



1 White wine and cidre		Key to description of fermented foods / Colour code for main groups of fermentation organisms										18 Meats																																																																																																																																						
1 worldwide Feder-weisser grapes 3.5-4.0 n/a 2-8 d E: 4-10	2 Red and fruit wines grapes 3.5-4.0 n/a E: 12-15	<div><div><div></div><div></div><div></div><div></div></div><div>Yeasts</div><div>Other organisms</div><div>Bacilli</div><div>Staphylococci</div><div>Enterobacteriaceae</div><div>Mycelial fungi</div></div> <div><div>number →</div><div>Name →</div><div>Main ingredient →</div><div>pH →</div><div>aw →</div><div>Fermentation time →</div></div> <div><div>109</div><div>Westphalia, D</div><div>Pumper-nickel</div><div>rye</div><div>5.0</div><div>0.96</div><div>1d</div><div>F. sanfrancisc.</div><div>Ks. humilis</div><div>C. mindensis</div><div>L: 0.15; A: 0.01; G</div></div> <div>← Typical Origin or "Novel"</div> <div>← <u>(double) underlined</u> = <u>(optional)</u> back-slopped fermentation</div> <div>← Major / selected fermentation organisms</div> <div>← Selected metabolites</div> <div><div></div><div></div><div></div><div></div></div> <div>Lactic acid bacteria</div> <div>Propionibacteria</div> <div>Brevibacterium</div> <div>Acetic acid bacteria</div> <tr><td>3 worldwide White wine grapes 3.5-4.0 n/a 1m-5y E: 8-12; L: <0.04</td><td>4 worldwide Red Wine grapes 3.5-4.0 n/a E: 12-15</td><td colspan="10"><div><div><div></div><div></div><div></div><div></div></div><div>Main metabolites:</div><div>L Lactate (mol / L)</div><div>A Acetate (mol / L)</div><div>E Ethanol (%)</div><div>P Propionate (mol / L)</div><div>EPS</div><div>2Ac Diacetyl</div><div>G Glutamate</div><div>N,S Ammonia, H2S or dimethylsulfide</div><div>Ac Acetaldehyde</div></div><div><div>h: hour</div><div>d: day</div><div>w week</div><div>m: month</div><div>y: year</div><div>c: century</div></div></td><td>10 Thailand Nham pork Lp. plantanum Pc. pentosaceus Kc. varians L: 0.1</td></tr> <tr><td>11 Champagne (F) Champagne grapes 3.5-4.0 n/a 1-5 y E: 8-12</td><td>12 Germany Botrytised wine grapes 3.5-4.0 n/a 1-10 y E: 8-12</td><td>3 Light beer</td><td>4 Dark beer</td><td>5 Tubers and roots</td><td>6 Beverages from cereals or tubers</td><td>7 Cereal porridges</td><td>8 Bread (wheat)</td><td>9 Bread (wheat and other)</td><td>10 Mixed cereal fermentations</td><td>11 Vegetables and Olives</td><td>12 Soy and beans</td><td>5 Thailand (East Asia) Ang kak rice Monascus purpureus Monasconrubin 1w</td><td>6 Europe and others Buttermilk / cultured butter bovine Lc. lactis Lc. cremoris Lc. cremoris 12h L: 0.1; 2Ac; Ac</td><td>7 U.K. Cottage Cheese bovine Lc. lactis Lc. cremoris Lc. cremoris 1-3 d L: 0.1</td><td>8 Gruyere (CH) Gruyère raw bovine L. helveticus Sc. thermophil. Br. linens L: 0.1</td><td>9 Japan Narezushi (馴れ寿司) fish, rice Lp. plantanum Lv. brevis D. hansenii L: 0.05; G</td><td>10 Thailand Nham pork Lp. plantanum Pc. pentosaceus Kc. varians L: 0.1</td></tr> <tr><td>19 Normandie (F) Cidre apples 3.5-4.0 n/a 2-4 w E: 5-8, L: 0.05</td><td>20 worldwide Fruit wines prunes 3.5-4.0 n/a 1w E: >12</td><td>21 U.K., Trinidad Ginger beer ginger 3.5-4 n/a 4 w E: 2-4</td><td>22 U.K., Belgium, Germany Dark ale barley 3.5-4.0 n/a 4 w E: 5-14</td><td>23 Amazon Tarubá cassava Lp. plantanum Lm. mesenteroid To. delbrueckii n/a 2 w L: 0.1; A: 0.05</td><td>24 Turkey, Bulgaria Boza wheat Lm. mesenteroid Lp. plantanum Candida spp. E: 1; L: 0.15</td><td>25 Ghana Koko millet W. confusa Lm. fermentum Pc. pentosaceus 1-3 d L: 0.12</td><td>26 France Baguette wheat S. cerevisiae Ls. sakei Pc. pentosaceus 8-16h L: 0.1; E: 0.5</td><td>27 Novel Gluten-free bread various S. cerevisiae Lp. plantanum Lm. fermentum 8-24h L: 0.05; dextran</td><td>28 Turkey Saigam (+ black carrots) wheat Lp. plantanum Lv. brevis Lc. paracasei 14 d L: 0.15; A: 0.01</td><td>29 Europe, Asia, North America Sauerkraut cabbage Lu kimchi Lp. plantanum Lv. brevis 2-4 w L: 0.15; A: 0.02</td><td>30 Japan Natto (納豆) soy Bc. subtilis Polyglutamate 1d</td><td>31 Benin Tayohounta B. licheniformis B. subtilis Pc. pentosaceus 2 d G</td><td>32 Zambia Mabisi bovine Lc. lactis Sc. infantarius