SY-02 The case against herbalism: what the systematic reviews say, and the harms

HEALING after the FALL, research library, SY-02

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1. Why the sceptic goes first

This book will carry a pharmacopoeia, and a pharmacopoeia written for people without a pharmacy can easily become a herbal of false hope. The reader will be frightened, often alone with a sick child, and ready to believe that the right leaf will do what the lost hospital did. This chapter therefore puts the strongest case against plant medicine first, tests it, and then sets the rules by which later chapters may speak about plants.

It keeps apart, as FO-03 asks, what a tradition says a plant does, what the record shows it did, and what modern science infers. It grades claims on the book's ladder: A (randomised trials or systematic reviews), B (consistent observational or clinical series), C (convergent traditional use across unrelated cultures with plausible pharmacology), D (one tradition, anecdote or theory) and X (shown ineffective or harmful). It adds a rule the sceptics themselves supply: a grade belongs to a use, a preparation and a dose, never to a plant.

Two warnings. Almost every trial cited here tested a standardised commercial extract, not a village decoction, so a positive trial of a tablet does not prove the tea works and a negative one does not prove it fails. And much of the harm literature comes from rich countries where the alternative to a herb was a hospital. After the Fall that alternative is often gone, which changes the arithmetic of harm by delay but not the arithmetic of poisoning.

2. The sceptic's case at full strength

2.1 The critics

The leading critic is Edzard Ernst, the first professor of complementary medicine at the University of Exeter, whose group produced many of the reviews cited here. In 2002 he judged that six best-selling herbs seemed to do more good than harm, but that none was free of adverse effects and the evidence was too incomplete for firm judgement (Ernst 2002). His view hardened. Trick or Treatment, written with Simon Singh, accepts that a few herbal medicines work, judges others such as bilberry, chamomile and ginseng ineffective, and stresses contamination and interactions (Ernst and Singh 2008, read only in secondary summaries).

His sharpest argument separates two kinds of herbal medicine (Ernst 2013). Rational phytotherapy uses a defined extract of one plant for one condition, tested in trials. Individualised herbalism has a practitioner diagnose in traditional terms and prescribe a personal mixture, so ten patients with the same illness may get ten mixtures. The mixtures have no evidence even when each ingredient has some, and they carry more risk of interactions and contamination. Searching for trials of individualised herbal medicine, Guo, Canter and Ernst found only three. Two showed no difference from placebo, and in the third the individualised treatment beat placebo but lost to a standard formula

on all outcomes (Guo, Canter and Ernst 2007). A later trial of tailor-made Chinese mixtures in 102 patients with osteoarthritis found no difference from a control mixture at 20 weeks (as reported in Ernst 2013).

Other critics named below attack particular harms: Robert Saper on heavy metals, Jean-Louis Vanherweghem, Joëlle Nortier and Arthur Grollman on aristolochic acid, Christine Haller and Neal Benowitz on ephedra, and Skyler Johnson on harm by delay.

2.2 What the systematic reviews show: the scorecard

"Positive" below means benefit over placebo for the preparation tested, not that any preparation of the plant works.

