ME-12 Living medicines: ferments, yoghurt, kefir, yeast and the microbiome

HEALING after the FALL, research library, ME-12

Researched 10 October 2026 by Claude Opus agent for THRIVING after the FALL, Book Four. Library document, unverified.

How to read this document

This report asks what a household or village can do with living microbes that actually helps the sick, and what it should stop doing. It builds on earlier library reports without repeating them: oral rehydration (HY-03), which no ferment replaces, deficiency diseases (HY-08), dysentery and cholera (IN-11), and botulism, brucellosis and the raw-milk zoonoses (IN-16). The household recipes for sauerkraut, sourdough, vinegar, Dickmilch and yoghurt are in the companion cookbook (FEASTING ch. 13), and this report gives only the medical reading of them, with one disagreement.

Two words are kept apart throughout. A fermented food is food "made through desired microbial growth and enzymatic conversions of food components" (Marco 2021). A probiotic is a defined, live strain, given in a stated dose, that has been shown in trials to confer a health benefit. Most home ferments are the first and not the second. The difference matters because nearly all the trial evidence below is for named strains in counted doses, and a jar of home yoghurt is neither.

Following the brief and the dangerous-substance rule, faecal transplant and any culture of microbes beyond ordinary food ferments are covered for history, evidence, dose, risk and feasibility only. No method is given that cultivates, concentrates or transfers a pathogen, and no preparation steps for faecal material are given at all.

1. Findings by section

1.1 Metchnikoff and the soured milks of the world

The traditions on their own terms. Soured milk is one of the oldest medicines in Eurasia and Africa, and it was food first. Metchnikoff himself listed the soured milks he knew: leben raib in Egypt, yahourth in the Balkans, prostokwacha and varenetz in Russia, kephir among the Ossetes of the Caucasus and koumiss, from mare's milk, among the Kirghiz of the steppe (Metchnikoff 1907). In Bulgaria, home yoghurt (kiselo mlyako, "sour milk") is still made the way grandmothers made it. A spoonful of the last batch, about one tablespoon per 500 mL, is stirred into milk that has been boiled and cooled to about 45 °C, and the pot is wrapped in blankets for 4 to 5 hours (Petrova 2020). Bulgarians tell that nomads found it by accident while carrying milk in skins, and Petrova notes that it was probably found many times in many places.

In Ayurveda, takra (buttermilk, curd churned with water and the fat removed) is a medicine in its own right. The Charaka Samhita prescribes it for grahani (a disorder of digestion with alternating loose stools) and arsha (piles), and also within the treatment of atisara (diarrhoea), where it is given once the early, undigested (amaja) phase has passed.

The same chapter warns against checking early loose stools too soon (Charaka Samhita, Atisara Chikitsa). Secondary sources give takra as one part curd churned with four parts water (Wisdomlib, takra). The tradition's reasoning is that takra kindles agni (digestive fire) and is light, where milk is heavy.

Kefir belongs to the peoples of the North Caucasus, among them the Karachay, the Balkars and the Ossetes. In the story told there, the grains were a gift of the Prophet and were not to be given away to outsiders. The Russian dairy trade's story is that the grains reached Moscow around 1908, when a dairyman named Blandov sent a young employee, Irina Sakharova, to obtain them from a Karachay prince (Russian Life n.d.). That account is folklore and thinly documented [VERIFY]. Under the attribution rule (THRIVING library, SY-04), the book should name the Karachay, Balkar and Ossetian holders and treat the grains' origin story as theirs. I found no claim that any part of the kefir tradition is restricted.

What the record shows. Élie Metchnikoff (Ilya Mechnikov), Nobel laureate of 1908 and deputy director of the Pasteur Institute, made soured milk famous in The Prolongation of Life (1907, English 1908). His theory was autointoxication. Putrefying bacteria in the large intestine make poisons that age the body, and lactic bacilli, by acidifying the gut, hold putrefaction back. His evidence for longevity was weak, and he half said so. He quoted Chemin's count of "more than 5,000 centenarians (5,545)" living in Serbia, Bulgaria and Romania in 1896, and he quoted Chemin's own caution that "these figures appear to be exaggerated" (Metchnikoff 1907). He reported that Grigoroff, "a Bulgarian student at Geneva", had been struck by the number of centenarians in a country where yahourth was a staple. Stamen Grigorov had isolated the rod now called Lactobacillus delbrueckii subsp. bulgaricus in Geneva in 1905 (Petrova 2020). Metchnikoff's experimental support was Herter's dogs, Bélonowsky's mice and Cohendy's self-experiment. Cohendy took 280 to 350 g of yahourth culture a day for 74 days and reported that the Bulgarian bacillus could "take its place in the intestinal flora of man". Fouard at the Pasteur Institute measured about 10 g of lactic acid per litre in Metchnikoff's soured milk (Metchnikoff 1907).

What science infers. The centenarian story did not survive scrutiny, and the autointoxication theory was abandoned. L. bulgaricus does not settle in the gut, as section 1.2 shows. What survived is narrower and real: live yoghurt cultures help people digest lactose, and some specific strains, in counted doses, prevent some diarrhoea. Metchnikoff was right that the gut's bacteria matter to health. He was wrong about which ones, why, and what a pot of sour milk does about it.

1.2 What a home ferment actually delivers

Counts. The international standard for yoghurt asks for at least 10^7 colony-forming units (CFU) of starter organisms per gram at the end of shelf life. For kefir it asks for at least 10^7 CFU/g in total and at least 10^4 CFU/g of yeasts (Codex 2003, via the Philippine national standard) [VERIFY kefir figures against the Codex text]. The American "live and active cultures" seal sets 10^8 per gram at manufacture. Freshly made yoghurt usually holds 10^8 to 10^9 CFU/mL of Streptococcus thermophilus. L. bulgaricus dies off faster in the cold, and in one study it fell below 10^5 by day 20 at 4 °C (PubMed 24745665 study 2014) [VERIFY that the cold-storage figure is from this study]. Kefir grains carry about 10^7.6 to 10^7.9 CFU/g each of lactococci, lactobacilli and yeasts. The dominant organisms are Lactobacillus kefiranofaciens, the yeast Kluyveromyces marxianus and Kazachstania species (kefir microbiota review 2020). I found no published counts for kefir made at home from grains, and its make-up shifts with temperature, milk and the age of the grains.

