

# Micro-organisms



Current overview of the micro-organisms used by DSM and their applications  
2010

I: classical micro-organism; II: homologous or self-cloned GMM (genetically modified micro-organism); III heterologous GMM

| Production Micro-organism | I | II | III | Product               | Food & Feed | Pharma & Fine Chemicals | Energy & Environment |
|---------------------------|---|----|-----|-----------------------|-------------|-------------------------|----------------------|
| <i>Aspergillus niger</i>  | ● | ●  |     | Acid amylase          | ●           | -                       |                      |
| <i>Aspergillus niger</i>  |   |    | ●   | Acid lactase          | ●           | -                       |                      |
| <i>Aspergillus niger</i>  |   | ●  |     | Asparaginase          | ●           | -                       |                      |
| <i>Aspergillus niger</i>  | ● |    |     | Arabanase             | ●           | -                       |                      |
| <i>Aspergillus niger</i>  | ● | ●  |     | Arabinofuranosidase   | ●           | -                       |                      |
| <i>Aspergillus niger</i>  | ● |    |     | Beta-galactosidase    | ●           | -                       |                      |
| <i>Aspergillus niger</i>  | ● |    |     | Citric acid           | ●           | ●                       |                      |
| <i>Aspergillus niger</i>  |   | ●  |     | Carboxypeptidase      | ●           | -                       |                      |
| <i>Aspergillus niger</i>  |   | ●  |     | Fungal lipase         | ●           | -                       |                      |
| <i>Aspergillus niger</i>  | ● |    |     | Glucoamylase          | ●           | -                       |                      |
| <i>Aspergillus niger</i>  | ● |    |     | Glucose oxidase       | ●           | -                       |                      |
| <i>Aspergillus niger</i>  | ● |    |     | Glycosidase           | ●           |                         |                      |
| <i>Aspergillus niger</i>  | ● |    |     | Hemicellulase         | ●           | -                       |                      |
| <i>Aspergillus niger</i>  |   |    | ●   | Lipase                | ●           | -                       |                      |
| <i>Aspergillus niger</i>  | ● |    |     | Pectinase             | ●           | -                       |                      |
| <i>Aspergillus niger</i>  | ● | ●  |     | Pectin methylesterase | ●           | -                       |                      |
| <i>Aspergillus niger</i>  |   |    | ●   | Peroxidase            | ●           | -                       |                      |
| <i>Aspergillus niger</i>  |   | ●  |     | Phospholipase A1      | ●           | -                       |                      |
| <i>Aspergillus niger</i>  |   |    | ●   | Phospholipase A2      | ●           | -                       |                      |
| <i>Aspergillus niger</i>  |   | ●  |     | Phytase               | ●           | -                       |                      |
| <i>Aspergillus niger</i>  |   | ●  |     | Polygalacturonase     | ●           | -                       |                      |
| <i>Aspergillus niger</i>  | ● | ●  |     | Protease, endo-       | ●           | -                       |                      |

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| <i>Aspergillus niger</i>  | ● | ●  |     | Xylanase                    | ●           | -                       |                      |
| <i>Aspergillus niger</i>  |   |    | ●   | Xylanase, thermostable      | ●           | -                       |                      |
| <i>Aspergillus niger</i> var. <i>awamori</i>                    |   |    | ●   | Lactoferrin                 | -           | ●                       |                      |
| <i>Aspergillus oryzae</i>                                       | ● |    |     | Fungal amylase              | ●           | -                       |                      |
| <i>Aspergillus oryzae</i>                                       |   | ●  |     | Acid lactase                | ●           | -                       |                      |
| <i>Bacillus amyloliquefaciens</i>                               | ● | ●  |     | Alpha-amylase               | ●           | -                       |                      |
| <i>Bacillus amyloliquefaciens</i>                               |   |    | ●   | Amylomaltase                | ●           | -                       |                      |
| <i>Bacillus amyloliquefaciens</i>                               | ● | ●  |     | Beta-glucanase              | ●           | -                       |                      |
| <i>Bacillus amyloliquefaciens</i>                               | ● | ●  |     | Neutral protease            | ●           | -                       |                      |
| <i>Bacillus amyloliquefaciens</i>                               |   |    | ●   | Maltogenic amylase          | ●           | -                       |                      |
| <i>Bacillus amyloliquefaciens</i>                               | ● |    |     | Mixed enzyme cocktail       |             |                         | ●                    |
| <i>Bacillus licheniformis</i>                                   | ● | ●  |     | Alpha-amylase, thermostable | ●           | -                       |                      |
| <i>Bacillus licheniformis</i>                                   |   | ●  |     | Protease                    | ●           | -                       |                      |
| <i>Bacillus subtilis</i>  |   | ●  |     | Bacterial xylanase          | ●           | -                       |                      |
| <i>Bacillus subtilis</i>  |   |    | ●   | Maltogenic amylase          | ●           | -                       |                      |
| <i>Bacillus subtilis</i>  |   | ●  |     | Vitamin B <sub>2</sub>      | ●           | ●                       |                      |
| <i>Bifidobacterium animalis</i> spp. <i>lactis</i> <sup>1</sup> | ● |    |     | Starter culture             | ●           | -                       |                      |
| <i>Bifidobacterium animalis</i> spp. <i>Lactis</i> <sup>1</sup> | ● |    |     | Probiotic                   | ●           | -                       |                      |