Remedy and use	Evidence	Result
St John's wort (*Hypericum perforatum*) extract, depression	Cochrane, 29 trials, 5,489 patients (Linde, Berner and Kriston 2008)	Response rate ratio 1.28 in larger and 1.87 in smaller trials, about equal to standard antidepressants, fewer dropouts. More favourable in German-speaking countries
Willow bark (*Salix* spp.) extract, low back pain	Cochrane, 2 trials, 261 people (Oltean and others 2014)	120 or 240 mg salicin a day probably beats placebo in the short term (moderate quality)
Devil's claw (*Harpagophytum procumbens*) extract, low back pain	Same review, 2 trials, 315 people	50 or 100 mg harpagoside a day may help (low quality)
Cayenne (*Capsicum frutescens*) plaster or cream, chronic back pain	Same review, 3 trials, 755 people	Probably beats placebo (moderate quality)
Capsaicin 8 per cent patch, post-herpetic neuralgia	Cochrane (Derry and others 2017, secondary summaries)	Number needed to treat (NNT) 10 to 12 for good relief
Capsaicin creams below 1 per cent, nerve pain	Cochrane (Derry and Moore 2012)	No better than placebo
Senna (*Senna alexandrina*), chronic constipation	Review (Rao and Brenner 2021), trial of 90 (Morishita and others 2021)	Grade A recommendation. Response 69.2 against 11.7 per cent on placebo
Psyllium (*Plantago ovata*), chronic constipation	Rao and Brenner 2021	Grade B
Peppermint oil (*Mentha* × *piperita*) capsules, irritable bowel	12 trials, 835 patients (Alammar and others 2019), trial of 190 (Weerts and others 2020)	Risk ratio 2.39, NNT 3. But the largest recent trial missed both primary endpoints
Cranberry (*Vaccinium macrocarpon*), recurrent urinary infection	Cochrane, 50 trials, over 8,000 people (Williams and others 2023)	Fewer infections in women with recurrences, in children and after procedures. Not in the elderly, in pregnancy or with bladder-emptying problems
Kava (*Piper methysticum*) extract, anxiety	Cochrane, 7 trials, 380 people (Pittler and Ernst 2003)	Hamilton score 3.9 points lower, confidence interval 0.1 to 7.7. Small and fragile
Echinacea, colds	Cochrane, 24 trials, 4,631 people (Karsch-Völk and others 2014)	Weak evidence, at best a small treatment effect for some products
Ginkgo (*Ginkgo biloba*), preventing dementia	Trial of 3,069 people over 6.1 years (DeKosky and others 2008)	No reduction, hazard ratio 1.12, 0.94 to 1.33 (secondary summary)

Remedy and use	Evidence	Result
Saw palmetto (*Serenoa repens*), prostate symptoms	Cochrane (Tacklind and others 2012, and Franco and others 2023 with 27 trials, 4,656 men), CAMUS trial of 369 men (Barry and others 2011)	No better than placebo, even at triple dose
Ginseng (*Panax* spp.), any condition	Ernst 2002	No condition supported
Laetrile (amygdalin), cancer	Trial of 178 patients (Moertel and others 1982)	1 of 175 evaluable patients responded, with cyanide toxicity
Individualised herbal mixtures	Guo, Canter and Ernst 2007	Three trials, no convincing benefit

How often do herbal reviews conclude anything? An overview of 104 Cochrane reviews of traditional Chinese medicine, 70 of them herbal, found 5 with an overall positive conclusion, 42 with insufficient evidence and 54 with no firm conclusion. An earlier count of 51 non-empty reviews of Chinese herbal medicine found 23 inconclusive and 27 suggesting possible benefit limited by poor trials (overviews as summarised in search results, authors [VERIFY]). A 2004 conference analysis rated 16 of 23 Cochrane herbal reviews positive or possibly positive (Cochrane Colloquium 2004, abstract only). The honest summary is that a few single-plant extracts have reasonable support for a few uses, and that most herbal claims have never been tested well enough to say.

2.3 Dose and potency: the plant is not a dose

A plant is a chemical factory whose output varies with species, soil, season, part, drying, storage and extraction. The European Pharmacopoeia sets only a minimum of 1.5 per cent salicylic alcohol derivatives for willow bark, and commercial bark ranges from about 1.5 to 15 per cent with species and season (EMA 2009 assessment report and the Thieme review it cites, read in search summaries). To reach the 240 mg of salicin a day used in the positive trial (Chrubasik and others 2000), a healer would need roughly 1.6 g of bark at 15 per cent but 16 g at 1.5 per cent [VERIFY: own arithmetic, ignoring how much a decoction extracts]. A tenfold uncertainty in dose is the normal condition of a home remedy.