Citrobacter 2 d L: 0.15; 2Ac</td><td>33 Norway Mysost whey Lc. lactis Lu. mesenteroides L: 0.05</td><td>34 Quebec (CAN) Oka bovine Lc. lactis Br. linens G. candidum 1-3m L: 0.1; N.S</td><td>35 Ghana Momone B. subtilis Lp. plantanum D. hansenii 7 d G</td><td>36 China Suanzharou pork, rice Lp. plantanum St. camosus 4 w L: 0.1; G</td></tr> <tr><td>37 Spain Sherry grapes 3.5-4.0 n/a >6 y E: 15</td><td>38 Duoro (Portugal) Port wine grapes 3.5-4.0 n/a 1y-1c E: 10-23</td><td>39 Bavaria (D); Pilsen (CZ) Helles / Pilsner barley 3.5-4.0 n/a 4 w E: 5</td><td>40 Brazil Caxiri cassava B. subtilis Lm. fermentum S. cerevisiae 2 d E: 12; L: 0.1</td><td>41 Ethiopia Kocho cassava B. subtilis Lp. plantanum Lv. brevis 5 m L: 0.1</td><td>42 Zimbabwe Mahewu corn, malt Lm. fermentum Lp. plantanum W. cibaria 1-2 d L: 0.2</td><td>43 West Africa Mawe / Ogi corn Lm. fermentum Pc. pentosaceus Candida spp. 1-3 d L: 0.12</td><td>44 Milano (Italy) Panettone wheat, egg F. sanfrancisc. Lm. mesenteroides Ks. humilis 2 d L: 0.1; A: 0.01</td><td>45 Sudan Kisra sorghum Lm. fermentum A. amylovorus I. orientalis 2 d L: 0.1; A: 0.01</td><td>46 Turkey Tarhana (+ dairy, vegetables) wheat Sc. thermophilus S. cerevisiae 0.63 3 d L: 0.15 A: 0.02</td><td>47 worldwide Pickles cucumber Lu. mesenteroid Lv. brevis 2-4 w L: 0.1</td><td>48 Indonesia Tempe soy R. stolonifer A. oryzae Z. rouxii T. halophilus 1d phytase, G</td><td>49 Japan Miso (味噌) soy A. oryzae Z. rouxii T. halophilus 1-2y G</td><td>50 Silk Road Qurt bovine Lc. delbrueckii Sc. thermophil. 0.30 1m L: 0.5</td><td>51 Holland Gouda bovine Lc. lactis Sc. infantarius NSLAB 4 w L: 0.1; (G)</td><td>52 Normandie (F) Camembert raw bovine Lc. lactis Lc. cremoris P. camemberti 1-4m L: 0.1; N</td><td>53 Sweden Surströmming herring T. halophilus Ak. gillum Mn. psychrot. 2-3 m Ac: 0.01; G; N.S</td><td>54 Italy, Hungary Salami meats Lp. plantanum St. camosus P. nalgiovensis L: 0.1; G</td></tr> <tr><td>55 Quebec (CAN) Ice cidre apples 3.5-4.0 n/a 2-4 m E: 8-11</td><td>56 Germany Eiswein grapes 3.5-4.0 n/a 0.5-1y E: 12-16</td><td>71 Belgium Lambic wheat S. cerevisiae Bt. lambicus Pc. dammosus 4m-4y E: 5; L: 0.1</td><td>72 Tanzania Mbege barley S. cerevisiae Lp. plantanum W. confusa 4 w E: 4</td><td>73 West Africa Gari cassava Lp. plantanum Lm. fermentum W. cibaria 2 d L: 0.1</td><td>74 West Africa Gowe sorghum Lm. fermentum Pc. pentosaceus W. confusa 2 d L: 0.2</td><td>75 Novel Plant-based yoghurt oats L. acidophilus Lp. plantanum Lm. fermentum 1 d L: 0.2</td><td>76 Reutlingen, D / France Mutschli / Brioché wheat, egg F. sanfrancisc. Ks. humilis 1d L: 0.1; A: 0.01</td><td>77 China Mantou (馒头) wheat F. sanfrancisc. S. cerevisiae 1d L: 0.15; A: 0.02</td><td>78 South India Idli (+ beans) rice Lu. mesenteroid Lp. plantanum Pc. pentosaceus 1d L: 0.1; A: 0.02</td><td>79 Spain, Greece Olives olives Lp. plantanum Lp. pentosus Candida spp. 4d-1y L: 0.2</td><td>80 China Sufu soy Mucor spp. Bacillus spp. Enterococcus G 1-3y</td><td>81 Korea Gochujang (고추장) maize A. oryzae Z. rouxii Bc. subtilis 1-3y G</td><td>82 Central Asia Koumiss mare Lc. delbrueckii K. marianus Lc. helveticus 24 h L: 0.15; E: 1.5</td><td>83 Emmentaler (CH) Emmentaler (Swiss) raw bovine Sc. thermophil. Lc. helveticus Pr. jensenii 4-14m L: 0.1; P: 0.1</td><td>84 Roquefort (F) Roquefort raw ovine Lc. lactis Lc. cremoris P. roqueforti L: 0.1; N</td><td>85 Thailand Naam-Pla fish T. halophilus T. muraticus Lt. salicampi 6-18m L: 0.1; G</td><td>86 Farø Skerpikjøt sheep St. equorum Kocuria spp. 6 m G</td></tr> <tr><td>87 Japan Sake (清酒) rice A. oryzae S. cerevisiae L. helveticus 6-12 m E: 15; L: 0.02</td><td>88 Zhejiang (China) Shaoxing wine (绍兴酒) rice A. oryzae S. cerevisiae M. purpureus 6-12 m E: >14</td><td>103 Botswana, Zimbabwe Chibuku sorghum S. cerevisiae Lp. plantanum n/a 3-5 d E: 4; L: 0.1</td><td>104 South America Chicha maize S. cerevisiae Lm. fermentum Sc. mutans 4 d E: 3-4</td><td>105 Nigeria Elubo yams Lp. plantanum Lm. fermentum Bc. subtilis 1d L: 0.05</td><td>106 Uganda Bushera sorghum Lm. fermentum Lv. brevis Lp. plantanum 1-4 d L: 0.12; A: 0.01</td><td>107 Botswana Ting sorghum Lm. reuteri Lm. fermentum Lp. plantanum 1-2 d L: 0.12; A: 0.01</td><td>108 Bay Area (U.S.) San Francisco