



List of commercial enzymes

Enzyme activity	Production organism	Donor	IUBMB number*	Applications:		
				Food	Feed	Technical
Acetolactate decarboxylase (alpha)	<i>Bacillus amyloliquefaciens or subtilis</i>	<i>Bacillus sp.</i>	4.1.1.5	YES		
Acetolactate decarboxylase (alpha)	<i>Saccharomyces cerevisiae</i>	<i>Enterobacter sp.</i>	4.1.1.5	YES		
Acetylhexosaminidase (beta-L-N)	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	3.1.2.52	YES		
Acytransferase	<i>Bacillus licheniformis</i>	<i>Aeromonas sp.</i>	2.3.1.43	YES		
Alginate lyase	<i>Sphingobacterium multivorum</i>	none	4.2.2.3	YES		
Aminoacylase	<i>Aspergillus melleus</i>	none	3.5.1.14			YES
Aminopeptidase	<i>Aspergillus niger*</i>	none	3.4.11.x@	YES		YES
Aminopeptidase	<i>Aspergillus oryzae</i>	none	3.4.11.x@	YES		YES
Aminopeptidase	<i>Lactococcus lactis</i>	none	3.4.11.x@	YES		
Aminopeptidase	<i>Rhizopus oryzae***</i>	none	3.4.11.x@	YES		
Aminopeptidase	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	3.4.11.x@	YES		
AMP deaminase	<i>Aspergillus melleus</i>	none	3.5.4.6	YES		YES
AMP deaminase	<i>Streptomyces murinus</i>	none	3.5.4.6	YES		
Amylase (alpha)	<i>Aspergillus niger*</i>	none	3.2.1.1	YES		
Amylase (alpha)	<i>Aspergillus oryzae</i>	none	3.2.1.1	YES		YES
Amylase (alpha)	<i>Bacillus amyloliquefaciens or subtilis</i>	<i>Bacillus sp.</i>	3.2.1.1	YES	YES	YES
Amylase (alpha)	<i>Bacillus amyloliquefaciens or subtilis</i>	none	3.2.1.1	YES	YES	YES
Amylase (alpha)	<i>Bacillus amyloliquefaciens or subtilis</i>	<i>Thermoactinomyces sp.</i>	3.2.1.1	YES	YES	
Amylase (alpha)	<i>Bacillus licheniformis</i>	<i>Bacillus sp.</i>	3.2.1.1	YES		YES
Amylase (alpha)	<i>Bacillus licheniformis</i>	none	3.2.1.1	YES	YES	YES
Amylase (alpha)	<i>Bacillus stearothermophilus</i>	none	3.2.1.1	YES		YES
Amylase (alpha)	<i>Microbacterium imperiale</i>	none	3.2.1.1	YES		
Amylase (alpha)	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	3.2.1.1	YES		
Amylase (alpha)	<i>Trichoderma reesei or longibrachiatum</i>	<i>Aspergillus sp.</i>	3.2.1.1	YES		YES
Amylase (beta)	<i>Bacillus flexus</i>	none	3.2.1.2	YES		
Amylase (beta)	Barley	none	3.2.1.2	YES		
Amylase (beta)	Soybean	none	3.2.1.2	YES		
Amylase (beta)	Sweet potato	none	3.2.1.2	YES		
Arabinofuranosidase	<i>Aspergillus niger*</i>	none	3.2.1.55	YES		
Arylesterase	<i>Bacillus amyloliquefaciens or subtilis</i>	<i>Mycobacterium sp.</i>	3.1.1.2			YES
Ascorbate oxidase	<i>Cucurbita pepo</i>	none	1.10.3.3	YES		
Asparaginase	<i>Aspergillus niger*</i>	<i>Aspergillus sp.</i>	3.5.1.1	YES		
Asparaginase	<i>Aspergillus oryzae</i>	<i>Aspergillus sp.</i>	3.5.1.1	YES		
Branching glycosyltransferase	<i>Bacillus amyloliquefaciens or subtilis</i>	<i>Rhodothermus sp.</i>	2.4.1.18	YES		
Branching glycosyltransferase	<i>Geobacillus stearothermophilus</i>	none	2.4.1.18	YES		
Carboxypeptidase (serine-type)	<i>Aspergillus niger*</i>	<i>Aspergillus sp.</i>	3.4.16.x	YES		



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Catalase	<i>Aspergillus niger</i> *	<i>Aspergillus sp.</i>	1.11.1.6	YES		YES