Survival through the stomach. Live yoghurt bacteria do come out the other end. In a French study, 13 healthy adults ate commercial yoghurt, and viable S. thermophilus was recovered in 32 of 39 stool samples (median about 6.3 × 10^4 per gram) and L. delbrueckii in 37 of 39 (about 7.2 × 10^4 per gram) (Mater 2005). An Italian study of 20 volunteers also recovered both species (Elli 2006). A later study with a stricter, culture-free method found far fewer live cells [VERIFY, read only in a secondary summary and not listed]. The yoghurt bacteria pass through alive in small numbers. They do not take up residence, and they are gone within days of stopping.

The dose gap. The trials that work (section 1.4) use 5 to 40 billion CFU a day of a defined strain. At 10^8 CFU/g, a 200 g bowl of fresh yoghurt holds about 2 × 10^10, or 20 billion, starter organisms. That is my arithmetic, not a trial result [VERIFY]. So the number of bacteria in fresh yoghurt is in the range of the effective doses. The species, though, are not the ones tested. S. thermophilus and L. bulgaricus are not LGG (Lacticaseibacillus rhamnosus GG) or Saccharomyces boulardii, and the trials do not show that any lactic bacterium will do. A bowl of fresh yoghurt is therefore not a proven probiotic. It is a reasonable stand-in only where nothing better exists.

1.3 Probiotics to treat acute infectious diarrhoea

The record. The first Cochrane review was enthusiastic. Allen and colleagues pooled 63 studies with 8,014 participants and found that probiotics shortened diarrhoea by 24.76 hours (95% CI 15.9 to 33.6, 35 trials, 4,555 participants). They cut the risk of diarrhoea lasting 4 days or more by more than half (RR 0.41, 0.32 to 0.53, 29 trials), and no adverse events were attributed to them (Allen 2010). Then two large, well-run trials appeared in the same issue of the New England Journal of Medicine. In ten American emergency departments, 971 children aged 3 months to 4 years were given LGG at 1 × 10^10 CFU twice a day for five days. Moderate-to-severe illness followed in 11.8 per cent against 12.6 per cent on placebo (RR 0.96, 0.68 to 1.35), and diarrhoea lasted 49.7 against 50.9 hours (Schnadower 2018). In six Canadian emergency departments, 886 children were given L. rhamnosus R0011 with L. helveticus R0052. Moderate-to-severe illness followed in 26.1 against 24.7 per cent, and diarrhoea lasted 52.5 against 55.5 hours (Freedman 2018, read in secondary summaries).

The updated Cochrane review then reran the analysis with 82 studies and 12,127 participants, 11,526 of them children. When only trials at low risk of bias were kept, probiotics made no difference to diarrhoea lasting 48 hours or more (RR 1.00, 0.91 to 1.09, 2 trials, 1,770 participants, moderate certainty). Duration fell by 8.64 hours, but the confidence interval ran from 29.4 hours shorter to 12.1 hours longer (very low certainty). Across all trials the apparent benefit remained (RR 0.64 for diarrhoea of 48 hours, 21.3 hours shorter), but the funnel plots were lopsided (Egger P = 0.002, Harbord P < 0.001). This pattern, small positive trials and large null ones, is the signature of publication bias. The authors concluded: "Our findings do not support the use of probiotics for the treatment of acute infectious diarrhoea" (Collinson 2020).

The guidelines. The American Gastroenterological Association recommends against probiotics for children in North America with acute gastroenteritis (Su 2020). The European paediatric society, ESPGHAN, rated LGG and S. boulardii as strong recommendations on low-quality evidence in 2014. It downgraded them in 2023 to weak recommendations with low certainty, for LGG at 10^10 CFU a day or more for 5 to 7 days and S. boulardii at 250 to 750 mg a day for 5 to 7 days (Szajewska 2023).

Yoghurt instead of milk. This is a different question and has an older record. In Algeria, Boudraa and colleagues fed yoghurt or milk to 45 children with persistent diarrhoea. Treatment failed in 14 against 42 per cent (Boudraa 1990). In acute diarrhoea with sugar in the stool, diarrhoea persisted at 48 hours in 35 against 62 per cent (Boudraa 2001). In India, however, Bhatnagar and colleagues fed 96 malnourished boys yoghurt-based or milk-based diets and found no benefit (about 45 against 52 hours), and the milk diet gave better weight gain (Bhatnagar 1998, read through a BestBETs summary). Agarwal and Bhasin found that Indian dahi shortened diarrhoea by 0.3 days in hospital and 0.2 days in the community, and Actimel by 0.6 and 0.5 days (Agarwal 2002). A 2022 review pooled seven trials of fermented foods in children under five and found diarrhoea about 0.61 days shorter (−1.04 to −0.18) (Aston review 2022). For comparison, Cochrane found that lactose-free feeds shorten diarrhoea in young children by about 18 hours and halve treatment failure (RR 0.52), but every trial was in a high- or middle-income country (MacGillivray 2013).

What science infers. The likely reason yoghurt helps a little is that it carries less lactose and brings its own lactase, so a gut whose lining has been stripped by infection digests it better than milk. That is a feeding effect, not an anti-infective one. The traditions are consistent with this. Takra is light food, and the tradition gives it after the early

phase, not as the first remedy. Yoghurt is a better food than milk for a child with diarrhoea who is used to dairy. It is not a treatment for the infection, and it never replaces oral rehydration solution (THRIVING library, HY-03).

1.4 Antibiotic-associated diarrhoea and Clostridioides difficile

This is where the evidence for probiotics is strongest. Guo and colleagues pooled 33 trials in 6,352 children taking antibiotics. Diarrhoea followed in 8 per cent (259 of 3,232) on probiotics against 19 per cent (598 of 3,120) on placebo or nothing (RR 0.45, 0.36 to 0.56, moderate certainty). The number needed to treat was 9 (7 to 13). At high doses, 5 billion CFU a day or more, the figures were 8 against 23 per cent (RR 0.37, 0.30 to 0.46), with a number needed to treat of 6 (5 to 9). Low doses did not clearly work (RR 0.68, 0.46 to 1.01). The strains with the best support were LGG and S. boulardii at 5 to 40 billion CFU a day. No serious adverse events occurred in 24 trials with 4,415 children, but serious events have been reported outside trials in debilitated children and in those with central venous lines. Analysed strictly by intention to treat, the effect shrank (RR 0.54, 0.42 to 0.70), and the authors graded certainty down for missing data (Guo 2019).

