SUPPLEMENTARY DATA

Supplementary Table 1. Studies primarily focus on evaluating anti-melanogenesis and antioxidant

NO	Title	REFERENCE
1	The effect of fucoxanthin as coloring agent on the quality of catfish sausage,	(Aditya, 2020)
2	The Cosmeceutical Properties of Compounds Derived from Marine Algae	(Agatonovic-Kustrin and Morton, 2018)
3	Carotenoids and Dermoaesthetic Benefits : Public Health Implications	(Biskanaki *et al.*, 2023)
4	Biological and therapeutic potential of the edible brown marine seaweed *Padina australis* and their pharmacological mechanisms	(Chellappan *et al.*, 2020)
5	Acid-processing and fermentation of *Hizikia fusiforme* and bioactivities of fucoidan from the processed H. fusiforme	(Cui, 2020)
6	Marine Algal Derived Phenolic Compounds and their Biological Activities for Medicinal and Cosmetic Applications	(Gager *et al.*, 2021)
7	Protective effects of carotenoid fucoxanthin in fibroblasts cellular senescence	(Guvatova *et al.*, 2020)
8	Production of protein extracts from Swedish red, green, and brown seaweeds, *Porphyra umbilicalis* Kützing, *Ulva lactuca* Linnaeus, and *Saccharina latissima* (Linnaeus) J. V. Lamouroux using three different methods	(Harrysson *et al.*, 2018)
9	Evaluation the Phytochemicals and Nutritional Characteristics of Some Microalgae Grown in Egypt as Healthy Food Supplements	(Hashem *et al.*, 2021)
10	Absorption and metabolism of xanthophylls	(Kotake-Nara and Nagao, 2011)
11	Fucoxanthin and Phenolic Contents of Six Dictyotales From the Tunisian Coasts With an Emphasis for a Green Extraction Using a Supercritical CO<inf>2</inf> Method	(Ktari, 2021)
12	Engineering fucoxanthin-loaded probiotics' membrane vesicles for the dietary intervention of colitis	(Liang *et al.*, 2023)
13	Fucoxanthin production by heterokont microalgae	(Petrushkina *et al.*, 2017)

Supplementary Table 2. Studies primarily focus on evaluating antioxidants or tyrosinase

NO	Title	REFERENCE
1	Phytochemical analysis and evaluation of the antioxidant, anti-inflammatory, and antinociceptive potential of phlorotannin-rich fractions from three Mediterranean	(Abdelhamid *et al.*, 2018)
2	Evaluation of antioxidant compounds, antioxidant activities, and mineral composition of 13 collected purslane (*Portulaca oleracea* L.) accessions	(Alam *et al.*, 2014)
3	Evaluation of Antioxidant Capacity, *Tyrosinase* Inhibition, and Antibacterial Activities of Brown Seaweed, *Sargassum ilicifolium* (Turner) C. Agardh	(Arguelles, 2021)
4	Bioprospecting of turbinaria ornata (Fucales, phaeophyceae) for cosmetic application: Antioxidant, tyrosinase inhibition and antibacterial activities,	(Arguelles and Sapin, 2020)
5	The brown seaweed Cystoseira schiffneri as a source of sodium alginate: Chemical and structural characterization, and antioxidant activities	(Benslima *et al.*, 2021)