Bought products are not much better. In five St John's wort products, hypericin ranged from 1.7 to 38.5 per cent of the label claim (Hu and others 2004, news report). Davidson and colleagues found that Cochrane reviews of herbal medicine often failed to report part, dose, extract ratio and solvent, and that marker substances were stated for only 8 of 326 herbal medicines in the included trials (Davidson and others 2013). The St John's wort review itself warns that its results apply only to the extracts tested (Linde, Berner and Kriston 2008). This is the sceptic's strongest point, and it cuts against the book's own pharmacopoeia: a trial grade cannot pass to a garden plant without a dose the garden cannot measure.

2.4 Adulteration and contamination

The danger in a bought remedy is often something that is not a plant.

Heavy metals. Saper and colleagues bought 70 Ayurvedic products made in South Asia from Boston shops in 2003. Fourteen (20 per cent) contained lead, mercury or arsenic at levels that, taken as directed, could exceed safety limits, with lead from 5 to 37,000 micrograms per gram (Saper and others 2004). Of 193 Ayurvedic medicines bought online in 2005, 20.7 per cent contained metals, as often in United States products as in Indian ones. The authors count more than 80 cases of lead poisoning linked to Ayurveda since 1978 and note that rasa shastra adds metals on purpose (Saper and others 2008). This is not accidental contamination. It is a tradition that treats the metal as medicine.

Undeclared drugs. The FDA's database of tainted supplements for 2007 to 2016 held 776 products from 146 companies, 45.5 per cent sold for sexual enhancement, 40.9 per cent for weight loss and 11.9 per cent for muscle building. One in five contained more than one hidden drug, most often sildenafil, the withdrawn slimming drug sibutramine and steroids (Tucker and others 2018, secondary summaries). An overview of 26 systematic reviews found microbes, moulds, pesticides, toxic metals and prescription drugs in herbal products, with outcomes up to multi-organ failure, cancers and death. Adulteration was reported most in Indian remedies and contamination in Chinese ones (Posadzki, Watson and Ernst 2013b).

Hidden and substituted plants. In one Hong Kong report of 10 aconite poisonings, aconite was not on the prescription in four. In a series of 52 cases from 2004 to 2009, a third followed overdosed prescriptions and another third were hidden aconite (Hong Kong reports, read in search summary). The Belgian aristolochia disaster below began with one plant sold under the name of another.

The critics' own data. The best-known substitution study, a DNA barcoding survey of 44 herbal products reporting unlisted species in 59 per cent (Newmaster and others 2013), was retracted on 4 July 2024 after a University of Guelph investigation found data fabrication (BMC Medicine 2024). The book must not cite its figures. A sceptic's paper is still a paper, and is graded like any other.

2.5 The documented harms

Aristolochic acid. In 1993 Vanherweghem and colleagues in Brussels reported young women with rapidly progressive kidney fibrosis. After two cases they found seven more women under 50 who had needed dialysis in 1991 and 1992, all patients of one slimming clinic that in May 1990 had added Chinese herbs to its mixture (Vanherweghem and others 1993, secondary summaries). The herb sold as *Stephania tetrandra* was *Aristolochia fangchi*. By January 1994 there were 71 cases, 35 on dialysis or transplanted, and by 1998 more than 100. Of 39 end-stage patients whose kidneys and ureters were removed, 18 (46 per cent, confidence interval 29 to 62) had urothelial cancer. Over 200 g of the herb in total carried higher risk, and every sample held aristolochic acid DNA adducts (Nortier and others 2000). Plants containing aristolochic acid are carcinogenic to humans, IARC Group 1 (IARC 2012).