Sourdough Bread wheat F. sanfrancisc. Ks. humilis C. mindensis 1d L: 0.12; A: 0.01</td><td>109 Westphalia, D Pumper-nickel rye F. sanfrancisc. Ks. humilis 0.96 1d L: 0.15; A: 0.01; G</td><td>110 Novel Plant based cheeses (pulses, nuts, others) oats Lp. plantanum Lc. lactis others 2w-1y L: 0.15; A: 0.02</td><td>111 Taiwan Fu-Tsai Mustard Lu. mesenteroid C. futsail T. halophilus 2 w L: 0.15; A: 0.02</td><td>112 China Stinky tofu (臭豆腐) soy Sn. odoratitofu Bacillus spp. Eggerthella 2-3 d odour (strong)</td><td>113 East Asia Soy sauce soy A. sojae T. halophilus Z. rouxii 6-12 m L: 0.1; G</td><td>114 Caucasus Kefir bovine L. kefiranofaciens Lu. mesenteroid 0.98 K. marianus 2-24 h L: 0.08; E: 1.2Ac</td><td>115 Italy Pecorino raw ovine L. helveticus Sc. thermophil. 5.2-5.4 0.92 G. candidum 0.5-5 y L: 0.1; G</td><td>116 Alsace (F) Münster raw bovine Lc. lactis Br. linens G. candidum 1-3 m L: 0.1; N.S</td><td>117 Norway Rakfisk trout Cb. maltaromaticum Ls. sakei N: G 2-4m</td><td>118 Parma (Italy) Prosciutto di Parma pork staphylococci G 0.5-2 y</td></tr> <tr><td colspan="2">Spirits and vinegar</td><td>57 Russia Vodka (водка) potatoes S. cerevisiae n/a 2 d E: 40</td><td>58 Caribbean Rum sug. cane S. cerevisiae n/a 0.1-2 y E: 40-80</td><td>59 Black Forest (D) Kirsch-wasser cherries S. cerevisiae Pu. suebicus n/a 2-12 m E: 44 A: 0.01</td><td>60 Zimbabwe Kachasu Masau S. cerevisiae L. orientalis n/a 6-7 d E: 30-50</td><td>61 Normandie (F) Calvados apples S. uvarum NSLAB n/a 12 m E: 40; A: 0.02</td><td>62 Cognac (F) Cognac grape wine S. cerevisiae n/a 2-60 y E: 40</td><td>63 Italy Grappa pomace S. cerevisiae NSLAB n/a 2-4 d E: >40</td><td>64 Mexico Tequila agave S. cerevisiae T. delbrueckii W. cibaria 0.5-4 y E: 35-55</td><td>65 Scotland, Ireland, U.S.A. Whiskey / Whisky barley S. cerevisiae Ln. parabrachnii L. acidophilus n/a 1y-1c E: 44</td><td>66 China Baijiu (白酒) sorghum A. oryzae S. cerevisiae Lc. lactis L. acetotolerans n/a 15-3y E: 35-53; S</td><td>67 Torres Strait Steamed tuba coconut S. cerevisiae LAB n/a 1w E: 25-45</td><td>68 China Watermelon soy paste grains Bacillus spp. n/a 4 w A: 0.8-3</td><td>69 China Vinegar grains A. oryzae Al. jinshanensis n/a 3-6 m A: 1.0-0.1</td><td>70 Modena (I) Aceto Balsamico grapes S. cerevisiae Acetobacter n/a 12 y A: 1.0-0.01</td></tr> <tr><td colspan="2">Tea, coffee, chocolate, and non-alcoholic beverages</td><td>89 China Pu-erh tea (普洱茶) tea A. niger S. cerevisiae Bl. adenivorans volatiles 2 m</td><td>90 Ethiopia Coffee arabica coffee Pichia spp. Erwinia spp. n/a 2 d Acetate</td><td>91 Indonesia Kopi Luwak (Civet coffee) coffee Citrabacter Weissella Acetate 2 d</td><td>92 tropical countries Cocoa / chocolate cocoa Candida spp. Lactobacilli Ac. acetii volatiles 2 d</td><td>93 Mexico, Madagascar Vanilla vanilla Bc. subtilis n/a β-glucosidase Vanillin 2 d</td><td>94 Scandinavia Mead honey S. cerevisiae n/a E: 6 to 12 7 d</td><td>95 Turkey Gilaburu cranberry Lp. plantanum Lv. brevis n/a 7 d L: 0.15; A: 0.05</td><td>96 Novel Carrot juice carrots Lp. plantanum Lv. brevis n/a 3 w L: 0.15; A: 0.02</td><td>97 Scandinavia Birch beer birch sap Lp. plantanum Lc. lactis Lc. brevis n/a 14 d L: 0.15; A: 0.01</td><td>98 Mexico Pulque agave S. cerevisiae Lc. lactis Lq. dextranum Zymomonas n/a 1d E: 7; EPS</td><td>99 Mexico Tepache pineapple Lc. lactis E. faecium S. cerevisiae n/a 3 d E: 2; L: 0.1</td><td>100 East Asia Kombucha tea Gl. xylinum Brettanomyces n/a 14 d E: 0.5 A: 0.1; L: 0.1</td><td>101 unknown Water kefir sucrose Lq. hordei S. cerevisiae n/a 1d E: 3; L: 0.2; A: 0.1</td><td>102 Novel Lemonade (Bionade) barley Gluconobacter n/a 1d</td></tr>										3 worldwide White wine grapes 3.5-4.0 n/a 1m-5y E: 8-12; L: <0.04	4 worldwide Red Wine grapes 3.5-4.0 n/a E: 12-15	<div><div><div></div><div></div><div></div><div></div></div><div>Main metabolites:</div><div>L Lactate (mol / L)</div><div>A Acetate (mol / L)</div><div>E Ethanol (%)</div><div>P Propionate (mol / L)</div><div>EPS</div><div>2Ac Diacetyl</div><div>G Glutamate</div><div>N,S Ammonia, H2S or dimethylsulfide</div><div>Ac Acetaldehyde</div></div> <div><div>h: hour</div><div>d: day</div><div>w week</div><div>m: month</div><div>y: year</div><div>c: century</div></div>										