For adults, a meta-analysis of S. boulardii pooled 21 trials with 4,780 participants. Diarrhoea fell from 17.4 to 8.2 per cent in adults and from 20.9 to 8.8 per cent in children. The effect on C. difficile diarrhoea was significant only in children (Szajewska 2015, read in a secondary summary). The Cochrane review of C. difficile prevention found infection in 1.5 per cent on probiotics against 4.0 per cent on control (RR 0.40, 0.30 to 0.52). The number needed to treat was about 40 (Goldenberg 2017, read through a clinical synopsis).

The counterweight is PLACIDE, the largest trial. It gave 2,981 inpatients aged 65 or over a multi-strain lactobacillus and bifidobacterium capsule for 21 days. Antibiotic-associated diarrhoea followed in 10.8 against 10.4 per cent, and C. difficile diarrhoea in 0.8 against 1.2 per cent. The trial was null (Allen 2013, read in a secondary summary). The AGA makes only a conditional suggestion of S. boulardii or named multi-strain products to prevent C. difficile in adults on antibiotics, and recommends probiotics for treating C. difficile only within trials (Su 2020).

Kefir. One trial tested a home-style ferment directly. Merenstein and colleagues gave 125 children aged 1 to 5 years, all on antibiotics, 150 mL of kefir a day or a heat-treated placebo drink for 10 days. Diarrhoea followed in 18 against 21.9 per cent (RR 0.82, 0.54 to 1.43). The result was null, and the kefir maker funded the trial (Merenstein 2009).

An unexpected harm. Suez and colleagues gave healthy volunteers a broad antibiotic course and then either an eleven-strain probiotic, their own banked stool, or nothing. The probiotic colonised the gut lining, but it delayed the return of each person's normal flora for months, while their own banked stool restored it within days (Suez 2018, abstract). This is a small study, 21 volunteers, but it undercuts the casual habit of "taking probiotics after antibiotics to repair the gut".

What this means after the Fall. The trial strains in the trial doses prevent about one case of diarrhoea for every 6 to 9 children treated, and they are safe in healthy children. A salvaged blister pack of LGG or S. boulardii is worth keeping for a child on a long antibiotic course. Home yoghurt or kefir during an antibiotic course is a reasonable, cheap, low-risk practice, but it is unproven and should be graded C (Merenstein 2009 is the only direct test, and it was null). C. difficile is chiefly a disease of hospitals and heavy antibiotic use. After the Fall, with far fewer antibiotics given, it should become rarer, not commoner [VERIFY, my inference].

1.5 Preterm babies, necrotising enterocolitis and newborn sepsis

The record. Necrotising enterocolitis (NEC) is an inflammatory death of the bowel wall in premature babies. The 2023 Cochrane review pooled 54 trials with 10,484 very preterm or very low birthweight infants. Probiotics reduced death (RR 0.77, 0.66 to 0.90, moderate certainty), a number needed to treat of about 50. They probably reduced NEC (RR 0.54, 0.46 to 0.65, low certainty) and late-onset infection (RR 0.89). In extremely preterm infants, the benefit on death was uncertain (RR 0.92, low certainty) (Sharif 2023). The brief's "Sharpe 2018" appears to be this review series, which is by Sharif, Meader, Oddie, Rojas-Reyes and McGuire. The biggest single trial, PiPS, gave

Bifidobacterium breve BBG-001 to 1,315 infants of 23 to 30 weeks in England. NEC occurred in 9 against 10 per cent (adjusted RR 0.93), with no effect on sepsis or death (Costeloe 2016).

The harm. In 2023 a preterm infant weighing under 1,000 g died of sepsis caused by Bifidobacterium longum genetically matched to the probiotic product it was given. The US Food and Drug Administration sent a warning letter, noted that it has approved no probiotic for infants, and the American Academy of Pediatrics advises against routine use, especially below 1,000 g (FDA 2023, read in a secondary report).

Villages in Odisha. The most striking trial is the one most relevant to a world without hospitals. Panigrahi and colleagues enrolled 4,556 newborns of at least 2,000 g and 35 weeks in 149 villages of rural Odisha, India. They gave Lactiplantibacillus plantarum ATCC 202195 with fructo-oligosaccharide for seven days, starting in the first days of life. Sepsis or death fell by about 40 per cent (RR 0.60, 0.48 to 0.74), and the trial was stopped early. Deaths were few in both arms, 4 on placebo and 6 on the synbiotic, so the effect was on sepsis rather than death (Panigrahi 2017, read in secondary reports). It has not been replicated, the strain is specific, and the trial supplied a quality-controlled product. A household cannot reproduce it with a ferment.

1.6 Faecal transplant

History. The use of human faeces in Chinese medicine is old and documented. In the 4th century, Ge Hong (283 to 343) recorded in the Zhouhou beiji fang (Handbook of Prescriptions for Emergencies) the drinking of a human faecal suspension for food poisoning and severe diarrhoea. In 1596 Li Shizhen described in the Bencao Gangmu (Compendium of Materia Medica, volume 52) fresh faecal suspensions and dried faeces, known by names such as "yellow soup", for diarrhoea, fever, pain and jaundice (Chinese Medicine review 2019, citing Zhang and colleagues 2012). Some sources call the preparation fermented, which I could not confirm [VERIFY]. Modern use began with Ben Eiseman and colleagues, who in 1958 reported four patients with pseudomembranous enterocolitis treated with faecal enemas, a method then thought radical (Eiseman 1958, via Nature Milestones) [VERIFY hospital location].

Evidence. Recurrent C. difficile infection is the one indication with strong evidence. After a first episode, about one patient in four relapses, and after a first relapse 40 to 60 per cent relapse again [VERIFY, widely cited figures, source read only in summary]. In the trial by van Nood and colleagues in Amsterdam, 13 of 16 patients (81 per cent) were cured after a single infusion of donor faeces following a short vancomycin course and bowel lavage, and 15 of 16 after a second infusion from a different donor. Vancomycin alone cured 4 of 13 (31 per cent), and vancomycin with lavage 3 of 13 (23 per cent). The trial was stopped early because the difference was so large (van Nood 2013). A meta-analysis found cure in about 92 per cent overall. Fresh and frozen material worked equally (92 and 93 per cent), the lower route did slightly better than the upper (95 against 88 per cent), and randomised trials gave lower cure rates than case series (Quraishi 2017). Fulminant C. difficile colitis still kills 35 to 60 per cent of patients even with colectomy (Augusta University review n.d.). For other conditions (ulcerative colitis, irritable bowel, obesity, autism) the evidence is weak, mixed or absent.

Dose. In the trials, the dose was stool from one screened donor given once, with a second infusion from another donor if the first failed (van Nood 2013, Quraishi 2017). This report deliberately gives no preparation quantities or route instructions.