Catalase	<i>Aspergillus niger</i> *	none	1.11.1.6	YES		YES
Catalase	<i>Micrococcus luteus</i> or <i>lysodeikticus</i>	none	1.11.1.6	YES		YES
Catalase	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Aspergillus sp.</i>	1.11.1.6			YES
Cellobiose dehydrogenase	<i>Fusarium venenatum</i>	<i>Microdochium sp.</i>	1.1.99.18	YES		
Cellulase	<i>Aspergillus niger</i> *	none	3.2.1.4	YES	YES	
Cellulase	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	<i>Bacillus sp.</i>	3.2.1.4			YES
Cellulase	<i>Penicillium funiculosum</i>	none	3.2.1.4	YES	YES	YES
Cellulase	<i>Penicillium</i> or <i>Talaromyces emersonii</i>	none	3.2.1.4	YES		
Cellulase	<i>Streptomyces lividans</i>	<i>Streptomyces sp.</i>	3.2.1.4			YES
Cellulase	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	none	3.2.1.4	YES	YES	YES
Cellulase	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Staphylotrichum sp.</i>	3.2.1.4			YES
Cellulase	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Trichoderma sp.</i>	3.2.1.4	YES	YES	YES
Cellulase	<i>Trichoderma viride</i>	none	3.2.1.4	YES		
Chitinase	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	3.2.1.14	YES		
Cyclodextrin glucanotransferase	<i>Bacillus licheniformis</i>	<i>Thermoanaerobacter sp.</i>	2.4.1.19	YES		
Cyclodextrin glucanotransferase	<i>Bacillus macerans</i>	none	2.4.1.19	YES		
Cyclodextrin glucanotransferase	<i>Geobacillus stearothermophilus</i>	none	2.4.1.19	YES		
Dextranase	<i>Chaetomium erraticum</i>	none	3.2.1.11	YES		
Dextrin dextranase	<i>Chaetomium erraticum</i>	none	2.4.1.2	YES		YES
Dextrin dextranase	<i>Chaetomium gracile</i>	none	2.4.1.2	YES		
Ferulic acid esterase	<i>Streptomyces werraensis</i>	none	3.1.1.73	YES	YES	YES
Galactosidase (alpha)	<i>Aspergillus niger</i> *	none	3.2.1.22	YES		
Galactosidase (alpha)	<i>Saccharomyces cerevisiae</i>	<i>Guar plant</i>	3.2.1.22	YES	YES	
Glucanase (endo-1,3(4)-beta)	<i>Aspergillus niger</i> *	none	3.2.1.6	YES	YES	
Glucanase (endo-1,3(4)-beta)	<i>Aspergillus oryzae</i>	<i>Thermoascus sp.</i>	3.2.1.6	YES		
Glucanase (endo-1,3(4)-beta)	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	<i>Bacillus sp.</i>	3.2.1.6	YES	YES	YES
Glucanase (endo-1,3(4)-beta)	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	none	3.2.1.6	YES		
Glucanase (endo-1,3(4)-beta)	<i>Cellulosimicrobium cellulans</i>	none	3.2.1.6	YES		
Glucanase (endo-1,3(4)-beta)	<i>Disporotrichum dimorphosporum</i>	none	3.2.1.6	YES		
Glucanase (endo-1,3(4)-beta)	<i>Humicola insolens</i>	none	3.2.1.6	YES	YES	
Glucanase (endo-1,3(4)-beta)	<i>Penicillium</i> or <i>Talaromyces emersonii</i>	none	3.2.1.6	YES	YES	YES
Glucanase (endo-1,3(4)-beta)	<i>Trichoderma harzianum</i>	none	3.2.1.6	YES		
Glucanase (endo-1,3(4)-beta)	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	none	3.2.1.6	YES	YES	YES
Glucanase (endo-1,3(4)-beta)	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Trichoderma sp.</i>	3.2.1.6	YES	YES	YES