10 Thailand Nham pork Lp. plantanum Pc. pentosaceus Kc. varians L: 0.1	11 Champagne (F) Champagne grapes 3.5-4.0 n/a 1-5 y E: 8-12	12 Germany Botrytised wine grapes 3.5-4.0 n/a 1-10 y E: 8-12	3 Light beer	4 Dark beer	5 Tubers and roots	6 Beverages from cereals or tubers	7 Cereal porridges	8 Bread (wheat)	9 Bread (wheat and other)	10 Mixed cereal fermentations	11 Vegetables and Olives	12 Soy and beans	5 Thailand (East Asia) Ang kak rice Monascus purpureus Monasconrubin 1w	6 Europe and others Buttermilk / cultured butter bovine Lc. lactis Lc. cremoris Lc. cremoris 12h L: 0.1; 2Ac; Ac	7 U.K. Cottage Cheese bovine Lc. lactis Lc. cremoris Lc. cremoris 1-3 d L: 0.1	8 Gruyere (CH) Gruyère raw bovine L. helveticus Sc. thermophil. Br. linens L: 0.1	9 Japan Narezushi (馴れ寿司) fish, rice Lp. plantanum Lv. brevis D. hansenii L: 0.05; G	10 Thailand Nham pork Lp. plantanum Pc. pentosaceus Kc. varians L: 0.1	19 Normandie (F) Cidre apples 3.5-4.0 n/a 2-4 w E: 5-8, L: 0.05	20 worldwide Fruit wines prunes 3.5-4.0 n/a 1w E: >12	21 U.K., Trinidad Ginger beer ginger 3.5-4 n/a 4 w E: 2-4	22 U.K., Belgium, Germany Dark ale barley 3.5-4.0 n/a 4 w E: 5-14	23 Amazon Tarubá cassava Lp. plantanum Lm. mesenteroid To. delbrueckii n/a 2 w L: 0.1; A: 0.05	24 Turkey, Bulgaria Boza wheat Lm. mesenteroid Lp. plantanum Candida spp. E: 1; L: 0.15	25 Ghana Koko millet W. confusa Lm. fermentum Pc. pentosaceus 1-3 d L: 0.12	26 France Baguette wheat S. cerevisiae Ls. sakei Pc. pentosaceus 8-16h L: 0.1; E: 0.5	27 Novel Gluten-free bread various S. cerevisiae Lp. plantanum Lm. fermentum 8-24h L: 0.05; dextran	28 Turkey Saigam (+ black carrots) wheat Lp. plantanum Lv. brevis Lc. paracasei 14 d L: 0.15; A: 0.01	29 Europe, Asia, North America Sauerkraut cabbage Lu kimchi Lp. plantanum Lv. brevis 2-4 w L: 0.15; A: 0.02	30 Japan Natto (納豆) soy Bc. subtilis Polyglutamate 1d	31 Benin Tayohounta B. licheniformis B. subtilis Pc. pentosaceus 2 d G	32 Zambia Mabisi bovine Lc. lactis Sc. infantarius Citrobacter 2 d L: 0.15; 2Ac	33 Norway Mysost whey Lc. lactis Lu. mesenteroides L: 0.05	34 Quebec (CAN) Oka bovine Lc. lactis Br. linens G. candidum 1-3m L: 0.1; N.S	35 Ghana Momone B. subtilis Lp. plantanum D. hansenii 7 d G	36 China Suanzharou pork, rice Lp. plantanum St. camosus 4 w L: 0.1; G	37 Spain Sherry grapes 3.5-4.0 n/a >6 y E: 15	38 Duoro (Portugal) Port wine grapes 3.5-4.0 n/a 1y-1c E: 10-23	39 Bavaria (D); Pilsen (CZ) Helles / Pilsner barley 3.5-4.0 n/a 4 w E: 5	40 Brazil Caxiri cassava B. subtilis Lm. fermentum S. cerevisiae 2 d E: 12; L: 0.1	41 Ethiopia Kocho cassava B. subtilis Lp. plantanum Lv. brevis 5 m L: 0.1	42 Zimbabwe Mahewu corn, malt Lm. fermentum Lp. plantanum W. cibaria 1-2 d L: 0.2	43 West Africa Mawe / Ogi corn Lm. fermentum Pc. pentosaceus Candida spp. 1-3 d L: 0.12	44 Milano (Italy) Panettone wheat, egg F. sanfrancisc. Lm. mesenteroides Ks. humilis 2 d L: 0.1; A: 0.01	45 Sudan Kisra sorghum Lm. fermentum A. amylovorus I. orientalis 2 d L: 0.1; A: 0.01	46 Turkey Tarhana (+ dairy, vegetables) wheat Sc. thermophilus S. cerevisiae 0.63 3 d L: 0.15 A: 0.02	47 worldwide Pickles cucumber Lu. mesenteroid Lv. brevis 2-4 w L: 0.1	48 Indonesia Tempe soy R. stolonifer A. oryzae Z. rouxii T. halophilus 1d phytase, G	49 Japan Miso (味噌) soy A. oryzae Z. rouxii T. halophilus 1-2y G	50 Silk Road Qurt bovine Lc. delbrueckii Sc. thermophil. 0.30 1m L: 0.5	51 Holland Gouda bovine Lc. lactis Sc. infantarius NSLAB 4 w L: 0.1; (G)	52 Normandie (F) Camembert raw bovine Lc. lactis Lc. cremoris P. camemberti 1-4m L: 0.1; N	53 Sweden Surströmming herring T. halophilus Ak. gillum Mn. psychrot. 