate 5%, Avobenzone 3%, Octocrylene 4%, Drometrizole Trisil Oxane (Mexoryl ®XL) 0.5%, Terephthalylidene Dicamphor Sulfonic Acid (Mexoryl ®SX) 0.5%.	AQUA , Glycerin, Alcohol denat., C12-15 Alkyl benzoate, Styrene/Acrylates copolymer, Dimethicone, Propylene glycol, PEG-100 stearate glyceryl stearate, Parfum, Silica, Synthetic wax, Phenoxyethanol, Sodium polyacrylate, Triethanolamine, Stearic acid, Caprylyl glycol, Palmitic acid, Limonene, PEG-8 laurate, Xanthan gum, Tocopherol, Disodium EDTA, Linalool, Vitreoscilla ferment, Citronellol, Citral, Benzyl alcohol.
SPF30-B	Homosalate 10%, Octisalate 5%, Avobenzone 3%, Octocrylene 5.5%, Drometrizole Trisil Oxane (Mexoryl ®XL) 2.5%, Terephthalylidene Dicamphor Sulfonic Acid (Mexoryl ®SX) 0.5%	AQUA , Glycerin, Alcohol denat., Styrene/Acrylates copolymer, Dimethicone, Propylene glycol, PEG-100 stearate, Glyceryl stearate, Silica, Synthetic wax, Phenoxyethanol, Sodium polyacrylate, Triethanolamine, Stearic acid, Caprylyl glycol, Palmitic acid, Limonene, PEG-8 laurate, Xanthan gum, Tocopherol, Disodium EDTA, Linalool, Vitreoscilla ferment, Citronellol, Citral, Benzyl alcohol, Parfum.
SPF50-B	Homosalate 10%, Octisalate 5%, Avobenzone 3%, Octocrylene 5.5%, Drometrizole Trisil Oxane (Mexoryl ®XL) 2.5%, Terephthalylidene Dicamphor Sulfonic Acid (Mexoryl ®SX) 0.5%	AQUA , Pentasiloxane, Glycerin, Propylene glycol, Alcohol denat., Ascorbyl palmitate, Triethanolamine, Stearyl heptanoate, Polyvinylpyrrolidone (PVP)/ eicosene copolymer, Dimethicone, Glyceryl stearate, Stearyl caprylate, Sodium hydroxide, Ethylhexylglycerin, Phenoxyethanol, Acrylates/C10-30, Alkyl acrylate crosspolymer, Glycine soja, Tocopherol, Xanthan gum, Tetrasodium EDTA, Methylparaben, Vitreoscilla ferment, Hydrolyzed rice protein, Ethylparaben, Propylparaben, Butylparaben, Isobutylparaben, Copper gluconate, Manganese gluconate
Cream-N		Water , Glycerin, Mineral Oil, Myristyl alcohol, Butylene glycol, Alcohol denat., Stearic acid, Myristyl myristate, Microcrystalline wax, Glyceryl stearate, Hydrogenated coco-glycerides, Simmondsia chinensis (jojoba) seed oil, Tocopheryl acetate, Lanolin alcohol (Eucerit®), Polyglyceryl-2 caprate, Dimethicone, Carbomer, Sodium hydroxide, Phenoxyethanol fragrance.
Cream-L		AQUA , Glycerin, Dimethicone, Cetearyl Alcohol, Octyldodecanol, Caprylic, Petrolatum, Glyceryl stearate, Cetyl alcohol, Sorbitol, PEG-100 stearate, Allantoin, Propylene glycol, Butylene glycol, Glucose, Citric acid, Disodium EDTA, Ascorbyl palmitate, Bisabolol, BHT, Chamomilla recutita, Rosa centifolia, Hamamelis virginiana, Alcohol denat., Parfum, Phenoxyethanol, Methylparaben, Propylparaben.