Glucanase (endo-1,3-beta)	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	3.2.1.39	YES		



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Glucanotransferase	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	<i>Thermus sp.</i>	2.4.1.25	YES		
Glucanotransferase	<i>Geobacillus pallidus</i>	none	2.4.1.25	YES		
Glucoamylase or Amyloglucosidase	<i>Aspergillus niger</i> *	<i>Aspergillus sp.</i>	3.2.1.3	YES		
Glucoamylase or Amyloglucosidase	<i>Aspergillus niger</i> *	none	3.2.1.3	YES		YES
Glucoamylase or Amyloglucosidase	<i>Aspergillus niger</i> *	<i>Rhizomucor sp.</i>	3.2.1.3	YES		
Glucoamylase or Amyloglucosidase	<i>Aspergillus niger</i> *	<i>Talaromyces sp.</i>	3.2.1.3	YES		YES
Glucoamylase or Amyloglucosidase	<i>Rhizopus delemar</i>	none	3.2.1.3	YES		
Glucoamylase or Amyloglucosidase	<i>Rhizopus oryzae</i> ***	none	3.2.1.3	YES		
Glucoamylase or Amyloglucosidase	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Trichoderma sp.</i>	3.2.1.3	YES		YES
Glucose isomerase	<i>Streptomyces murinus</i>	none	5.3.1.5	YES		
Glucose isomerase	<i>Streptomyces rubiginosus</i>	<i>Streptomyces sp.</i>	5.3.1.5	YES		YES
Glucose oxidase	<i>Aspergillus niger</i> *	<i>Aspergillus sp.</i>	1.1.3.4	YES	YES	YES
Glucose oxidase	<i>Aspergillus niger</i> *	none	1.1.3.4	YES		YES
Glucose oxidase	<i>Aspergillus niger</i> *	<i>Penicillium sp.</i>	1.1.3.4	YES		
Glucose oxidase	<i>Aspergillus oryzae</i>	<i>Aspergillus sp.</i>	1.1.3.4	YES		
Glucose oxidase	<i>Penicillium chrysogenum</i>	none	1.1.3.4	YES		
Glucosidase (alpha)	<i>Aspergillus niger</i> *	none	3.2.1.20	YES		
Glucosidase (alpha)	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Aspergillus sp.</i>	3.2.1.20	YES		
Glucosidase (beta)	<i>Aspergillus niger</i> *	none	3.2.1.21	YES	YES	YES
Glucosidase (beta)	<i>Penicillium decumbens</i>	none	3.2.1.21	YES		
Glucosidase (beta)	<i>Penicillium multicolor</i>	none	3.2.1.21	YES		
Glucosidase (beta)	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Trichoderma sp.</i>	3.2.1.21			YES
Glucosidase (exo-1.3-beta)	<i>Trichoderma harzianum</i>	none	3.2.1.58	YES		
Glucosyltransferase or Transglucosidase	<i>Aspergillus niger</i> *	none	2.4.1.24	YES		
Glutaminase	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	none	3.5.1.2	YES		
Hemicellulase	<i>Aspergillus niger</i> *	<i>Aspergillus sp.</i>	_____	YES	YES	YES
Hemicellulase	<i>Aspergillus niger</i> *	none	_____	YES	YES	YES
Hemicellulase	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	none	_____	YES		
Hemicellulase	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	none	_____	YES		
Hexose oxidase	<i>Pichia angusta</i> or <i>Hansenula polymorpha</i>	<i>Chordrus sp.</i>	1.1.3.5	YES		
Inulase	<i>Aspergillus niger</i> *	none	3.2.1.7	YES		
Invertase or Fructofuranosidase (beta)	<i>Saccharomyces cerevisiae</i>	none	3.2.1.26	YES	YES	
Laccase	<i>Aspergillus oryzae</i>	<i>Myceliophthora sp.</i>	1.10.3.2	YES		YES
Laccase	<i>Aspergillus oryzae</i>	<i>Polyporus sp.</i>	1.10.3.2	YES		