2-3 m Ac: 0.01; G; N.S	54 Italy, Hungary Salami meats Lp. plantanum St. camosus P. nalgiovensis L: 0.1; G	55 Quebec (CAN) Ice cidre apples 3.5-4.0 n/a 2-4 m E: 8-11	56 Germany Eiswein grapes 3.5-4.0 n/a 0.5-1y E: 12-16	71 Belgium Lambic wheat S. cerevisiae Bt. lambicus Pc. dammosus 4m-4y E: 5; L: 0.1	72 Tanzania Mbege barley S. cerevisiae Lp. plantanum W. confusa 4 w E: 4	73 West Africa Gari cassava Lp. plantanum Lm. fermentum W. cibaria 2 d L: 0.1	74 West Africa Gowe sorghum Lm. fermentum Pc. pentosaceus W. confusa 2 d L: 0.2	75 Novel Plant-based yoghurt oats L. acidophilus Lp. plantanum Lm. fermentum 1 d L: 0.2	76 Reutlingen, D / France Mutschli / Brioché wheat, egg F. sanfrancisc. Ks. humilis 1d L: 0.1; A: 0.01	77 China Mantou (馒头) wheat F. sanfrancisc. S. cerevisiae 1d L: 0.15; A: 0.02	78 South India Idli (+ beans) rice Lu. mesenteroid Lp. plantanum Pc. pentosaceus 1d L: 0.1; A: 0.02	79 Spain, Greece Olives olives Lp. plantanum Lp. pentosus Candida spp. 4d-1y L: 0.2	80 China Sufu soy Mucor spp. Bacillus spp. Enterococcus G 1-3y	81 Korea Gochujang (고추장) maize A. oryzae Z. rouxii Bc. subtilis 1-3y G	82 Central Asia Koumiss mare Lc. delbrueckii K. marianus Lc. helveticus 24 h L: 0.15; E: 1.5	83 Emmentaler (CH) Emmentaler (Swiss) raw bovine Sc. thermophil. Lc. helveticus Pr. jensenii 4-14m L: 0.1; P: 0.1	84 Roquefort (F) Roquefort raw ovine Lc. lactis Lc. cremoris P. roqueforti L: 0.1; N	85 Thailand Naam-Pla fish T. halophilus T. muraticus Lt. salicampi 6-18m L: 0.1; G	86 Farø Skerpikjøt sheep St. equorum Kocuria spp. 6 m G	87 Japan Sake (清酒) rice A. oryzae S. cerevisiae L. helveticus 6-12 m E: 15; L: 0.02	88 Zhejiang (China) Shaoxing wine (绍兴酒) rice A. oryzae S. cerevisiae M. purpureus 6-12 m E: >14	103 Botswana, Zimbabwe Chibuku sorghum S. cerevisiae Lp. plantanum n/a 3-5 d E: 4; L: 0.1	104 South America Chicha maize S. cerevisiae Lm. fermentum Sc. mutans 4 d E: 3-4	105 Nigeria Elubo yams Lp. plantanum Lm. fermentum Bc. subtilis 1d L: 0.05	106 Uganda Bushera sorghum Lm. fermentum Lv. brevis Lp. plantanum 1-4 d L: 0.12; A: 0.01	107 Botswana Ting sorghum Lm. reuteri Lm. fermentum Lp. plantanum 1-2 d L: 0.12; A: 0.01	108 Bay Area (U.S.) San Francisco Sourdough Bread wheat F. sanfrancisc. Ks. humilis C. mindensis 1d L: 0.12; A: 0.01	109 Westphalia, D Pumper-nickel rye F. sanfrancisc. Ks. humilis 0.96 1d L: 0.15; A: 0.01; G	110 Novel Plant based cheeses (pulses, nuts, others) oats Lp. plantanum Lc. lactis others 2w-1y L: 0.15; A: 0.02	111 Taiwan Fu-Tsai Mustard Lu. mesenteroid C. futsail T. halophilus 2 w L: 0.15; A: 0.02	112 China Stinky tofu (臭豆腐) soy Sn. odoratitofu Bacillus spp. Eggerthella 2-3 d odour (strong)	113 East Asia Soy sauce soy A. sojae T. halophilus Z. rouxii 6-12 m L: 0.1; G	114 Caucasus Kefir bovine L. kefiranofaciens Lu. mesenteroid 0.98 K. marianus 2-24 h L: 0.08; E: 1.2Ac	115 Italy Pecorino raw ovine L. helveticus Sc. thermophil. 5.2-5.4 0.92 G. candidum 0.5-5 y L: 0.1; G	116 Alsace (F) Münster raw bovine Lc. lactis Br. linens G. candidum 1-3 m L: 0.1; N.S	117 Norway Rakfisk trout Cb. maltaromaticum Ls. sakei N: G 2-4m	118 Parma (Italy) Prosciutto di Parma pork staphylococci G 0.5-2 y	Spirits and vinegar		57 Russia Vodka (водка) potatoes S. cerevisiae n/a 2 d E: 40	58 Caribbean Rum sug. cane S. cerevisiae n/a 0.1-2 y E: 40-80	59 Black Forest (D) Kirsch-wasser cherries S. cerevisiae Pu. suebicus n/a 2-12 m E: 44 A: 0.01	60 Zimbabwe Kachasu Masau S. cerevisiae L. orientalis n/a 6-7 d E: 30-50	61 Normandie (F) Calvados apples S. uvarum NSLAB n/a 12 m E: 40; A: 0.02	62 Cognac (F) Cognac grape wine S. cerevisiae n/a 2-60 y E: 40	63 Italy Grappa pomace S. cerevisiae NSLAB n/a 2-4 d E: >40	64 Mexico Tequila agave S. cerevisiae T. delbrueckii W. cibaria 0.5-4 y E: 35-55	65 Scotland, Ireland, U.S.A. Whiskey / Whisky barley S. cerevisiae Ln. parabrachnii L. acidophilus n/a 1y-1c E: 44	66 China Baijiu (白酒) sorghum A. oryzae S. cerevisiae Lc. lactis L. acetotolerans n/a 15-3y E: 35-53; S	67 Torres Strait Steamed tuba coconut S. cerevisiae LAB n/a 1w E: 25-45	68 China Watermelon soy paste grains Bacillus spp. n/a 4 w A: 0.8-3	69 China Vinegar grains A. oryzae Al. jinshanensis n/a 3-6 m A: 1.0-0.1	70 Modena (I) Aceto Balsamico grapes S. cerevisiae Acetobacter n/a 12 y A: 1.0-0.01	Tea, coffee, chocolate, and non-alcoholic beverages		89 China Pu-erh tea (普洱茶) tea A. niger S. cerevisiae Bl. adenivorans volatiles 2 m	90 Ethiopia Coffee arabica coffee Pichia spp. Erwinia spp. n/a 2 d Acetate	91 Indonesia Kopi Luwak (Civet coffee) coffee Citrabacter Weissella Acetate 2 d	92 tropical countries Cocoa / chocolate cocoa Candida spp. Lactobacilli Ac. acetii volatiles 2 d	93 Mexico, Madagascar Vanilla vanilla Bc. subtilis n/a β-glucosidase Vanillin 2 d	94 Scandinavia Mead honey S. cerevisiae n/a E: 6 to 12 7 d	95 Turkey Gilaburu cranberry Lp. plantanum Lv. brevis n/a 7 d L: 0.15; A: 0.05	96 Novel Carrot juice carrots Lp. plantanum Lv. brevis n/a 3 w L: 0.15; A: 0.02	97 Scandinavia Birch beer birch sap Lp. plantanum Lc. lactis Lc. brevis n/a 14 d L: 0.15; A: 0.01	98 Mexico Pulque agave S. cerevisiae Lc. lactis Lq. dextranum Zymomonas n/a 1d E: 7; EPS	99 Mexico Tepache pineapple Lc. lactis E. faecium S. cerevisiae n/a 3 d E: 2; L: 0.1	100 East Asia Kombucha tea Gl. xylinum Brettanomyces n/a 14 d E: 0.5 A: 0.1; L: 0.1	101 unknown Water kefir sucrose Lq. hordei S. cerevisiae n/a 1d E: 3; L: 0.2; A: 0.1	102 Novel Lemonade (Bionade) barley Gluconobacter n/a 1d