Harms. These are serious and documented. In 2019 two immunocompromised patients developed bacteraemia with an extended-spectrum beta-lactamase (ESBL) E. coli traced to a single donor. The capsules had been made before the programme screened for ESBL organisms. A 73-year-old man having a stem cell transplant died (DeFilipp 2019, read in a secondary report). In March 2020 the FDA reported six patients infected with enteropathogenic (2) or Shiga toxin-producing (4) E. coli from a stool bank's material, and two deaths of uncertain cause (FDA 2020). A survey of 84 people who had given themselves faecal transplants at home found adverse events in 12 per cent and self-reported improvement in 82 per cent. It was self-selected and uncontrolled (DIY FMT survey report n.d., secondary).

Screening. A stool bank's exclusion list includes HIV, hepatitis B and C, syphilis, HTLV, a history of malaria or

tuberculosis, high-risk sexual behaviour or a sexually transmitted infection in the last 12 months, recent tropical travel, antibiotics within 3 months, any diarrhoea or household gut illness, a recent tattoo, and recent imprisonment (OpenBiome n.d.). Then come blood and stool tests for pathogens, parasites and resistant organisms (Cammarota 2017, abstract only). Programmes typically accept only a small fraction of volunteers: 1.7 per cent of 7,968 candidates in one bank and about 3 per cent of 2,071 in China [VERIFY which figure belongs to which source], with deferral of 90 to 96 per cent being common (Microbial Cell Factories 2021, donor programme review 2018). A Korean programme found multidrug-resistant organisms in 55 per cent and Helicobacter pylori in 44 per cent of donors who had already passed the questionnaire, and it added a breath test (donor screening summary, via search). The lesson is that questionnaires, which a village can run, remove only the obvious risks. The dangerous carriers in 2019 and 2020 were healthy-looking people.

When is it justified, and can a village screen a donor? Faecal transplant is justified only for C. difficile that has recurred at least twice, or that is threatening life, when no effective antibiotic is available and surgery is not possible. The decision belongs at the district infirmary or above, where at least some serology and stool culture can be done. A village with a lay healer and a microscope can run the questionnaire and look for ova, cysts and parasites. It cannot test for HIV, hepatitis, ESBL carriage or Shiga toxin E. coli, and it cannot identify C. difficile in the donor. My judgement is that village-level screening is not adequate, and that the book should say so plainly [VERIFY, my inference].

1.7 Yeast and ferments as carriers of nutrients

The record. This is the least glamorous and best supported use of living medicines. Joseph Goldberger showed between 1914 and 1927 that pellagra was a dietary disease (THRIVING library, HY-08). After the Mississippi flood of 1927, the Red Cross distributed brewer's yeast, at a cost of a few cents per person, to the region's flood survivors on Goldberger's advice (Hektoen International 2018, Encyclopedia of Arkansas n.d.). The two sources differ on scale. One speaks of tens of thousands fed and the other of about 4,000 cured [VERIFY]. I found no daily dose from the period. In Bombay in 1931, Lucy Wills found that Marmite, a yeast extract, cured the macrocytic anaemia of pregnancy in poor textile workers when purified liver extracts did not. The "Wills factor" was later identified as folic acid (Embryo Project n.d.).

What yeast contains. Active dry baker's yeast (Saccharomyces cerevisiae) per 100 g holds about 11 mg thiamin, 4 mg riboflavin, 40 mg niacin, 2,340 µg folate, 40 g protein and no vitamin B12 (Matvaretabellen, active dry yeast). Compressed fresh yeast holds about 1.9 mg thiamin, 12.3 mg niacin and 785 µg folate per 100 g (Matvaretabellen, compressed yeast). So 10 g of dry yeast supplies about 1.1 mg thiamin, about a day's need for an adult, 4 mg niacin (a quarter of a day's need, before counting tryptophan) and 234 µg folate, about half a day's need. That is my arithmetic from the tables [VERIFY].

Other ferments. Sauerkraut holds 15 to 36 mg of vitamin C per 100 g (THRIVING library, HY-08). Fermenting grain cuts its phytate, which binds iron and zinc. In a Swedish isotope study, women absorbed 19.1 per cent of the iron from 80 g of sourdough rye bread against 7.0 per cent from unfermented rye bread (n = 8), and 15.0 against 4.6 per cent from 120 g (n = 17) (Hoppe 2025). A review reports that sourdough removed 62 per cent of wheat phytate against 38 per cent for yeast fermentation (figures traced to Reale 2007 and Lopez 2001, primary studies not read) [VERIFY].

What science infers. Here the ferment is a carrier of nutrients, and the evidence is as strong as the evidence for the nutrient. The cautions are practical. Yeast holds no vitamin B12. Live yeast eaten raw may take up thiamin in the gut rather than supply it [VERIFY]. It is safer to stir dry yeast into hot food or bake it into bread. Treatment of established pellagra or beriberi follows HY-08, not this report.

1.8 Yoghurt and lactose, and yoghurt against thrush

Lactose. The European Food Safety Authority accepted that live yoghurt cultures improve digestion of the lactose in the yoghurt in people who digest lactose poorly. Thirteen of the 14 studies it reviewed were positive. Its condition of use is at least 10^8 CFU of live starter per gram, though one summary gives the figure per serving [VERIFY unit] (EFSA 2010). The mechanism is that the bacteria carry their own beta-galactosidase (lactase), which is released when bile breaks them open in the small intestine. Heat-treated yoghurt loses most of this effect. The widely quoted figure that 68 per cent of the world's adults malabsorb lactose came from a 2017 meta-analysis that was later retracted (Storhaug 2017). It can be cited only as a figure that once circulated. What is not in doubt is that lactase persistence varies hugely between peoples. It is common in northern Europe and among some pastoral peoples of East Africa and the Arabian Peninsula, and rare in East Asia and much of West Africa [VERIFY, not re-read for this report].