Laccase	<i>Trametes hirsuta</i>	none	1.10.3.2	YES		YES
Laccase	<i>Trichoderma reesei</i> or <i>longibrachiatum</i> Ⓜ	<i>Thielavia sp.</i>	1.10.3.2			YES



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Lactase or Galactosidase (beta)	<i>Aspergillus oryzae</i>	<i>Aspergillus sp.</i>	3.2.1.23	YES		
Lactase or Galactosidase (beta)	<i>Aspergillus oryzae</i>	none	3.2.1.23	YES		YES
Lactase or Galactosidase (beta)	<i>Bacillus circulans</i>	none	3.2.1.23	YES		YES
Lactase or Galactosidase (beta)	<i>Kluyveromyces lactis</i>	<i>Kluyveromyces sp.</i>	3.2.1.23	YES		
Lactase or Galactosidase (beta)	<i>Kluyveromyces lactis</i>	none	3.2.1.23	YES		
Lipase monoacylglycerol	<i>Penicillium camembertii</i>	none	3.1.1.23	YES		
Lipase monoacylglycerol	<i>Penicillium camembertii</i>	<i>Penicillium sp.</i>	3.1.1.23	YES		
Lipase triacylglycerol	<i>Aspergillus niger</i> *	<i>Candida sp.</i>	3.1.1.3	YES		
Lipase triacylglycerol	<i>Aspergillus niger</i> *	<i>Fusarium sp.</i>	3.1.1.3	YES		
Lipase triacylglycerol	<i>Aspergillus niger</i> *	none	3.1.1.3	YES		
Lipase triacylglycerol	<i>Aspergillus oryzae</i>	<i>Candida sp.</i>	3.1.1.3	YES		YES
Lipase triacylglycerol	<i>Aspergillus oryzae</i>	<i>Fusarium sp.</i>	3.1.1.3	YES		
Lipase triacylglycerol	<i>Aspergillus oryzae</i>	<i>Rhizomucor sp.</i>	3.1.1.3	YES		YES
Lipase triacylglycerol	<i>Aspergillus oryzae</i>	<i>Thermomyces sp.</i>	3.1.1.3	YES		YES
Lipase triacylglycerol	<i>Calf gullets</i>	none	3.1.1.3	YES		
Lipase triacylglycerol	<i>Candida cylindracea</i>	none	3.1.1.3	YES		
Lipase triacylglycerol	<i>Candida lipolytica</i>	none	3.1.1.3	YES		
Lipase triacylglycerol	<i>Candida rugosa</i>	none	3.1.1.3	YES		YES
Lipase triacylglycerol	<i>Goat gullets</i>	none	3.1.1.3	YES		
Lipase triacylglycerol	<i>Lamb gullets</i>	none	3.1.1.3	YES		
Lipase triacylglycerol	<i>Mucor javanicus</i>	none	3.1.1.3	YES		
Lipase triacylglycerol	<i>Penicillium roqueforti</i>	none	3.1.1.3	YES		
Lipase triacylglycerol	<i>Pichia angusta</i> or <i>Hansenula polymorpha</i>	<i>Fusarium sp.</i>	3.1.1.3	YES		
Lipase triacylglycerol	<i>Pseudomonas fluorescens</i>	environment sample	3.1.1.3	YES		
Lipase triacylglycerol	<i>Rhizomucor miehei</i>	none	3.1.1.3	YES		
Lipase triacylglycerol	<i>Rhizopus delemar</i>	none	3.1.1.3	YES		
Lipase triacylglycerol	<i>Rhizopus niveus</i>	none	3.1.1.3	YES		
Lipase triacylglycerol	<i>Rhizopus oryzae</i> ***	none	3.1.1.3	YES	YES	YES
Lysozyme	<i>Chicken egg</i>	none	3.2.1.17	YES		
Lysozyme	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	3.2.1.17	YES		
Maltodextrin α -D-glucosyltransferase	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	5.4.99.15	YES		
Maltogenic amylase	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	<i>Bacillus sp.</i>	3.2.1.133	YES		
Maltogenic amylase	<i>Bacillus licheniformis</i>	<i>Bacillus sp.</i>	3.2.1.133	YES		
Maltogenic amylase	<i>Bacillus stearothermophilus</i>	<i>E. coli</i>	3.2.1.133	YES		
