Marine Fungi: Biotechnological Perspectives from Deep-Hypersaline Anoxic Basins

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Table S1. Enzymes potentially produced by DHABs fungi: bioactivity and environmental conditions.

Enzyme	Class	Bioactivity	Fungi	Environmental conditions	References
α-Amylase (EC 3.2.1.1)	Hydrolase	Hydrolysis of alpha bonds of alpha-linked polysaccharides, such as starch and glycogen, yielding glucose and maltose	*Aspergillus penicilloides TISTR 3639*	Hypersaline man-made saltern	[1]
			Aspergillus gracilis	Hypersaline man-made saltern	[2]
			Aspergillus oryzae		[3]
CMCase (EC 3.2.1.4), β-Glucosidase (EC 3.2.1.21), FPase EC 3.2.1.91)	Hydrolase	Break-down of the cellulose molecule into monosaccharides	*Aspergillus niger NS-2*	Agricultural and kitchen waste residues	[4]
Cellulase (EC 3.2.1.4)			*Aspergillus terreus*	Sea water	[5]
endo-β-1,4-glucanases (EC 3.2.1.4), exo-β-1,4-glucanases (EC 3.2.1.91) and cellobiases (EC 3.2.1.21)			*Aspergillus ZJUBE-1*	Coastal sea sediments	[6]
Chitinase (EC 3.2.1.14)	Hydrolase	Break-down of the glycosidic bonds in chitin	*Aspergillus terreus*	Antarctica	[7]
Chitinase (EC 3.2.1.14)			*Penicillium sp.*		[8]
Chitinase (EC 3.2.1.14)			*Aspergillus flavus (AUMC 13576)*	Suez Gulf sediment	[9]
β-Glucosidase 1 (EC 3.2.1.21)	Hydrolase	Hydrolysis of terminal, non-reducing β-D-glucosyl residues releasing of β-D-glucose	*Aspergillus aculeatus*	Soil	[10]
β-Glucosidase (EC 3.2.1.21)			*Aspergillus fumigatus ABK9*	Compost	[11]
β-Glucosidase (EC 3.2.1.21)			*Aspergillus niger*	East China Sea	[12]
β-Glucosidase (EC 3.2.1.21)			*Aspergillus terreus*	Soil	[13]
β-Glucosidase (EC 3.2.1.21)			*Penicillium canescens*		[14]
Laccase (EC 1.10.3.2)	Oxidoreductases	Catalysis of the monoelectronic oxidation of various substrates (e.g. phenols, and aromatic or aliphatic amines) to the corresponding radicals, using molecular oxygen as the final electron acceptor	*Aspergillus sclerotiorum, Cladosporium cladosporioides*	Cnidarians	[15]
Mn-peroxidase (EC 1.11.1.13)			*Aspergillus sclerotiorum, Cladosporium cladosporioides*	Cnidarians	[15]
Laccase, Li/Mn-peroxidase (1.10.3.2)			several strains	*Posidonia oceanica*	[16]

Table S1. Continued.