3 worldwide White wine grapes 3.5-4.0 n/a 1m-5y E: 8-12; L: <0.04	4 worldwide Red Wine grapes 3.5-4.0 n/a E: 12-15	<div><div><div></div><div></div><div></div><div></div></div><div>Main metabolites:</div><div>L Lactate (mol / L)</div><div>A Acetate (mol / L)</div><div>E Ethanol (%)</div><div>P Propionate (mol / L)</div><div>EPS</div><div>2Ac Diacetyl</div><div>G Glutamate</div><div>N,S Ammonia, H2S or dimethylsulfide</div><div>Ac Acetaldehyde</div></div> <div><div>h: hour</div><div>d: day</div><div>w week</div><div>m: month</div><div>y: year</div><div>c: century</div></div>										10 Thailand Nham pork Lp. plantanum Pc. pentosaceus Kc. varians L: 0.1																																																																																																																																						
11 Champagne (F) Champagne grapes 3.5-4.0 n/a 1-5 y E: 8-12	12 Germany Botrytised wine grapes 3.5-4.0 n/a 1-10 y E: 8-12	3 Light beer	4 Dark beer	5 Tubers and roots	6 Beverages from cereals or tubers	7 Cereal porridges	8 Bread (wheat)	9 Bread (wheat and other)	10 Mixed cereal fermentations	11 Vegetables and Olives	12 Soy and beans	5 Thailand (East Asia) Ang kak rice Monascus purpureus Monasconrubin 1w	6 Europe and others Buttermilk / cultured butter bovine Lc. lactis Lc. cremoris Lc. cremoris 12h L: 0.1; 2Ac; Ac	7 U.K. Cottage Cheese bovine Lc. lactis Lc. cremoris Lc. cremoris 1-3 d L: 0.1	8 Gruyere (CH) Gruyère raw bovine L. helveticus Sc. thermophil. Br. linens L: 0.1	9 Japan Narezushi (馴れ寿司) fish, rice Lp. plantanum Lv. brevis D. hansenii L: 0.05; G	10 Thailand Nham pork Lp. plantanum Pc. pentosaceus Kc. varians L: 0.1																																																																																																																																	
19 Normandie (F) Cidre apples 3.5-4.0 n/a 2-4 w E: 5-8, L: 0.05	20 worldwide Fruit wines prunes 3.5-4.0 n/a 1w E: >12	21 U.K., Trinidad Ginger beer ginger 3.5-4 n/a 4 w E: 2-4	22 U.K., Belgium, Germany Dark ale barley 3.5-4.0 n/a 4 w E: 5-14	23 Amazon Tarubá cassava Lp. plantanum Lm. mesenteroid To. delbrueckii n/a 2 w L: 0.1; A: 0.05	24 Turkey, Bulgaria Boza wheat Lm. mesenteroid Lp. plantanum Candida spp. E: 1; L: 0.15	25 Ghana Koko millet W. confusa Lm. fermentum Pc. pentosaceus 1-3 d L: 0.12	26 France Baguette wheat S. cerevisiae Ls. sakei Pc. pentosaceus 8-16h L: 0.1; E: 0.5	27 Novel Gluten-free bread various S. cerevisiae Lp. plantanum Lm. fermentum 8-24h L: 0.05; dextran	28 Turkey Saigam (+ black carrots) wheat Lp. plantanum Lv. brevis Lc. paracasei 14 d L: 0.15; A: 0.01	29 Europe, Asia, North America Sauerkraut cabbage Lu kimchi Lp. plantanum Lv. brevis 2-4 w L: 0.15; A: 0.02	30 Japan Natto (納豆) soy Bc. subtilis Polyglutamate 1d	31 Benin Tayohounta B. licheniformis B. subtilis Pc. pentosaceus 2 d G	32 Zambia Mabisi bovine Lc. lactis Sc. infantarius Citrobacter 2 d L: 0.15; 2Ac	33 Norway Mysost whey Lc. lactis Lu. mesenteroides L: 0.05	34 Quebec (CAN) Oka bovine Lc. lactis Br. linens G. candidum 1-3m L: 0.1; N.S	35 Ghana Momone B. subtilis Lp. plantanum D. hansenii 7 d G	36 China Suanzharou pork, rice Lp. plantanum St. camosus 4 w L: 0.1; G																																																																																																																																	