Maltogenic amylase	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	<i>Bacillus sp.</i>	3.2.1.133	YES		
Maltotetrahydrolase	<i>Bacillus licheniformis</i>	<i>Pseudomonas sp.</i>	3.2.1.60	YES		



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Mannanase (endo-1,4-beta)	<i>Aspergillus niger</i> *	none	3.2.1.78	YES	YES	
Mannanase (endo-1.4-beta)	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Trichoderma sp.</i>	3.2.1.78		YES	YES
Organophosphate esterase	<i>Escherichia coli</i>	<i>Flavobacterium sp.</i>	3.1.8.1			YES
Pectate lyase	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	none	4.2.2.2	YES		YES
Pectin lyase	<i>Aspergillus niger</i> *	<i>Aspergillus sp.</i>	4.2.2.10	YES	YES	YES
Pectin lyase	<i>Aspergillus niger</i> *	none	4.2.2.10	YES		
Pectin lyase	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Aspergillus sp.</i>	4.2.2.10	YES	YES	YES
Pectin methylesterase or Pectinesterase	<i>Aspergillus niger</i> *	<i>Aspergillus sp.</i>	3.1.1.11	YES	YES	
Pectin methylesterase or Pectinesterase	<i>Aspergillus niger</i> *	none	3.1.1.11	YES		
Pectin methylesterase or Pectinesterase	<i>Aspergillus oryzae</i>	<i>Aspergillus sp.</i>	3.1.1.11	YES		YES
Pectin methylesterase or Pectinesterase	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Aspergillus sp.</i>	3.1.1.11	YES	YES	YES
Penicillin amidase	<i>Escherichia coli</i>	<i>Alcaligenes sp.</i>	3.5.1.11			YES
Pentosanase	<i>Aspergillus niger</i> *	<i>Aspergillus sp.</i>	_____	YES		
Pentosanase	<i>Aspergillus niger</i> *	none	_____	YES		
Pentosanase	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	<i>Bacillus sp.</i>	_____	YES		
Pentosanase	<i>Humicola insolens</i>	none	_____	YES		
Pentosanase	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	none	_____	YES	YES	
Peroxidase	<i>Aspergillus niger</i> *	<i>Marasmius sp.</i>	1.11.1.7	YES		
Peroxidase	Soybean hulls	none	1.11.1.7	YES		
Phosphodiesterase	<i>Leptographium procerum</i>	none	3.1.4.1	YES		
Phosphodiesterase	<i>Penicillium citrinum</i>	none	3.1.4.1	YES		YES
Phospholipase A2	<i>Aspergillus niger</i> *	<i>Pig pancreas</i>	3.1.1.4	YES		
Phospholipase A2	<i>Aspergillus oryzae</i>	<i>Fusarium sp.</i>	3.1.1.4	YES		
Phospholipase A2	<i>Pig pancreas</i>	none	3.1.1.4	YES		
Phospholipase A2	<i>Streptomyces violaceoruber</i>	none	3.1.1.4	YES		
Phospholipase A2	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	3.1.1.4	YES		
Phospholipase A2	<i>Trichoderma reesei</i> or <i>longibrachiatum</i> ☒	<i>Aspergillus sp.</i>	3.1.1.4	YES	YES	YES
Phospholipase B	<i>Aspergillus niger</i> *	<i>Aspergillus sp.</i>	3.1.1.5	YES		
Phospholipase B	<i>Aspergillus niger</i> *	none	3.1.1.5	YES		
Phospholipase B	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Aspergillus sp.</i>	3.1.1.5	YES	YES	
Phospholipase C	<i>Pichia pastoris</i>	environment sample	3.1.4.3	YES		
Phospholipase C	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	3.1.4.3	YES		YES
Phospholipase D	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	3.1.4.4	YES		