Thrush. The tradition, and a generation of magazines, held that eating yoghurt or putting it in the vagina prevents vaginal candidiasis (Candida albicans). Hilton and colleagues gave women 8 ounces (about 225 g) of yoghurt with L. acidophilus a day. Infections fell from 2.54 to 0.38 per six months, but only 13 of the 33 women enrolled completed the trial (Hilton 1992). In Melbourne, Pirotta and colleagues gave 235 women taking antibiotics oral lactobacillus, vaginal lactobacillus, both, or neither. Post-antibiotic vulvovaginitis followed in 23 per cent overall, with no effect from oral (OR 1.06, 0.58 to 1.94) or vaginal (OR 1.38, 0.75 to 2.5) treatment (Pirotta 2004). Cochrane found that probiotics added to an antifungal raised short-term cure (RR 1.14, 1.05 to 1.24) and cut relapse at one month (RR 0.34), with no long-term benefit and low or very low certainty (Xie 2017). Yoghurt alone, without an antifungal, has no good evidence. Putting home ferments, including those made from raw milk, into the vagina brings their pathogens (section 1.9) to a mucous membrane, and the book should drop it.

1.9 Kefir, kombucha and sourdough

Kefir. On its own terms, kefir is a drink of health and long life in the Caucasus, given to the sick and the old. The record is thin. The only trial of kefir against diarrhoea was null (Merenstein 2009), and claims of benefit for blood pressure, cholesterol and immunity rest on small studies or animal work. Kefir is a good fermented milk with less lactose than milk and a mixed culture that includes yeasts. It is not a cure-all.

Kombucha. Kombucha is sweetened tea (Camellia sinensis) fermented by a cellulose mat of acetic acid bacteria and yeasts, and its history is recent and poorly documented. In 1995 two women in Iowa fell ill with severe lactic acidosis (blood pH about 6.9) and one died. Both drank home kombucha from a shared source, but more than 115 other people had cultures from the same source without illness, and the link was never proven (CDC 1995). The CDC's advice was to avoid ceramic and lead-crystal vessels, because acid draws lead from glazes. In Australia, a family brewing kombucha in a glazed ceramic pot developed lead poisoning (MJA 1998, the kombucha held 198 mg/L of lead). Ernst found no clinical studies in 2003 (Ernst 2003), and Kapp and Sumner found one human study among 310 articles in 2019 (Kapp 2019). At warm temperatures, moulds such as Aspergillus can grow on a weak brew, with the risk of mycotoxins (Frontiers in Medicine 2024). In one study of home brews, some samples were contaminated with Penicillium and Candida albicans (home kombucha study 2024) [VERIFY]. Extension guidance tells home brewers to acidify each batch with starter liquid from the last one, to use glass, and to discard any batch with fuzzy or coloured mould (UGA Extension n.d.). The amount usually given is 2 cups of starter per gallon (about 125 mL per litre), with a starting pH below 4.6, but these figures come from hobbyist sources only [VERIFY]. Kombucha has no medical use in this book.

Sourdough. Sourdough is a stable community of lactic bacteria and yeasts, about 100 bacteria per yeast cell in a rye starter (FEASTING ch. 13). Its medical value is the phytate and iron effect in 1.7, and the fact that it raises bread without bought yeast. The bacteria are killed in baking, so sourdough bread is not a living medicine, and claims that it carries probiotics should be dropped.

1.10 The microbiome: hype and what has replicated

William Hanage of Harvard warned in Nature in 2014 that microbiome science "needs a healthy dose of scepticism". He gave five questions for any claim. Can experiments detect differences that matter? Does the study show causation or only correlation? What is the mechanism? How much does the claim rest on mice? Could anything else explain the result? (Hanage 2014). The replicated findings are few. Antibiotics disturb the gut flora, and that disturbance causes diarrhoea and opens the way to C. difficile. Faecal transplant cures recurrent C. difficile. Some specific probiotic strains prevent antibiotic-associated diarrhoea in children and NEC in preterm infants. One small randomised study is suggestive. At Stanford, 36 adults were randomised, 18 to a diet high in fermented foods and 18 to a comparison diet [VERIFY the comparison arm and duration]. The fermented-food diet raised gut microbial diversity and lowered several inflammatory markers (Wastyk 2021). The study was small and its outcomes were laboratory markers, not illness. In Malawi, 795 children with severe acute malnutrition were given a synbiotic alongside therapeutic food. Cure was 53.9 against 51.3 per cent, with a non-significant trend toward lower outpatient deaths (Kerac 2009). Malnutrition is treated with food, not microbes.

2. Evidence grades

Claim	Tradition says	Record shows	Grade
Live yoghurt helps lactose maldigesters digest its lactose	Soured milk is lighter than milk	EFSA, 13 of 14 studies	A
Yoghurt or dahi instead of milk in childhood diarrhoea	Takra after the early phase	Small trials, about 0.2 to 0.6 days shorter, mixed	B
Defined probiotic strains, 5 billion CFU a day or more, prevent AAD in children	None (modern)	Cochrane, NNT 6 to 9	A
Home yoghurt or kefir prevents AAD	None specific	One null kefir trial	C
Probiotics treat acute infectious diarrhoea	Sour milk for loose bowels	Low-bias trials null, publication bias	X
Probiotics prevent C. difficile in adults	None	RR 0.40 but PLACIDE null	B
Probiotics in preterm infants cut death and NEC	None	Cochrane, NNT about 50, harms under 1,000 g	A (hospital only)
Synbiotic cuts newborn sepsis in villages	None	One trial, not replicated	B
Faecal transplant for recurrent C. difficile	Ge Hong, Li Shizhen	RCT 81 against 31 per cent	A (screened donors only)
Faecal transplant for other conditions	Many uses in old texts	Weak or absent	D
Yeast against pellagra, beriberi, folate anaemia	Yeast as food	Goldberger 1927, Wills 1931, tables	B
Sauerkraut for vitamin C, sourdough for iron	Northern European winter food	Content and isotope data	B

Claim	Tradition says	Record shows	Grade
Yoghurt (oral or vaginal) prevents post-antibiotic thrush	Popular belief	Pirotta null	X
Kombucha as a medicine	Recent folk claims	One human study	D, with harms
Soured milk for long life	Metchnikoff, Balkan centenarians	Figures doubted at the time	X
Kefir as a cure-all	Caucasian tradition	No trial support	D

3. Means ledger

Rung	What it can do	What it changes
Hands and knowledge	Recognise dehydration and give ORS first (HY-03). Know which ferments are safe and which signs mean discard. Keep the antibiotic-course rule.	Prevents the main harm, which is a ferment given instead of fluid.
Hearth	Boil milk, keep a yoghurt or Dickmilch culture going, make sauerkraut and a rye starter, bake with yeast.	Delivers the three real uses (lactose-friendly milk food, nutrients, cheap support during antibiotics). Pasteurising by boiling removes brucella, M. bovis and listeria risk.
Garden and still	Grow cabbage (Brassica oleracea var. capitata) and rye (Secale cereale), keep healthy, tested dairy animals, make vinegar. Brew beer, which yields yeast.	Secures raw materials through the year. Brewer's yeast becomes a B-vitamin reserve.
Village dispensary (300 people, lay healer, microscope)	Hold salvaged LGG or S. boulardii for children on long antibiotic courses. Inspect ferments. Look at stool under the microscope for parasites. Run a donor questionnaire, but not a faecal transplant.	Turns the AAD evidence into practice with real strains. The microscope finds amoebae and Giardia, which change treatment (IN-11).
District infirmary (3,000 people, nurse or doctor, lab bench)	Stool culture, Gram stain, basic serology if test kits are salvaged. Consider salvaged probiotics for preterm infants over 1,000 g. Consider faecal transplant for twice-recurrent or life-threatening C. difficile with the fullest screening possible.	The only rung where faecal transplant could be justified, and then only with honest acknowledgement that screening is incomplete.