37 Spain Sherry grapes 3.5-4.0 n/a >6 y E: 15	38 Duoro (Portugal) Port wine grapes 3.5-4.0 n/a 1y-1c E: 10-23	39 Bavaria (D); Pilsen (CZ) Helles / Pilsner barley 3.5-4.0 n/a 4 w E: 5	40 Brazil Caxiri cassava B. subtilis Lm. fermentum S. cerevisiae 2 d E: 12; L: 0.1	41 Ethiopia Kocho cassava B. subtilis Lp. plantanum Lv. brevis 5 m L: 0.1	42 Zimbabwe Mahewu corn, malt Lm. fermentum Lp. plantanum W. cibaria 1-2 d L: 0.2	43 West Africa Mawe / Ogi corn Lm. fermentum Pc. pentosaceus Candida spp. 1-3 d L: 0.12	44 Milano (Italy) Panettone wheat, egg F. sanfrancisc. Lm. mesenteroides Ks. humilis 2 d L: 0.1; A: 0.01	45 Sudan Kisra sorghum Lm. fermentum A. amylovorus I. orientalis 2 d L: 0.1; A: 0.01	46 Turkey Tarhana (+ dairy, vegetables) wheat Sc. thermophilus S. cerevisiae 0.63 3 d L: 0.15 A: 0.02	47 worldwide Pickles cucumber Lu. mesenteroid Lv. brevis 2-4 w L: 0.1	48 Indonesia Tempe soy R. stolonifer A. oryzae Z. rouxii T. halophilus 1d phytase, G	49 Japan Miso (味噌) soy A. oryzae Z. rouxii T. halophilus 1-2y G	50 Silk Road Qurt bovine Lc. delbrueckii Sc. thermophil. 0.30 1m L: 0.5	51 Holland Gouda bovine Lc. lactis Sc. infantarius NSLAB 4 w L: 0.1; (G)	52 Normandie (F) Camembert raw bovine Lc. lactis Lc. cremoris P. camemberti 1-4m L: 0.1; N	53 Sweden Surströmming herring T. halophilus Ak. gillum Mn. psychrot. 2-3 m Ac: 0.01; G; N.S	54 Italy, Hungary Salami meats Lp. plantanum St. camosus P. nalgiovensis L: 0.1; G																																																																																																																																	
55 Quebec (CAN) Ice cidre apples 3.5-4.0 n/a 2-4 m E: 8-11	56 Germany Eiswein grapes 3.5-4.0 n/a 0.5-1y E: 12-16	71 Belgium Lambic wheat S. cerevisiae Bt. lambicus Pc. dammosus 4m-4y E: 5; L: 0.1	72 Tanzania Mbege barley S. cerevisiae Lp. plantanum W. confusa 4 w E: 4	73 West Africa Gari cassava Lp. plantanum Lm. fermentum W. cibaria 2 d L: 0.1	74 West Africa Gowe sorghum Lm. fermentum Pc. pentosaceus W. confusa 2 d L: 0.2	75 Novel Plant-based yoghurt oats L. acidophilus Lp. plantanum Lm. fermentum 1 d L: 0.2	76 Reutlingen, D / France Mutschli / Brioché wheat, egg F. sanfrancisc. Ks. humilis 1d L: 0.1; A: 0.01	77 China Mantou (馒头) wheat F. sanfrancisc. S. cerevisiae 1d L: 0.15; A: 0.02	78 South India Idli (+ beans) rice Lu. mesenteroid Lp. plantanum Pc. pentosaceus 1d L: 0.1; A: 0.02	79 Spain, Greece Olives olives Lp. plantanum Lp. pentosus Candida spp. 4d-1y L: 0.2	80 China Sufu soy Mucor spp. Bacillus spp. Enterococcus G 1-3y	81 Korea Gochujang (고추장) maize A. oryzae Z. rouxii Bc. subtilis 1-3y G	82 Central Asia Koumiss mare Lc. delbrueckii K. marianus Lc. helveticus 24 h L: 0.15; E: 1.5	83 Emmentaler (CH) Emmentaler (Swiss) raw bovine Sc. thermophil. Lc. helveticus Pr. jensenii 4-14m L: 0.1; P: 0.1	84 Roquefort (F) Roquefort raw ovine Lc. lactis Lc. cremoris P. roqueforti L: 0.1; N	85 Thailand Naam-Pla fish T. halophilus T. muraticus Lt. salicampi 6-18m L: 0.1; G	86 Farø Skerpikjøt sheep St. equorum Kocuria spp. 6 m G																																																																																																																																	
87 Japan Sake (清酒) rice A. oryzae S. cerevisiae L. helveticus 6-12 m E: 15; L: 0.02	88 Zhejiang (China) Shaoxing wine (绍兴酒) rice A. oryzae S. cerevisiae M. purpureus 6-12 m E: >14	103 Botswana, Zimbabwe Chibuku sorghum S. cerevisiae Lp. plantanum n/a 3-5 d E: 4; L: 0.1	104 South America Chicha maize S. cerevisiae Lm. fermentum Sc. mutans 4 d E: 3-4	105 Nigeria Elubo yams Lp. plantanum Lm. fermentum Bc. subtilis 1d L: 0.05	106 Uganda Bushera sorghum Lm. fermentum Lv. brevis Lp. plantanum 1-4 d L: 0.12; A: 0.01	107 Botswana Ting sorghum Lm. reuteri Lm. fermentum Lp. plantanum 1-2 d L: 0.12; A: 0.01	108 Bay Area (U.S.) San Francisco Sourdough Bread wheat F. sanfrancisc. Ks. humilis C. mindensis 1d L: 0.12; A: 0.01	109 Westphalia, D Pumper-nickel rye F. sanfrancisc. Ks. humilis 0.96 1d L: 0.15; A: 0.01; G	110 Novel Plant based cheeses (pulses, nuts, others) oats Lp. plantanum Lc. lactis others 2w-1y L: 0.15; A: 0.02	111 Taiwan Fu-Tsai Mustard Lu. mesenteroid C. futsail T. halophilus 2 w L: 0.15; A: 0.02	112 China Stinky tofu (臭豆腐) soy Sn. odoratitofu Bacillus spp. Eggerthella 2-3 d odour (strong)	113 East Asia Soy sauce soy A. sojae T. halophilus Z. rouxii 6-12 m L: 0.1; G	114 Caucasus Kefir bovine L. kefiranofaciens Lu. mesenteroid 0.98 K. marianus 2-24 h L: 0.08; E: 1.2Ac	115 Italy Pecorino raw ovine L. helveticus Sc. thermophil. 5.2-5.4 0.92 G. candidum 0.5-5 y L: 0.1; G	116 Alsace (F) Münster raw bovine Lc. lactis Br. linens G. candidum 1-3 m L: 0.1; N.S	117 Norway Rakfisk trout Cb. maltaromaticum Ls. sakei N: G 2-4m	118 Parma (Italy) Prosciutto di Parma pork staphylococci G 0.5-2 y																																																																																																																																	