Enzyme	Class	Bioactivity	Fungi	Environmental conditions	References
Lipase (EC 3.1.1.3)	Hydrolase	Hydrolysis of acylglycerols to release a fatty acid and lower acylglycerols or glycerol	several strains	Antarctica	[17]
Lipase (EC 3.1.1.3)			*Aspergillus awamori* BTMFW032	Coastal seawater	[18]
Lipase (EC 3.1.1.3)			*Candida intermedia* YA01a	*Sargassum pallidum* from sea-water	[19]
Lipase (EC 3.1.1.3)			*Rhodotorula mucilaginosa* L10-2	*Laminaria japonica* from sea-water	[19]
Lipase (EC 3.1.1.3)			*Aspergillus pullulans* HN2.3	Salterns	[19]
Lipase (EC 3.1.1.3)			*Candida parapsilosis* 3eA2	*Apostichopus japonicus* from seawater	[19]
Lipase (EC 3.1.1.3)			*Candida quercitrusa* JHSb	Salterns	[19]
Lipase (EC 3.1.1.3)			*Candida rugosa* wl8	*Nemipterus virgatus* from sea-water	[19]
Protease (EC 3.4.21)	Hydrolase	Hydrolysis of peptide bonds	and several strains	Antarctica	[17]
Protease (EC 3.4.21)			*Aspergillus ustus* (NIOCC #20)	Deep-sea sediments	[20]
Protease (EC 3.4.21)			*Penicillium chrysogenum* FS010	Seawater	[21]
Protease (EC 3.4.21)			*Rhodotorula mucilaginosa* L7	Antarctica	[22]
Tannase (EC 3.1.1.20)	Hydrolase	Hydrolysis of ester and depsidic linkage in hydrolysable tannins such as tannic acid, releasing glucose and gallic acid	*Aspergillus fumigatus CAS-21*	*Posidonia oceanica*	[23]
Tannase (EC 3.1.1.20)			several strains		[16]
Tannase (EC 3.1.1.20)			*Aspergillus candidus* MTTC 9628	Solid waste	[24]
Tannase (EC 3.1.1.20)			*Aspergillus awamori* BTMFW032	Seawater	[25]
Tannase (E.C.3.1.20)			*Penicillium notatum* NCIM 923		[26]
Xylanase (EC 3.2.1.8)	Hydrolase	Hydrolysis of the bond between lignin and hemicellulose	several strains	Antarctica	[17]
Xylanase (EC 3.2.1.8)			*Aspergillus niger*	Chagos trench	[27]
Xylanase (EC 3.2.1.8)			*Aspergillus niger*	Forest soil	[28]

Table S1. Continued.

Enzyme	Class	Bioactivity	Fungi	Environmental conditions	References
α-rhamnosidase (EC 3.2.1.40)	Hydrolase	Hydrolyis of terminal non-reducing alpha-L-rhamnose residues in alpha-L-rhamnosides	*Aspergillus aculeatus*	Soil	[29]
α-rhamnosidase (EC 3.2.1.40)			*Aspergillus niger* JMUTS528		[30]
α-rhamnosidase (EC 3.2.1.40)			*Penicillium decumbens*	Soil	[31]
GH7 endo-1,4-β-glucanase (EC 3.2.1.73)	Hydrolase	Cleavage of internal glucosidic bonds in the cellulose microfibril crystalline structure	*Aspergillus fumigatus*	Compost	[32]
β-glucanase (EC 3.2.1.6)	Hydrolase	Endohydrolysis of linkages in beta-D-glucans	*Aspergillus terreus* DSM 826	Sugar cane bagasse	[33]
β-glucanase (EC 3.2.1.6)			*Aspergillus terreus* NIH2624		[34]
Endoglucanase (EC 3.2.1.4)	Cellulase	Endohydrolysis of (1->4)-beta-D-glucosidic linkages	*Aspergillus terreus*	Rice straw	[35]
Xylanase (EC 3.2.1.8)	Hydrolase	Degradation of the linear polysaccharide xylan into xylose	*Cladosporium* sp.	Antarctic marine sponges	[36]
Inulinase (3.2.1.7)	Hydrolase	Endohydrolysis of beta-D-fructosidic linkages in inulin	*Candida membranifaciens* subspecie *flavinogenie* W14-3	Seawater	[37]
Inulinase (3.2.1.7)			Several strains of *Aspergillus and Penicillium*	Seawater and sediments	[38]
AtFAE-1, AtFAE-2, AtFAE-3	Feruloyl esterase	Cleavage of covalent ester linkage between a phenolic acid and poly- or oligosaccharide liberating hydroxycinnamic acids	*Aspergillus terreus* MTCC 11096	Soil	[39]
Feruloyl esterase (EC 3.1.1.73)			*Aspergillus terreus* CBS138435		[40]
L-asparaginase (EC.3.5.1.1)	Hydrolase	Deamination of L-asparagine to L-aspartate and ammonia	Several strains	Diverse	[41]
L-methioninase (EC 4.4.1.11)	Lyases	Conversion of sulphur containing amino acids such as methionine and cysteine to α-keto acids, ammonia, and volatile thiols by α, γ -elimination and γ replacement reactions	Several strains of *Aspergillus*	Soil	[42]

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