Rung	What it can do	What it changes
Pre-Fall hospital (reference)	Licensed strains, stool banks with full screening, vancomycin and fidaxomicin, intensive care.	Shows what is lost. FMT is only as safe as the screening behind it, and probiotics kill a few of the sickest patients even in hospital.

4. Harm test

Probiotics in the very sick. Probiotics are live organisms, and in the very sick they invade. Munoz and colleagues described three cardiac surgery patients in intensive care who developed Saccharomyces cerevisiae fungaemia after S. boulardii had been used on their unit [VERIFY whether each patient took it or was exposed through the ward]. Across the 60 published cases they reviewed, 93 per cent had a central venous line (Munoz 2005, read in a secondary summary). A later review of 69 cases found a fatality rate of 36.2 per cent [VERIFY source]. In 2017 the European Medicines Agency concluded that the risk outweighs the benefit in the critically ill and the immunocompromised. The Malaysian regulator later reported 61 cases and 10 deaths from S. boulardii fungaemia worldwide (NPRA 2018). In one hospital, 6 of 522 intensive care patients given LGG (1.1 per cent) developed LGG bacteraemia, against 2 of 21,652 not given it (0.009 per cent), and genome sequencing matched the blood isolates to the capsules (Yelin 2019). In a world without intensive care, the people at risk are those with indwelling lines, the gravely ill and the immunosuppressed. They should not be given probiotic capsules or opened capsules.

Faecal transplant. Infection transmitted from donor to recipient is the main harm (section 1.6). It killed patients in 2019 and 2020 in the best-screened system in the world.

Raw-milk ferments. Souring does not reliably kill pathogens. In Mexico, Brucella abortus survived 10 days at 10^5 CFU/mL in fermented milk at a pH below 4.0 (UAEH study 2005). A Berlin study found brucellae surviving only 1 to 4 days in yoghurt, which is still long enough to infect a household (Freie Universität Berlin thesis n.d.). E. coli O157 and Listeria monocytogenes survived 21 days in ayran-style yoghurt and kefir, and grew during fermentation (Veterinarni Medicina 2003). Salmonella survived in homemade kefir (Istanbul kefir study n.d.). In New York City between 2001 and 2004, 35 people caught Mycobacterium bovis tuberculosis, mostly linked to fresh cheese brought from Mexico, and a 15-month-old child died of peritoneal tuberculosis (CDC 2005). Brucellosis kills 1 to 5 per cent of untreated cases, and listeria in pregnancy causes fetal loss in about a quarter of cases (THRIVING library, IN-16).

Disagreement with the cookbook. FEASTING ch. 13 says of Dickmilch: “Use fresh milk, raw from a healthy cow or scalded and cooled”. This report disagrees. After the Fall nobody can certify that a cow is free of brucella or M. bovis, and souring is not a kill step (IN-16). For anyone pregnant, very young, old or sick, the milk must be scalded first, and the safest rule for every household is to scald it always. The cookbook’s yoghurt method, heating to 85 °C and holding 30 minutes, already does this.

Fermented fish and low-acid ferments. Botulism from traditional fermented fish and sea-mammal foods is well documented in Alaska (THRIVING library, IN-16). The rules are in IN-16, and the book should send readers there. Vegetable ferments are safe only if they are salted and acidify below pH 4.6. Sauerkraut does this, but salt-free or oil-covered vegetables do not.

Kombucha. Kombucha brings mould and mycotoxins, lead leached from glazed vessels, and possible acidosis in heavy drinkers (section 1.9).

Lactose and the very young. Fresh milk ferments still hold some lactose. For a child with severe lactose intolerance after diarrhoea, a well-soured yoghurt is better tolerated than milk but not risk-free. Reduce the amount if diarrhoea worsens with each feed.

Delay to care. This is probably the biggest harm. A family that trusts a ferment to cure diarrhoea may stop the

oral rehydration solution or wait too long with a child who has blood in the stool, a fever or signs of dehydration (THRIVING library, HY-03, IN-11).

Sauerkraut and salt. At 22 g of salt per kg, sauerkraut is salty. People who must limit salt, those with heart failure or high blood pressure, should rinse it or eat small amounts [VERIFY].

5. Red flags

Stop the home remedy and get help (HY-03, IN-11, IN-16) if any of these appear:

- Signs of dehydration (sunken eyes, dry mouth, no urine for 6 hours in a child, drowsiness, a skin pinch that goes back slowly).
- Blood or mucus in the stool, fever above 38.5 °C, or diarrhoea lasting more than 14 days.
- A baby under 6 months with diarrhoea, or a newborn who is feeding poorly, lethargic, cold or hot.
- Fever, chills or new confusion in someone with an indwelling line, or in an immunosuppressed person who has been given a probiotic. Think of fungaemia or bacteraemia.
- Fever, sweats, joint pain or a swollen testicle weeks after eating raw-milk ferments. Think of brucellosis (IN-16).
- Fever in a pregnant woman who has eaten raw-milk cheese or yoghurt. Think of listeria.
- Double vision, drooping eyelids, slurred speech or difficulty swallowing within 12 to 72 hours of eating fermented fish, sea-mammal food or a low-acid preserve. Think of botulism. It is an emergency (IN-16).
- Fever, abdominal pain or bloody diarrhoea after a faecal transplant.
- Severe abdominal pain and swelling in someone with C. difficile, or a falling stool count with a swelling belly. Think of toxic megacolon.

Signs of a failed ferment are listed in Protocol 7.