<sup>1</sup> formerly *Bifidobacterium lactis*

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|--|---|----|-----|------------------------------------|-------------|-------------------------|----------------------|
| <i>Blakeslea trispora</i>                          | ● |    |     | Beta carotene                      | ●           | -                       |                      |
| <i>Brevibacterium linens</i>                       | ● |    |     | Starter culture                    | ●           | -                       |                      |
| <i>Chryphonectria parasitica</i> <sup>2</sup>      | ● |    |     | Rennet                             | ●           | -                       |                      |
| <i>Disporotrichum dimorphosporum</i>               | ● |    |     | Beta-glucanase                     | ●           | -                       |                      |
| <i>Enterobacter cloacae</i>                        | ● |    |     | Butter aroma                       | ●           | -                       |                      |
| <i>Enterococcus faecium</i>                        | ● |    |     | Animal Probiotic                   | ●           | -                       |                      |
| <i>Escherichia coli</i>                            |   |    | ●   | Glutaryl-acylase                   | -           | ●                       |                      |
| <i>Escherichia coli</i>                            |   | ●  | ●   | Penicillin/cephalosporin-acylase   | -           | ●                       |                      |
| <i>Escherichia coli</i>                            |   |    | ●   | Aminopeptidase                     | -           | ●                       |                      |
| <i>Escherichia coli</i>                            |   | ●  |     | Aldolase                           | -           | ●                       |                      |
| <i>Escherichia coli</i>                            |   |    | ●   | L-amidase                          | -           | ●                       |                      |
| <i>Escherichia coli</i>                            |   | ●  |     | Shikimate                          | -           | ●                       |                      |
| <i>Escherichia coli</i>                            |   |    | ●   | Esterase                           | -           | ●                       |                      |
| <i>Escherichia coli</i>                            |   |    | ●   | Nitrilase                          | -           | ●                       |                      |
| <i>Escherichia coli</i>                            |   |    | ●   | Hydantoinase/racemase/carbamoylase |             | ●                       |                      |
| <i>Escherichia coli</i>                            |   |    | ●   | Phenylalanine-ammonia-lyase        | -           | ●                       |                      |
| <i>Glarea lozoyensis</i>                           | ● |    |     | Caspofungin precursor              | -           | ●                       |                      |
| <i>Geobacillus stearothermophilus</i> <sup>3</sup> | ● |    |     | Antibiotic residue tests           | ●           | -                       |                      |
| <i>Gluconobacter oxydans</i>                       | ● |    |     | Vitamin C intermediate             | ●           | ●                       |                      |