Spirits and vinegar		57 Russia Vodka (водка) potatoes S. cerevisiae n/a 2 d E: 40	58 Caribbean Rum sug. cane S. cerevisiae n/a 0.1-2 y E: 40-80	59 Black Forest (D) Kirsch-wasser cherries S. cerevisiae Pu. suebicus n/a 2-12 m E: 44 A: 0.01	60 Zimbabwe Kachasu Masau S. cerevisiae L. orientalis n/a 6-7 d E: 30-50	61 Normandie (F) Calvados apples S. uvarum NSLAB n/a 12 m E: 40; A: 0.02	62 Cognac (F) Cognac grape wine S. cerevisiae n/a 2-60 y E: 40	63 Italy Grappa pomace S. cerevisiae NSLAB n/a 2-4 d E: >40	64 Mexico Tequila agave S. cerevisiae T. delbrueckii W. cibaria 0.5-4 y E: 35-55	65 Scotland, Ireland, U.S.A. Whiskey / Whisky barley S. cerevisiae Ln. parabrachnii L. acidophilus n/a 1y-1c E: 44	66 China Baijiu (白酒) sorghum A. oryzae S. cerevisiae Lc. lactis L. acetotolerans n/a 15-3y E: 35-53; S	67 Torres Strait Steamed tuba coconut S. cerevisiae LAB n/a 1w E: 25-45	68 China Watermelon soy paste grains Bacillus spp. n/a 4 w A: 0.8-3	69 China Vinegar grains A. oryzae Al. jinshanensis n/a 3-6 m A: 1.0-0.1	70 Modena (I) Aceto Balsamico grapes S. cerevisiae Acetobacter n/a 12 y A: 1.0-0.01																																																																																																																																			
Tea, coffee, chocolate, and non-alcoholic beverages		89 China Pu-erh tea (普洱茶) tea A. niger S. cerevisiae Bl. adenivorans volatiles 2 m	90 Ethiopia Coffee arabica coffee Pichia spp. Erwinia spp. n/a 2 d Acetate	91 Indonesia Kopi Luwak (Civet coffee) coffee Citrabacter Weissella Acetate 2 d	92 tropical countries Cocoa / chocolate cocoa Candida spp. Lactobacilli Ac. acetii volatiles 2 d	93 Mexico, Madagascar Vanilla vanilla Bc. subtilis n/a β-glucosidase Vanillin 2 d	94 Scandinavia Mead honey S. cerevisiae n/a E: 6 to 12 7 d	95 Turkey Gilaburu cranberry Lp. plantanum Lv. brevis n/a 7 d L: 0.15; A: 0.05	96 Novel Carrot juice carrots Lp. plantanum Lv. brevis n/a 3 w L: 0.15; A: 0.02	97 Scandinavia Birch beer birch sap Lp. plantanum Lc. lactis Lc. brevis n/a 14 d L: 0.15; A: 0.01	98 Mexico Pulque agave S. cerevisiae Lc. lactis Lq. dextranum Zymomonas n/a 1d E: 7; EPS	99 Mexico Tepache pineapple Lc. lactis E. faecium S. cerevisiae n/a 3 d E: 2; L: 0.1	100 East Asia Kombucha tea Gl. xylinum Brettanomyces n/a 14 d E: 0.5 A: 0.1; L: 0.1	101 unknown Water kefir sucrose Lq. hordei S. cerevisiae n/a 1d E: 3; L: 0.2; A: 0.1	102 Novel Lemonade (Bionade) barley Gluconobacter n/a 1d																																																																																																																																			

Key to Fermentation Organisms in Food

Lactic acid bacteria				Other Bacteria (Gram positive)		Gram-negative bacteria		Yeasts and Fungi		
Lactobacillaceae	Paucilactobac.: Pu.	Weissella, W.	Carnobacteriaceae		Acetic Acid Bacteria		Yeasts		Torulaspora	To.
Lactobacillus: L	Limosilactobac.: Lm.	Oenococcus, O.	Marinilactobacillus		Mn	Acetobacter	Ac.	Bl.	Zygosaccharomyces	Z.
Companilactobac.: C	Fructilactobacillus: F.	Enterococcaceae		Bacillus	Bc.	Gluconacetobacter	Gl.	Bt.	Mycelial fungi	
Schleiferilactobac.: Sl.	Acetilactobacillus, Al.	Tetragenococcus	T.	Lentibacillus	Lt.	Plant-associated Enterobacteriaceae		D.	Aspergillus	A.
Latilactibacillus: Ls	Levilactobacillus: Lv.	Enterococcus	E.	Brevibacterium	Br.			I.	Geotrichum	G.
Lactocaseibacillus: Lb	Secundilactobac.: Sn.	Streptococcaceae		Propionibacterium	Pr.			Erwinia spp.	Kluyveromyces	M.
Liquorilactobac.: Lq.	Lentilactobacillus: Ln	Lactococcus	Lc.	Staphylococcus	St.			Enterobacter spp.	Ks.	Penicillium
Pediococcus: Pc	Periweissella, Pr	Streptococcus	Sc.	Kocuria	Kc.	Pantoea spp.	Ko.	S.	Rhizopus	R.
Lactiplantibacillus: Lp	Leuconostoc, Lu.	Non-Starter LAB		Alkalibacterium	Ak	Kosakonia spp.				
Loigolactobacillus: Lo.	Carnobacterium, Cb.	(mainly Lp., Lb. and Lt.)		Eggerthella	Eq					

Acknowledgements: Dr. Lynn McMullen and Dr. Ying Hu are acknowledged for helpful suggestions

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