Honest comfort. Most ferments that go wrong show it. The jar smells foul, the colour is wrong, or mould grows, and the household throws it out. A properly salted sauerkraut and a yoghurt made from boiled milk are among the safest foods a household can make, because acid and competition keep pathogens out. Most children with diarrhoea who get oral rehydration solution and keep eating, yoghurt included, recover within a few days. A probiotic is not needed for that.

6. The case against

Against the probiotic claims. Collinson, Freedman and Schnadower and their colleagues showed that the early enthusiasm for probiotics in acute diarrhoea was largely a product of small, biased trials. The low-risk trials are null (Collinson 2020, Freedman 2018, Schnadower 2018). Allen's own later trial, PLACIDE, was null for prevention in elderly inpatients (Allen 2013). Suez, Elinav and colleagues showed that probiotics may slow the gut's recovery after antibiotics (Suez 2018). The FDA, the AAP and the AGA have all narrowed or advised against routine use (Su 2020, FDA 2023). The general critique is Hanage's: the microbiome field produces many correlations and few causes (Hanage 2014).

Against Metchnikoff, kombucha, kefir and home FMT. Chemin doubted his own centenarian figures (Metchnikoff 1907), and the bacilli Metchnikoff prized do not settle in the gut (Mater 2005, Elli 2006). Ernst, and Kapp and Sumner, found almost no human evidence for kombucha (Ernst 2003, Kapp 2019). The only kefir trial was null (Merenstein 2009). Stool banks reject most volunteers and still miss dangerous carriers (DeFilipp 2019, FDA 2020).

The case against this report. A reader might argue that I have been too harsh on home ferments. The evidence on strains is not evidence against ferments, and ferments were eaten for millennia by people who lived well. That is fair. The grade C for home ferments in AAD reflects an absence of trials, not trials that failed. A household that already eats yoghurt loses nothing by eating more during an antibiotic course.

Today versus after the Fall. Today the honest advice is to buy a named strain at a stated dose, or do nothing. After the Fall, named strains will run out, antibiotics will be rare, and C. difficile will be rarer with them. The balance shifts toward the hearth ferments, which are nutrient carriers and lactose-friendly foods, and away from the capsule. The safety balance shifts the other way, toward strict milk pasteurisation, because nobody will be testing herds.

7. Ten-line summary

1. A fermented food is not a probiotic. Almost all trial evidence is for named strains at counted doses.
2. Probiotics do not usefully treat acute infectious diarrhoea. Oral rehydration solution does (HY-03).
3. Named strains (LGG, S. boulardii) at 5 billion CFU a day or more prevent antibiotic-associated diarrhoea in children, NNT 6 to 9.
4. Home yoghurt or kefir during antibiotics is cheap, safe and unproven (grade C).
5. Live yoghurt helps people who digest lactose poorly, and is a better food than milk during diarrhoea.
6. Yeast, sauerkraut and sourdough carry B vitamins, vitamin C and absorbable iron. This is their strongest medical use.
7. Faecal transplant cures recurrent C. difficile (81 against 31 per cent), but unscreened donors have killed patients. It is not a village procedure.
8. Probiotics can cause fatal blood infection in the critically ill and in premature babies under 1,000 g.
9. Always scald milk before souring it. Souring does not kill brucella, tuberculosis or listeria.
10. Drop kombucha, longevity claims, yoghurt for thrush, raw-milk ferments and home faecal transplant.

8. Open questions

- Do home yoghurt or kefir, at real household counts, prevent antibiotic-associated diarrhoea? No trial except Merenstein's.
- What are the live counts in home kefir from grains, kept for months without refrigeration?
- Can the Odisha synbiotic result be replicated, and could any household ferment approximate it safely? (Probably not.)
- How much of the yoghurt effect in childhood diarrhoea is lactose and how much is the culture?
- What daily dose of brewer's yeast did the Red Cross use in 1927?
- How should a district infirmary without serology weigh the risk of faecal transplant against fulminant C. difficile?
- How quickly does a raw-milk ferment kill brucella and M. bovis at household temperatures and pH? The studies disagree (1 to 4 days against at least 10 days).

9. Sources to read in full

- Collinson 2020, Cochrane, for the low-risk-of-bias analysis and the publication-bias tests. Read in full here.
- Guo 2019, Cochrane, for the dose thresholds.
- Sharif 2023, Cochrane, for preterm subgroups and harms.
- van Nood 2013 and Quraishi 2017, for FMT outcomes.
- Cammarota 2017, Gut, for the full European donor screening tables. Not reached.
- Metchnikoff, The Prolongation of Life (1907), Project Gutenberg. Read in part here.
- Charaka Samhita, Atisara Chikitsa and Grahani Chikitsa, for takra in its own setting.
- Yelin 2019, Nature Medicine, for probiotic bacteraemia.
- EFSA 2010, for the lactose claim and its conditions.
- Ge Hong, Zhouhou beiji fang, and Li Shizhen, Bencao Gangmu volume 52, in translation, to confirm the "yellow soup" passages.

At the bedside after the Fall

A child with diarrhoea: start ORS at once and keep it going (HY-03). Keep breastfeeding. After the first hours, if the child normally takes dairy, give boiled-milk yoghurt or Dickmilch in place of plain milk. If diarrhoea worsens after each dairy feed, reduce it. Do not give yoghurt instead of fluid. Watch for the red flags.

A child on a long course of antibiotics: if a salvaged LGG or S. boulardii product is in the dispensary, give it at 5 billion CFU a day or more, two hours apart from the antibiotic, for the length of the course. If none exists, give a daily bowl of fresh boiled-milk yoghurt or kefir, and tell the family it may help and will do no harm.

A gravely ill patient with a line, or an immunosuppressed patient: no probiotic capsules, and do not open them near the patient.

A family with winter illness and a poor diet: sauerkraut daily for vitamin C, yeast in bread or hot food for B vitamins, and sourdough rather than unfermented rye for iron.

A household that makes ferments: scald the milk, salt the cabbage by weight, use glass or unglazed stoneware never lead-glazed pots, and throw out anything slimy, pink or furry.

A patient with relapsing C. difficile: refer to the district. Do not attempt a home faecal transplant.