<sup>2</sup> formerly *Endothia parasitica*

<sup>3</sup> Formerly *Bacillus stearothermophilus*

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| <i>Kluyveromyces lactis</i>  |   |    | ●   | Chymosin          | ●           | -                       |                      |
| <i>Kluyveromyces lactis</i>  | ● | ●  |     | Neutral lactase   | ●           | -                       |                      |
| <i>Kluyveromyces lactis</i>  |   |    | ●   | Lipase            | ●           | -                       |                      |
| <i>Lactobacillus acidophilus</i>   | ● |    |     | Starter culture   | ●           | -                       |                      |
| <i>Lactobacillus acidophilus</i>   | ● |    |     | Probiotic         | ●           | -                       |                      |
| <i>Lactobacillus delbruckii</i> ssp<br><i>bulgaricus</i>                   | ● |    |     | Starter culture   | ●           | -                       |                      |
| <i>Lactobacillus rhamnosus</i>   | ● |    |     | Starter culture   | ●           | -                       |                      |
| <i>Lactobacillus casei</i>   | ● |    |     | Starter culture   | ●           | -                       |                      |
| <i>Lactobacillus casei</i>   | ● |    |     | Probiotic         | ●           | -                       |                      |
| <i>Lactobacillus helveticus</i>  | ● |    |     | Starter culture   | ●           | -                       |                      |
| <i>Lactococcus lactis</i> ssp <i>cremoris</i>                              | ● |    |     | Starter culture   | ●           | -                       |                      |
| <i>Lactococcus lactis</i> ssp <i>lactis</i><br>biovar <i>diacetylactis</i> | ● |    |     | Starter culture   | ●           | -                       |                      |
| <i>Lactococcus lactis</i> ssp <i>lactis</i>                                | ● |    |     | Starter culture   | ●           | -                       |                      |
| <i>Leuconostoc mesenteroides</i> ssp<br><i>cremoris</i>                    | ● |    |     | Starter culture   | ●           | -                       |                      |
| <i>Leptographium procerum</i> <sup>4</sup>                                 | ● |    |     | Phosphodiesterase | ●           | -                       |                      |
| <i>Mortierella alpina</i>  | ● |    |     | Arachidonic acid  | ●           | -                       |                      |
| <i>Mucor miehei</i>  | ● |    |     | Rennet            | ●           | -                       |                      |

<sup>4</sup> formerly *Verticicladiella procera*

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| <i>Mucor miehei</i>                     | ● |    |     | Esterase / lipase                               | ●           | -                       |                      |
| <i>Penicillium brevicompactum</i>       | ● |    |     | Mycophenolate                                   | -           | ●                       |                      |
| <i>Penicillium chrysogenum</i>          | ● |    |     | Penicillin-G                                    | -           | ●                       |                      |
| <i>Penicillium chrysogenum</i>          | ● |    |     | 6-Amino penicillanic acid (6-APA)               | -           | ●                       |                      |
| <i>Penicillium chrysogenum</i>          |   |    | ●   | 7-Aminodesacetoxy-cephalosporanic acid (7-ADCA) | -           | ●                       |                      |
| <i>Penicillium chrysogenum</i>          |   |    | ●   | Pravastatin                                     | -           | ●                       |                      |
| <i>Pichia pastoris</i>                  |   |    | ●   | Hydroxy-nitrile-lyase                           | -           | ●                       |                      |
| <i>Propionibacterium freudenreichii</i> | ● |    |     | Starter culture                                 | ●           | -                       |                      |
| <i>Rhizopus oryzae</i>                  | ● |    |     | Fungal lipase                                   | ●           | -                       |                      |
| <i>Saccharomyces cerevisiae</i>         | ● |    |     | Wine yeast                                      | ●           | -                       |                      |
| <i>Saccharomyces cerevisiae</i>         | ● |    |     | Alcohol yeast                                   | ●           | -                       |                      |
| <i>Saccharomyces cerevisiae</i>         | ● |    |     | Yeast extract                                   | ●           | -                       |                      |
| <i>Saccharomyces cerevisiae</i>         | ● |    |     | Flavour enhancers                               | ●           | -                       |                      |
| <i>Saccharomyces cerevisiae</i>         | ● |    |     | Invertase                                       | ●           | -                       |                      |
| <i>Saccharomyces cerevisiae</i>         |   | ●  |     | Trienol (=cholesta 5, 7, 24 trienol)            | ●           | ●                       |                      |
| <i>Streptococcus thermophilus</i>       | ● |    |     | Starter culture                                 | ●           | -                       |                      |
| <i>Streptomyces clavuligerus</i>        | ● |    |     | Clavulanic acid                                 | -           | ●                       |                      |
| <i>Streptomyces natalensis</i>          | ● |    |     | Natamycin                                       | ●           |                         |                      |
| <i>Streptomyces noursei</i>             | ● |    |     | Nystatin  | -           | ●                       |                      |

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| <i>Talaromyces emersonii</i>                    | ● |    |     | Beta-glucanase         | ●           | -                       |                      |
| <i>Trichoderma longibrachiatum</i> <sup>5</sup> | ● |    |     | Hemicellulase          | ●           | -                       |                      |
| <i>Trichoderma reesei</i> <sup>6</sup>          | ● |    |     | Cellulase              | ●           | -                       |                      |
| <i>Trichoderma reesei</i> <sup>6</sup>          | ● |    |     | Beta-glucanase         | ●           | -                       |                      |
| <i>Trichoderma reesei</i> <sup>6</sup>          | ● |    |     | Mixed enzymes cocktail | -           | -                       | ●                    |

<sup>5</sup> Also known as *Trichoderma reesei*

<sup>6</sup> formerly *Trichoderma longibrachiatum*