6	Food-grade bioactive ingredient obtained from the Durvillaea incurvata brown seaweed: Antibacterial activity and antioxidant activity	(Burgos-Díaz *et al.*, 2022)
7	Inhibitory effects of *Sargassum polycystum* on tyrosinase activity and melanin formation in B16F10 murine melanoma cells	(Chan *et al.*, 2011)
8	In vitro antioxidant activities of three selected brown seaweeds of Indi	(Chandini *et al.*, 2008)
9	Antioxidant capacities of fucoxanthin-producing algae as influenced by their carotenoid and phenolic contents	(Foo *et al.*, 2017)
10	Optimization of ultrasound-assisted extraction conditions for phenolics, antioxidant, and tyrosinase inhibitory activities of Vietnamese brown seaweed (Padina)	(Hassan *et al.*, 2021)
11	Antioxidant activities of enzymatic extracts from brown seaweeds	(Heo *et al.*, 2005)
12	Effectiveness of Brown Algae (*Padina australis*) Extract as Antioxidant Agen	(Junopia *et al.*, 2020)
13	Fucoxanthin—an antibacterial carotenoid, *Antioxidants*,	(Karpiński, 2019)
14	A Potent Tyrosinase Inhibitor, (E)-3-(2,4-Dihydroxyphenyl)-1-(thiophen-2-yl)prop-2-en-1-one, with Anti-Melanogenesis Properties in α-MSH and IBMX-Induced B16F10 Melanoma Cells	(Kim *et al.*, 2018)
15	Antioxidant activity and cell bioactivity of *Sargassum macrocarpum* extract	(Kim, 2021)
16	Anti-oxidant and fucoxanthin contents of brown alga ishimozuku (*Sphaerotrichia divaricata*) from the west coast of aomori, Japan	(Maeda *et al.*, 2018)
17	Comparative antioxidant activities of carotenoids measured by ferric reducing antioxidant power (FRAP), ABTS bleaching assay (αTEAC), DPPH assay and peroxyl radical scavenging assay	(Müller *et al.*, 2011)
18	Profiling of bioactives and in vitro evaluation of antioxidant and antidiabetic property of polyphenols of marine algae *Padina tetrastromatica*	(Naveen *et al.*, 2021)
19	Upregulation of Melanogenesis and Tyrosinase Activity: Potential Agents for Vitiligo	(Niu and Aisa, 2017)
20	Effects of Antioxidant, Anti-Collagenase, Anti-Elastase, Anti-Tyrosinase of The Extract and Fraction From *Turbinaria decurrens* Bory	(Nurrochmad *et al.*, 2018)
21	Use of Different Spices as Potential Natural Antioxidant Additives on Cooked Beans (Phaseolus vulgaris). Increase of DPPH Radical Scavenging Activity and Total Phenolic Conten	(Pereira and Tavano, 2014)
22	Antityrosinase activity of *Euphorbia characias* extracts	(Pintus *et al.*, 2015)
23	Antioxidant capacity of cornelian cherry (Cornus mas L.) - Comparison between permanganate reducing antioxidant capacity and other antioxidant methods	(Popović *et al.*, 2012)
24	In-vitro antioxidant properties of lipophilic antioxidant compounds from 3 brown seaweed	(Rajauria, 2019)
25	Identification and characterization of phenolic antioxidant compounds from brown Irish seaweed *Himanthalia elongata* using LC-DAD–ESI-MS/MS	(Rajauria *et al.*, 2016)
26	Antioxidant and neuroprotective potential of the brown seaweed *bifurcaria bifurcata* in an in vitro Parkinson's disease model,	(Silva *et al.*, 2019)
27	,Antioxidant properties of edible sea weed from the Northern Coast of the Sea of Japan	(Tabakaev *et al.*, 2021)
28	Antioxidant potential of two Brazilian seaweeds in response to temperature: *Pyropia spiralis* (red alga) and *Sargassum stenophyllum* (brown alga)	(Urrea-Victoria *et al.*, 2022)
29	In-vitro antioxidant activities of aqueous and alcoholic extracts of Sargassum species—Indian brown seaweed	(Vasanthi *et al.*, 2020)
30	Production, characterization, and antioxidant activity of fucoxanthin from the marine diatom *Odontella aurita*	(Xia *et al.*, 2013)

Supplementary Table 3. Studies primarily focus on evaluating tyrosinase or antioxidant

NO	Title	Reference
1	Phytochemical analysis and evaluation of the antioxidant, anti-inflammatory, and antinociceptive potential of phlorotannin-rich fractions from three Mediterranean	(Abdelhamid *et al.*, 2018)
2	Evaluation of antioxidant compounds, antioxidant activities, and mineral composition of 13 collected purslane (*Portulaca oleracea* L.) accessions	(Alam *et al.*, 2014)
3	Evaluation of Antioxidant Capacity, Tyrosinase Inhibition, and Antibacterial Activities of Brown Seaweed, *Sargassum ilicifolium* (Turner) C. Agardh	(Arguelles, 2021)
4	Bioprospecting of *Turbinaria ornata* (Fucales, phaeophyceae) for cosmetic application: Antioxidant, tyrosinase inhibition and antibacterial activities,	(Arguelles and Sapin, 2020)
5	Ethanolic extract from *Sargassum serratifolium* attenuates hyperpigmentation through CREB/ERK signaling pathways in α-MSH-stimulated B16F10 melanoma cell	(Azam *et al.*, 2017)
6	The brown seaweed *Cystoseira schiffneri* as a source of sodium alginate: Chemical and structural characterization, and antioxidant activities	(Benslima *et al.*, 2021)
7	Food-grade bioactive ingredient obtained from the *Durvillaea incurvata* brown seaweed: Antibacterial activity and antioxidant activity	(Burgos-Díaz *et al.*, 2022)
8	Inhibitory effects of *Sargassum polycystum* on tyrosinase activity and melanin formation in B16F10 murine melanoma cells	(Chan *et al.*, 2011)
9	In vitro antioxidant activities of three selected brown seaweeds of India	(Chandini *et al.*, 2008)
10	The anti-melanogenic effects of 3-O-ethyl ascorbic acid via Nrf2-mediated α-MSH inhibition in UVA-irradiated keratinocytes and autophagy induction in melanocytes	(Chen *et al.*, 2021)
11	Melanins and melanogenesis: From pigment cells to human health and technological applications	(d'Ischia *et al.*, 2015)
12	Signaling pathways in melanogenesis	(D'Mello *et al.*, 2016)
13	Antioxidant capacities of fucoxanthin-producing algae as influenced by their carotenoid and phenolic contents	(Foo *et al.*, 2017)
14	Optimization of ultrasound-assisted extraction conditions for phenolics, antioxidant, and tyrosinase inhibitory activities of Vietnamese brown seaweed (Padina)	(Hassan *et al.*, 2021)
15	Antioxidant activities of enzymatic extracts from brown seaweeds	(Heo *et al.*, 2005)
16	Anti-Melanogenesis Activity of 6-O-Isobutyrylbritannilactone from Inula britannica on B16F10 Melanocytes and In Vivo Zebrafish Models	(Jang *et al.*, 2020)
17	Effectiveness of Brown Algae (*Padina australis*) Extract as Antioxidant Agen	(Junopia *et al.*, 2020)
18	Fucoxanthin—an antibacterial carotenoid, *Antioxidants*,	(Karpiński, 2019)
19	A Potent Tyrosinase Inhibitor, (E)-3-(2,4-Dihydroxyphenyl)-1-(thiophen-2-yl)prop-2-en-1-one, with Anti-Melanogenesis Properties in α-MSH and IBMX-Induced B16F10 Melanoma Cells	(Kim *et al.*, 2018)
20	Melanogenesis inhibitory activity of Korean *Undaria pinnatifida* in mouse B16 melanoma	(Kim *et al.*, 2014)
21	Antioxidant activity and cell bioactivity of *Sargassum macrocarpum* extract	(Kim, 2021)