Protocols

Protocol 1. Yoghurt from boiled milk (two sources)

1. Heat milk to 85 °C and hold 30 minutes (FEASTING ch. 13), or bring it to the boil (Petrova 2020). Both kill brucella, listeria and M. bovis, which pasteurise at 63 °C for 30 minutes or 72 °C for 15 seconds (IN-16).
2. Cool to 42 to 45 °C. Test with a clean finger. It should feel hot but bearable for a count of ten [VERIFY finger test].
3. Stir in starter from the last batch: 1 to 3 tablespoons (15 to 45 g) per litre (FEASTING ch. 13), or about 1 tablespoon per 500 mL (Petrova 2020). The two sources agree within that range.
4. Cover and keep warm near 42 °C, wrapped in blankets or in a hay box, for 4 to 8 hours (FEASTING ch. 13) or 4 to 5 hours (Petrova 2020), until set.
5. Cool, and eat within a few days. Save a spoonful as the next starter.
6. Signs of success: firm curd, clean sour smell, a little clear whey.
7. Discard if slimy, ropy where it was not before, pink, foul-smelling, bitter, or fuzzy with mould (FEASTING ch. 13).
8. The cookbook notes that shop starters may fail by about the fourth generation. A household culture that keeps working is worth guarding, and a neighbour's spoonful is the backup.

Protocol 2. Dickmilch (soured milk) from scalded milk

1. Scald the milk (as Protocol 1, step 1) and cool to room temperature, 18 to 25 °C.
2. Add 1 to 3 tablespoons of last batch's Dickmilch per litre.
3. Leave covered at 18 to 25 °C for 12 to 24 hours, until set (FEASTING ch. 13).
4. Discard on the signs in Protocol 1, step 7.
5. This report departs from the cookbook here: do not use raw milk (see the harm test).

Protocol 3. Kefir from scalded milk

1. Scald the milk and cool to room temperature.
2. Add the grains, roughly 1 tablespoon of grains per 250 to 500 mL [VERIFY, no second source found].

3. Leave covered at room temperature for about 24 hours [VERIFY], strain off the grains with a plastic or stainless sieve, and drink the kefir.
4. Grains grow. Share the surplus, which honours how the tradition passed them on, or dry a spare.
5. Discard grains that turn pink, orange or slimy, or that smell foul or rotten rather than sour and yeasty.

Protocol 4. Sauerkraut

1. Shred cabbage and weigh it. Add 22 g of salt per kg, never below 20 g or above 30 g (FEASTING ch. 13). [VERIFY: second source for the salt ratio not read for this report.]
2. Pack hard into glass or stoneware until the brine rises above the cabbage. Weigh it down.
3. Ferment at 18 to 22 °C for 2 to 4 weeks, then store in a cellar at 10 to 15 °C (FEASTING ch. 13).
4. A white, flat film (kahm yeast) is harmless and can be skimmed. Blue, green, black, pink or fuzzy mould that is thick or has spread means discard. So does sliminess or a rotten smell (FEASTING ch. 13).
5. Daily portion for vitamin C: about 100 g gives 15 to 36 mg (HY-08).

Protocol 5. Rye sourdough starter

1. Mix 50 g rye flour with 50 g water daily for 14 days (FEASTING ch. 13).
2. Expect a false rise on days 2 to 3 and a flat day around days 4 to 5. Keep feeding.
3. Pink or orange streaks, or fur, mean the starter is dead. Burn it and start again (FEASTING ch. 13).
4. Keep a dried spare.

Protocol 6. Yeast as a B-vitamin food

1. Dry baker's yeast: about 10 g a day, stirred into hot porridge or soup, or baked in bread, gives about 1.1 mg thiamin, 4 mg niacin and 234 µg folate (Matvaretabellen, my arithmetic) [VERIFY].
2. Do not eat it raw in quantity [VERIFY].
3. Yeast holds no B12.
4. For established pellagra or beriberi, follow HY-08 (nicotinamide 100 mg three times a day if salvaged, thiamine, and a corrected diet). Yeast supports that, but does not replace it when the disease is severe.

Protocol 7. Rules that bind every ferment

- Ferments never replace ORS (HY-03).
- Scald all milk before souring.
- No lead-glazed or unknown ceramic for acid ferments or kombucha (CDC 1995, MJA 1998).
- Vegetable ferments need salt by weight and must sour. Never ferment low-acid vegetables or fish without salt and acid (IN-16).
- No probiotic capsules for anyone with a central line, gravely ill, immunosuppressed, or born under 1,000 g.
- Discard anything slimy, pink, orange, black, furry, foul, or bulging.

Protocol 8. Faecal transplant: decision and screening checklist (no method)

1. Is the diagnosis C. difficile, confirmed as well as the district can confirm it?
2. Has it recurred at least twice despite the best available antibiotic, or is it life-threatening with no other option?
3. Is the patient at the district infirmary or above, with someone who can manage sepsis?
4. Donor questionnaire: no HIV, hepatitis, syphilis, TB or malaria history, no high-risk sex or STI in 12 months, no recent tropical travel, no antibiotics in 3 months, no diarrhoea in the donor or household, no recent tattoo or imprisonment (OpenBiome n.d.).
5. Donor tests: as many of blood serology, stool culture, ova and parasites, C. difficile and resistant organisms as can be done. Record what could not be tested.

6. Tell the patient and family plainly what was not tested, that hospital programmes with full screening still transmitted fatal infections, and what the alternative outcomes are.
7. If any answer above is no, do not proceed.

Numbers to carry

- Probiotics in acute diarrhoea, low-risk trials: RR 1.00, no effect (Collinson 2020).
- AAD in children, high-dose strains: 8 against 23 per cent, NNT 6 (Guo 2019).
- Effective probiotic dose: 5 billion CFU a day or more.
- C. difficile prevention: 1.5 against 4.0 per cent, NNT about 40 (Goldenberg 2017).
- Preterm infants: death RR 0.77, NNT about 50, harm below 1,000 g (Sharif 2023, FDA 2023).
- FMT: 81 against 31 per cent after one infusion (van Nood 2013), about 92 per cent pooled (Quraishi 2017).
- Donors qualifying: as few as 1.7 per cent.
- LGG bacteraemia in ICU patients given it: 1.1 per cent (Yelin 2019).
- Yoghurt standard: at least 10^7 CFU/g. Fresh yoghurt: 10^8 to 10^9.
- Yoghurt: 85 °C for 30 minutes, then 42 to 45 °C, 15 to 45 g starter per litre, 4 to 8 hours.
- Sauerkraut: 22 g salt per kg (20 to 30 g), 18 to 22 °C for 2 to 4 weeks.
- Botulism line: pH 4.6.
- Pasteurisation: 63 °C for 30 minutes or 72 °C for 15 seconds, or boil.
- Dry yeast per 100 g: thiamin 11 mg, niacin 40 mg, folate 2,340 µg, B12 none.
- Sourdough rye: iron absorption about 19 against 7 per cent.

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