Phytase **	<i>Aspergillus niger</i> *	<i>Aspergillus sp.</i>	3.1.3.x	YES		YES
Phytase **	<i>Aspergillus oryzae</i>	<i>Peniophora sp.</i>	3.1.3.x	YES	YES	
Phytase **	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Aspergillus sp.</i>	3.1.3.x		YES	



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Phytase**	<i>Schizosaccharomyces pombe</i>	<i>Escherichia sp.</i>	3.1.3.x		YES	
Phytase**	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Buttiauxella sp.</i>	3.1.3.x	YES	YES	YES
Polygalacturonase or Pectinase	<i>Aspergillus niger*</i>	none	3.2.1.15	YES		YES
Polygalacturonase or Pectinase	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Aspergillus sp.</i>	3.2.1.15	YES	YES	YES
Protease (incl. milkclotting enzymes)	<i>Actinida chinensis</i>	none	3.4.2x.xx#	YES		
Protease (incl. milkclotting enzymes)	<i>Ananas bracteatus</i>	none	3.4.2x.xx#	YES		
Protease (incl. milkclotting enzymes)	<i>Ananas comosus</i>	none	3.4.2x.xx#	YES	YES	YES
Protease (incl. milkclotting enzymes)	<i>Aspergillus melleus</i>	none	3.4.2x.xx#	YES		YES
Protease (incl. milkclotting enzymes)	<i>Aspergillus niger*</i>	<i>Aspergillus sp.</i>	3.4.2x.xx#	YES		
Protease (incl. milkclotting enzymes)	<i>Aspergillus niger*</i>	none	3.4.2x.xx#	YES	YES	YES
Protease (incl. milkclotting enzymes)	<i>Aspergillus oryzae</i>	<i>Rhizomucor sp.</i>	3.4.2x.xx# ^o	YES		YES
Protease (incl. milkclotting enzymes)	<i>Bacillus alcalophilus</i>	<i>Bacillus sp.</i>	3.4.2x.xx#			YES
Protease (incl. milkclotting enzymes)	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	<i>Bacillus sp.</i>	3.4.2x.xx#	YES	YES	YES
Protease (incl. milkclotting enzymes)	<i>Bacillus amyloliquefaciens</i> or <i>subtilis</i>	none	3.4.2x.xx#	YES	YES	YES
Protease (incl. milkclotting enzymes)	<i>Bacillus clausii</i>	none	3.4.2x.xx#	YES		YES
Protease (incl. milkclotting enzymes)	<i>Bacillus clausii</i>	<i>Bacillus sp.</i>	3.4.2x.xx#			YES
Protease (incl. milkclotting enzymes)	<i>Bacillus licheniformis</i>	<i>Nocardioopsis sp.</i>	3.4.2x.xx#	YES	YES	
Protease (incl. milkclotting enzymes)	<i>Bacillus licheniformis</i>	none	3.4.2x.xx#	YES	YES	YES
Protease (incl. milkclotting enzymes)	<i>Bacillus stearothermophilus</i>	none	3.4.2x.xx#	YES		YES
Protease (incl. milkclotting enzymes)	<i>Calf stomach</i>	none	3.4.2x.xx#	YES		
Protease (incl. milkclotting enzymes)	<i>Carica papaya</i>	none	3.4.2x.xx#	YES	YES	YES
Protease (incl. milkclotting enzymes)	<i>Cryphonectria</i> or <i>Endothia parasitica</i>	<i>Cryphonectria sp.</i>	3.4.2x.xx#	YES		
Protease (incl. milkclotting enzymes)	<i>Ficus glabrata</i>	none	3.4.2x.xx#	YES	YES	YES
Protease (incl. milkclotting enzymes)	<i>Fusarium venenatum</i>	<i>Fusarium sp.</i>	3.4.2x.xx#	YES		YES
Protease (incl. milkclotting enzymes)	<i>Geobacillus caldoproteolyticus</i>	none	3.4.2x.xx#	YES		YES
Protease (incl. milkclotting enzymes)	<i>Goat stomach</i>	none	3.4.2x.xx#	YES		
Protease (incl. milkclotting enzymes)	<i>Kluyveromyces lactis</i>	<i>Calf stomach</i>	3.4.2x.xx#	YES		
