

Review

Improved Foods using Enzymes from Basidiomycetes

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Supplement

Supplementary Table S1. Overview of the different basidiomycetous enzymes, their use for foods and production hosts of recombinantly available enzymes.

Basidiomycete	Enzyme(s)	Utilisation	Production host of recombinant enzyme	Reference
Degradation of toxins				
<i>Agaricus bisporus</i>	n.d.	Degradation of polycyclic aromatic hydrocarbons (PAH)	-	[66]
<i>Cerrena unicolor</i>	Laccase		-	[68]
<i>Pleurotus eryngii</i>	Laccase (n.v.)		-	[69]
<i>Pleurotus ostreatus</i> , co-cultivated with <i>Aspergillus niger</i>	n.d.	Degradation of aflatoxin B ₁	-	[20]

<i>Trametes</i> species			<i>Saccharomyces cerevisiae</i>	[70]
	Laccase			
<i>Trametes versicolor</i>			<i>K. phaffii</i>	[71]
<i>Flammulina velutipes</i>	Peroxidase	Degradation of deoxynivalenol	-	[72]
<i>Ganoderma</i> species	Laccase	Degradation of aflatoxin B ₁ and zearalenone	-	[73]
<i>Pleurotus ostreatus</i>	Laccase	Degradation of sulphonamides	-	[65]
<i>Pleurotus ostreatus</i>	Laccase	Degradation of Bisphenol A	-	[67]
<i>Trametes versicolor</i>				[64]

Generation and degradation of colourants

<i>Agaricus bisporus</i>	Laccase, Tyrosinase	Generation of yellow to orange theaflavins	-	[83,84]
<i>Bjerkandera adusta</i>	Horseradish-like peroxidase	Degradation of melanoidins	-	[90]
<i>Bjerkandera adusta</i>	β -Glucosidase	Degradation of food colours	<i>K. phaffii</i>	[88]
<i>Pleurotus pulmonarius</i>	Laccase			[87]
<i>Funalia trogii</i>	n.d.	Bleaching of molasses	-	[79]
<i>Trametes versicolor</i>				
<i>Laetiporus sulphureus</i>	n.d.	Generation of orange to red laetiporic acids	-	[82]
<i>Mycetinis scorodonius</i>			-	[78]
<i>Pleurotus sapidus</i>	DyP-peroxidase	Bleaching of annatto	<i>K. phaffii</i>	[100]
<i>Mycetinis scorodonius</i> +	DyP-peroxidase +	Bleaching of Reactive Blue 5	<i>Coprinus cinerea</i>	[94]
<i>Pleurotus sapidus</i>	Aryl-alcohol oxidase			
<i>Pleurotus ostreatus</i>	Versatile peroxidase	Degradation of azo dyes	-	[89]
<i>Pycnoporus sanguineus</i>	Laccase	Generation of deep-red cinnabarinic acid	-	[85]
		Degradation of synthetic dyes	-	[86]

Generation of flavour compounds

<i>Agrocybe pediades</i>	Linalool synthase	Production of (R)-linalool	<i>E. coli</i>	[31]
(<i>Candida antarctica</i>)* +	Lipase +		-	
<i>Funalia trogii</i> +	Laccase +	Generation of vanillin	-	[99]

<i>Pleurotus eryngii</i>	Feruloyl esterase	-	
<i>Cerrena unicolor</i>	Sesquiterpene cyclase	<i>E. coli</i>	[107]
<i>Coniophora puteana</i>			[106]
<i>Tyromyces floriformis</i>		-	[108]
<i>Flammulina velutipes</i>	Desaturase (n.v.)	Generation of a precursor of dodec-11-enal	- [112]
<i>Fomitopsis betulina</i>	n.d.	Generation of (5E/Z,7E,9)-decatrien-2-one	- [110,111]
<i>Funalia trogii</i>	DyP-peroxidase + Laccase	Generation of (+)-nootkatone	<i>K. phaffii</i> - [109]
<i>Lentinula edodes</i>	n.d.	Generation of umami peptides	- [119]
<i>Pleurotus sapidus</i>	DyP-peroxidase Lipoxygenase	Generation of volatile flavours	<i>K. phaffii</i> [100] <i>E. coli</i> [101]
<i>Rhizoctonia solani</i> + <i>Schizophyllum commune</i>	Feruloyl esterase + Feruloyl decarboxylase	Generation of 4-vinylguaiacol	<i>K. phaffii</i> [113,114]
<i>Trametes versicolor</i>	Peptidases	Generation of salt-taste enhancing dipeptides	- [122]
Generation of food components			
<i>Funalia trogii</i>	Laccase	Generation of arabinoxylan gels	- [74]
<i>Pleurotus pulmonarius</i>		<i>K. phaffii</i>	[75]
<i>Lentinula edodes</i>	n.d.	Release of saccharides	- [48]
<i>Pycnoporus species</i>	Cellobiose dehydrogenase + laccase	Production of lactobionic acid	- [77]
<i>Ustilago maydis</i>	Chlorogenic acid esterase	Production of <i>p</i> -coumaric and caffeic acid Softening of wheat dough	<i>K. phaffii</i> [40] [41]
Increasing the quality or digestibility of foods			
<i>Flammulina velutipes</i>	Prolylpeptidase	Hydrolysis of celiac disease provoking toxic peptides	<i>Aspergillus oryzae</i> [56]
<i>Ganoderma australe</i>	Asparaginase	Prevention of acrylamide formation	- [97]

<i>Ganoderma australe</i>	<i>Phytase</i>	Increase the bioavailability of minerals in feeds	-	[46,47]
<i>Irpes lacteus</i>			<i>K. phaffii</i>	[49,50]
<i>Leucopaxillus tricolor</i>	α -Glycosidase	Simplify the generation of plant protein-based foods	-	[51]
<i>Tremella aurantialba</i>			-	[52]
<i>Phanerochaete chrysosporium</i>	Aspartic peptidase	Cleavage of casein for cheese production	-	[54]
<i>Rhizoctonia solani</i>	<i>p</i> -Coumaryl esterase	Increase the digestibility of coffee and apple juice	<i>K. phaffii</i>	[44,45]
<i>Rhodosporidium toruloides</i>	Phenylalanine ammonium lyase	Degradation of phenylalanine	-	[96]
<i>Sarcodon aspratus</i>	n.d.	(Plant) meat tenderisation	-	[57]
<i>Schizophyllum commune</i>	Feruloyl esterase	Increase the usability of rapeseed protein as food	<i>K. phaffii</i>	[43]
<i>Termitomyces clypeatus</i>	Metallopeptidase		-	[55]

Others

<i>Malassezia globosa</i>	Lipase	Hydrolysis of mono- and diacylglycerols	<i>K. phaffii</i>	[39]
<i>Phanerochaete chrysosporium</i>	Laccase (n.v.)	Filtration of tequila vinasses	-	[12]
<i>Trametes versicolor</i>				
<i>Pleurotus eryngii</i>	Aryl-alcohol oxidase	Production of building blocks for biodegradable plastics	<i>S. cerevisiae</i>	[93]
<i>Pleurotus sapidus</i>	Ferulic acid esterase	Production of feruloyl-saccharide esters	<i>K. phaffii</i>	[76]
<i>Schizophyllum commune</i>	n.d.	Production of hydrophobins	-	[23]

n.v.: not verified; n.i.: not determined; *: not a basidiomycete