22	Modulation of Melanogenesis by Heme Oxygenase-1 via p53 in Normal Human Melanocytes	(Lim *et al.*, 2016)
23	Anti-oxidant and fucoxanthin contents of brown alga ishimozuku (*Sphaerotrichia divaricata*) from the west coast of aomori, Japan	(Maeda *et al.*, 2018)
24	Comparative antioxidant activities of carotenoids measured by ferric reducing antioxidant power (FRAP), ABTS bleaching assay (αTEAC), DPPH assay and peroxyl radical scavenging assay	(Müller *et al.*, 2011)
25	The anti-melanogenesis activities of some selected brown macroalgae from northern coasts of the persian gulf	(Namjooyan *et al.*, 2019)
26	Profiling of bioactives and in vitro evaluation of antioxidant and antidiabetic property of polyphenols of marine algae *Padina tetrastromatica*	(Naveen *et al.*, 2021)
27	Upregulation of Melanogenesis and Tyrosinase Activity: Potential Agents for Vitiligo	(Niu and Aisa, 2017)
28	Effects of Antioxidant, Anti-Collagenase, Anti-Elastase, Anti-Tyrosinase of The Extract and Fraction From *Turbinaria decurrens* Bory	(Nurrochmad *et al.*, 2018)
29	Use of Different Spices as Potential Natural Antioxidant Additives on Cooked Beans (Phaseolus vulgaris). Increase of DPPH Radical Scavenging Activity and Total Phenolic Conten	(Pereira and Tavano, 2014)
30	Antityrosinase activity of *Euphorbia characias* extracts	(Pintus *et al.*, 2015)
31	Antioxidant capacity of cornelian cherry (*Cornus mas* L.) - Comparison between permanganate reducing antioxidant capacity and other antioxidant methods	(Popović *et al.*, 2012)
32	In-vitro antioxidant properties of lipophilic antioxidant compounds from 3 brown seaweed	(Rajauria, 2019)
33	Identification and characterization of phenolic antioxidant compounds from brown Irish seaweed *Himanthalia elongata* using LC-DAD–ESI-MS/MS	(Rajauria *et al.*, 2016)
34	Anti-pigmentary activity of fucoxanthin and its influence on skin mRNA expression of melanogenic molecules	(Shimoda *et al.*, 2010)
35	Antioxidant and neuroprotective potential of the brown seaweed *Bifurcaria bifurcata* in an in vitro Parkinson's disease model,	(Silva *et al.*, 2019)
36	,Antioxidant properties of edible sea weed from the Northern Coast of the Sea of Japan	(Tabakaev *et al.*, 2021)
37	Antioxidant potential of two Brazilian seaweeds in response to temperature: *Pyropia spiralis* (red alga) and *Sargassum stenophyllum* (brown alga)	(Urrea-Victoria *et al.*, 2022)
38	In-vitro antioxidant activities of aqueous and alcoholic extracts of Sargassum species—Indian brown seaweed	(Vasanthi *et al.*, 2020)
39	Production, characterization, and antioxidant activity of fucoxanthin from the marine diatom *Odontella aurita*	(Xia *et al.*, 2013)

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