In Taiwan more than a third of the population was prescribed aristolochic acid herbs between 1997 and 2003. Over 30 g of Mu Tong or 60 g of Guang Fang Ji was linked to chronic kidney disease, and herbalists who handled the herbs had a standardised mortality ratio of 3.10 for urological cancer (Taiwanese review 2014, authors [VERIFY]). In the Balkans, endemic nephropathy has been traced to *Aristolochia clematitis*, birthwort, a weed of wheat fields whose seed got into home-baked bread (Grollman and colleagues). Grollman's estimates of exposure in China range from 10 to 300 million people and should be read as an order of magnitude only [VERIFY]. The Balkan case matters most here: a village milling its own wheat could repeat it with no herbalist involved.

Pyrrolizidine alkaloids. These alkaloids, found in *Heliotropium*, *Senecio*, *Crotalaria*, comfrey and many other plants, block the small veins of the liver (veno-occlusive disease). In Gulran district, Afghanistan, in 1974 to 1976, about 7,800 people were affected and about 1,600 died after eating bread from wheat contaminated with *Heliotropium popovii* seed (Mohabbat and others 1976, as cited in Kakar and others 2010). It returned in 1999 to 2001, with about 400 cases and over 100 deaths, and again in 2007 to 2008, when bread carried an odds ratio of 35.8 in a study of 67 cases and 199 controls. The mark was sudden massive fluid in the belly without swelling of the face or arms. Earlier epidemics struck South Africa in 1920 and Uzbekistan in 1931 to 1945 (Kakar and others 2010). Comfrey by mouth carries the same poison. Case reports describe veno-occlusive disease after comfrey tea and leaves, including a death (Yeong and others 1990, cited in secondary sources [VERIFY]), and in 2001 the FDA asked makers to withdraw oral comfrey [VERIFY date and instrument].

Kava. Liver failures in Europe around 2000 led to bans. A WHO assessment in 2007 linked only five cases to traditional water extracts, and a re-examination of 26 German and Swiss cases rated causality probable or highly probable in only three, with overdose, long use, co-medication and poor raw material common (Teschke and others 2008, with

WHO 2007, secondary summaries). The risk looks real but rare. It is still unwise where no one can test the liver.

Ephedra. Of 140 adverse event reports to the FDA from 1997 to 1999, Haller and Benowitz judged 31 per cent definitely or probably related to ephedra and 31 per cent possibly related, including 10 strokes and 7 seizures, with 10 deaths and 13 permanent disabilities (Haller and Benowitz 2000). A meta-analysis found 0.9 kg a month more weight loss than placebo, 0.2 kg in better studies, at 2.2 to 3.6 times the odds of psychiatric, autonomic and gut symptoms and palpitations (Shekelle and others 2003). After the pitcher Steve Bechler died in February 2003, the US banned ephedra supplements, announced in December 2003 and in force in April 2004 (NPR 2003, ESPN 2003).

Pennyroyal. Pennyroyal (*Mentha pulegium*, and in North America *Hedeoma pulegioides*) is an old abortifacient. A review of 18 earlier cases found moderate to severe poisoning after 10 mL or more of oil, and one of two newly reported patients died (Anderson and others 1996, abstract). It empties the womb, when it does, at doses that destroy the liver.

Interactions. St John's wort speeds the breakdown of many drugs. Two heart transplant patients in Zürich suffered acute rejection after it lowered their ciclosporin (Ruschitzka and others 2000). With a low-dose contraceptive pill, intermenstrual bleeding rose from 35 per cent to 77 to 88 per cent of cycles (Pfrunder and others 2003), and hormone breakdown sped up (Hall and others 2003). Across interaction case reports, warfarin was the drug and St John's wort the herb most often involved, though 68.5 per cent of reports could not be evaluated (Fugh-Berman and Ernst 2001). After the Fall, salvaged contraceptive pills may be a village's most valuable drug. This herb can make them fail.