Protease (incl. milkclotting enzymes)	<i>Pig pancreas</i>	none	3.4.2x.xx#			YES
Protease (incl. milkclotting enzymes)	<i>Rhizomucor miehei</i>	none	3.4.2x.xx#	YES		
Protease (incl. milkclotting enzymes)	<i>Rhizopus niveus</i>	none	3.4.2x.xx#	YES		
Protease (incl. milkclotting enzymes)	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	3.4.2x.xx#	YES		YES
Protease (incl. milkclotting enzymes)	<i>Trichoderma reesei</i> or <i>longibrachiatum</i>	<i>Trichoderma sp.</i>	3.4.2x.xx#	YES		YES
Protease (incl. milkclotting enzymes)	<i>Pig pancreas</i>	none	3.4.2x.xx#	YES		
Protein-glutamine glutaminase	<i>Chryseobacterium proteolyticum</i>	none	3.2.1.41	YES		
Pullulanase	<i>Bacillus acidopullulyticus</i>	none	3.2.1.41	YES		
Pullulanase	<i>Bacillus licheniformis</i>	<i>Bacillus sp.</i>	3.2.1.41	YES		YES



List of commercial enzymes

Enzyme activity	Production organism	Donor	IUBMB number*	Applications:		
				Food	Feed	Technical
Pullulanase	<i>Bacillus licheniformis</i>	none	3.2.1.41	YES		
Pullulanase	<i>Bacillus amyloliquefaciens or subtilis</i>	<i>Bacillus sp.</i>	3.2.1.41	YES		
Pullulanase	<i>Klebsiella pneumoniae</i>	none	3.2.1.41	YES		
Pullulanase	<i>Pullulanibacillus naganoensis</i>	none	3.2.1.41	YES		
Rhamnosidase	<i>Penicillium decumbens</i>	none	3.2.1.40	YES		
Sulfhydryl oxidase	<i>Bacillus amyloliquefaciens or subtilis</i>	<i>Saccharomyces sp.</i>	1.8.3.2	YES		YES
Tannase	<i>Aspergillus niger*</i>	none	3.1.1.20	YES	YES	
Transglutaminase	<i>Streptomyces mobaraensis</i>	none	2.3.2.13	YES		
Urease	<i>Lactobacillus fermentum</i>	none	3.5.1.5	YES		
Xaa-Pro dipeptidase	<i>Escherichia coli</i>	<i>Alteromonas sp.</i>	3.4.13.9			YES
Xylanase	<i>Aspergillus niger*</i>	<i>Aspergillus sp.</i>	3.2.1.8	YES	YES	
Xylanase	<i>Aspergillus niger*</i>	none	3.2.1.8	YES	YES	
Xylanase	<i>Aspergillus niger*</i>	<i>Talaromyces sp.</i>	3.2.1.8	YES		
Xylanase	<i>Aspergillus oryzae</i>	<i>Aspergillus sp.</i>	3.2.1.8	YES		
Xylanase	<i>Aspergillus oryzae</i>	<i>Thermomyces sp.</i>	3.2.1.8	YES	YES	
Xylanase	<i>Bacillus amyloliquefaciens or subtilis</i>	<i>Bacillus sp.</i>	3.2.1.8	YES		
Xylanase	<i>Bacillus licheniformis</i>	<i>Bacillus sp.</i>	3.2.1.8	YES	YES	
Xylanase	<i>Bacillus amyloliquefaciens or subtilis</i>	none	3.2.1.8	YES		
Xylanase	<i>Disporotrichum dimorphosporum</i>	none	3.2.1.8	YES		
Xylanase	<i>Humicola insolens</i>	none	3.2.1.8	YES	YES	
Xylanase	<i>Penicillium or Talaromyces emersonii</i>	none	3.2.1.8	YES	YES	
Xylanase	<i>Streptomyces violaceoruber</i>	<i>Streptomyces sp.</i>	3.2.1.8	YES	YES	
Xylanase	<i>Trichoderma reesei or longibrachiatum</i>	<i>Actinomadura sp.</i>	3.2.1.8		YES	
Xylanase	<i>Trichoderma reesei or longibrachiatum</i>	<i>Aspergillus sp.</i>	3.2.1.8	YES		
Xylanase	<i>Trichoderma reesei or longibrachiatum</i> ☐	none	3.2.1.8	YES	YES	
Xylanase	<i>Trichoderma reesei or longibrachiatum</i> ☐	<i>Trichoderma sp.</i>	3.2.1.8	YES	YES	YES
Xylanase	<i>Trichoderma viride</i>	none	3.2.1.8	YES		