Supplementary

Table 1. Micro-organism with astaxanthin producing potential

Microorganism	Specifics	Production efficiency	Reference
Haematococcus pluvialis	Chlorophyta (Green algae)	> 30 g/ kg biomass	[1]
Haematococcus lacustris	Microalgae	55.1- 84.12 mg/L	[2]
Sphingomonas faeni ISY	An orange pigmented psychrotolerant bacterium	-	[3]
Sphingomonas astaxanthinifaciens	Red-pigmented, Gram-negative, motile, strictly aerobic, mesophilic, oval- or short rod-shaped bacterium	0.69 mg/g dry cells	[4]
Sphingomonas astaxanthinifaciens TDMA-17^{T}	A radio-tolerant bacterium; produces astaxanthin dirhamnoside	-	[5]
Sphingomonas lacus sp.	Astaxanthin-dideoxyglycoside-producing strain; Gram-staining-negative, strictly aerobic, orange-colored and motile	-	[6]
Sphingomonas sp. PB304	Astaxanthin dideoxyglycoside producing	-	[7]
Synechocystis sp. PCC 6803	Photosynthetic eubacterium	1.11 ± 0.07 mg/l/day	[8]
Paracoccus marcussi	An orange Gram-negative coccus	-	[9]
Paracoccus carotinifaciens	Aerobic Gram-negative bacteria	-	[10]; [11]
Paracoccus haeundaensis sp. nov.	Gram-negative, halophilic, astaxanthin-producing	-	[12]

	bacterium		
Paracoccus sp. MBIC 01143	-	177±3 to 217±5 µg/L	[13]
Paracoccus NBRC 101723	-	1035 µg/g of dried biomass	[14]
Agrobacterium aurantiacum (Paracoccus sp. N81106/ MBIC 01143*)*		-	[15]
Corynebacterium glutamicum	Marine bacterium; Astaxanthin produced through metabolic engineering	0.4 mg $L^{-1}h^{-1}$	[16]
Altererythrobacter ishigakiensis NBRC 107699	Marine sediment collected from a site on the coast of Ishigaki Island, Japan	-	[17]
Xanthophyllomyces dendrorhous	Heterobasidiomycetous yeast	-	[18]
Phaffia rhodozyma (Mutants)	Red yeast	300-1300 µg/ g biomass	[19]
		1.54±0.21 mg carotenoid/mg dry matter	[20]
Xanthophyllomyces dendrorhous (formerly *Phaffia rhodozyma*)		1.206 mg/g biomass	[21]
Spirulina platensis mutants	multicellular, filamentous cyanobacterium	142.50 ± 0.04 µg/g (under nitrogen stress)	[22]
Chlorella vulgaris	Microalgae	-	[23]
Chlorella zofingiensis	-	3.9 mg/g dry weight	[24]
Chlorella sorokiniana	Microalgae	0.38 ± 0.02 µg/mg of dried algal biomass	[25]

Chlorococcum sp	Microalgae	-	[26]
Brevundimonas sp. strain N-5	Marine bacterium	364.6 μg g−1 dry cells	[27]
ATCC 90197 *(Yamadazyma guilliermondii);* ATCC 24060 *(Yarrowia lipolytica);* ATCC 24202 *(Xanthophyllomyces dendrorhous);* ATCC 24259 *(Sporidiobolus salmonicolor)*	Produced astaxanthin with solid state fermentation of wheat waste	Maximum yield (μg AX/g wheat wastes): 22.29±0.04; 17.47±3.24 109.23±12.08; 60.54±1.83	[28]
ATCC 24,202 (*Xanthophyllomyces dendrorhous*) and ATCC 24,259 (*Sporidiobolus salmonicolor*)	Produced astaxanthin with solid state fermentation of olive pomace	Maximum yield (μg/gdp): 220.24±17.47; 191.33±2.81	[29]
Saccharina japonica	Species of marine algae extensively cultivated in East Asia	37.26 μg/g dry mass	[30]
Deinococcus sp. strain WMA-LM9	Radio-resistant bacterium	-	[31]
Saccharomyces cerevisiae	Yeast	3 and 29 $\mu g g^{-1}$ dry cell weight	[32]
Candida utilis	Yeast	400 $\mu g g^{-1}$ dry cell weight	[33]
Rhodosporidium sp	Yeast	-	[34]
Rhodosporidium	Oleaginous yeast	0.34±0.02 g/L	[35]

diobovatum IMB Y-5023			
Mucor circinelloides	Fungi		[36]
Dunaliella salina	Halophile green microalgae	-	[37]
Schizochytrium sp	Unicellular eukaryotes in the family Thraustochytriaceae	-	[38]
Schizochytrium	Heterotrophic marine fungus	107.74 ± 9.24 $\mu g g^{-1}$	[39]
limacinum B4D1			
Gordonia alkanivorans strain 1B	Aerobic, gram-positive, catalase-positive, oxidase-negative and pink/ orange-pigmented bacterium	-	[40]
Coelastrella sp. KGU-Y002	Aerial microalga; Selective reactions of esterified astaxanthin	-	[41]
Neochloris oleoabundans	Green microalga; astaxanthin esters	-	[42]
Scenedesmus sp.	Microalgae	0.209 ± 0.009 % of dry weight	[43]
Chromochloris zofingiensis	Green algae	-	[44]
Laminaria japonica	brown seaweed	-	[45]

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