Misidentification. Many deaths come from the wrong plant picked in good faith. An elderly couple in Washington State died in 1977 after making tea from foxglove (*Digitalis purpurea*) they took for comfrey (CDC 1977). In Taiwan nine people drank a "comfrey" tea that was foxglove (Lin and others 2010). A 76-year-old man in Slovenia ate two autumn crocus plants (*Colchicum autumnale*) as wild garlic and died on the third day. Colchicine has no antidote (Brvar and others 2004). Seven infants aged 2 to 12 weeks in Miami had seizures after star anise tea for colic, from overdose of *Illicium verum*, contamination with toxic *Illicium anisatum*, or both. All recovered within 48 hours (Ize-Ludlow and others 2004).

How common? Nobody counts doses taken, so rates are poor. An overview of 50 reviews of 50 herbs found serious adverse effects for four (a standardised herbal powder, chaparral *Larrea tridentata*, kava and senna), moderate ones for 15 and minor ones for 31 (Posadzki, Watson and Ernst 2013a). In the US Drug-Induced Liver Injury Network, herbs and supplements caused 130 of 839 cases (15.5 per cent) from 2004 to 2013, rising from 7 to 20 per cent, and death or transplant followed 13 per cent of injuries from non-bodybuilding supplements against 3 per cent for medicines (Navarro and others 2014). In Hong Kong, confirmed aconite poisoning ran at a median 0.22 cases per 100,000 people a year from 2008 to 2021 (Hong Kong reports). A UK poisons service pilot found 5,536 enquiries, symptoms in 657 and a probable link to the remedy in 42 (Perharič and others 1994, secondary summary). The harm is rare but severe, and concentrated in a few plants and in contaminated or mislabelled products.

2.6 Harm by delay

The sceptic's gravest charge is not poisoning. It is that people who trust herbs stop doing what would save them.

Johnson and colleagues found in the US National Cancer Database 281 patients with curable breast, prostate, lung or colorectal cancer, diagnosed 2004 to 2013, who chose alternative medicine alone, and matched 280 of them with 560 who had conventional treatment. Over a median 66 months the alternative group had 2.5 times the risk of death (hazard ratio 2.50, 1.88 to 3.27) and five-year survival of 54.7 against 78.3 per cent. For breast cancer the hazard ratio was 5.68 (survival 58.1 against 86.6 per cent), for colorectal cancer 4.57 (32.7 against 79.4). For slow-growing prostate cancer the difference was not significant (Johnson and others 2018a). Those choosing alternative medicine were younger, richer, better educated and healthier, so confounding does not explain their worse survival.

The companion paper, the JAMA Oncology study the brief names, looked at 258 patients who used complementary

medicine alongside some conventional care, matched with 1,032 who did not. Users refused surgery in 7.0 against 0.1 per cent, chemotherapy in 34.1 against 3.2, radiotherapy in 53.0 against 2.3 and hormone therapy in 33.7 against 2.8. Their risk of death was about double (hazard ratio 2.08), but after adjustment for refusal and delay the difference lost significance (1.39, 0.83 to 2.33) (Johnson and others 2018b). The harm came through refusal of effective treatment, not from the remedies.

The largest recorded harm by delay was political. From 2000 to 2005 the South African government resisted antiretroviral treatment while its health minister promoted garlic, beetroot and lemon. Comparing South Africa with Botswana and Namibia, Chigwedere and colleagues estimated more than 330,000 lives lost and 35,000 babies infected who need not have been (Chigwedere and others 2008, press summaries). These are model estimates, not counted deaths.

Laetrile shows the pattern in one remedy. In the 1982 trial, one of 175 evaluable patients met response criteria, with a risk of cyanide poisoning (Moertel and others 1982). The European Food Safety Authority found that one small apricot kernel can exceed the safe single dose of cyanide for a toddler, and three for an adult (EFSA 2016). Laetrile is still sold.

Malaria brings this closest to the Fall. Artemisinin from *Artemisia annua* underlies the best malaria drugs, yet in 2012 and again on 10 October 2019 the WHO advised against the plant material, tea included, because its content varies, is often too low to clear the parasites and may breed resistance (WHO 2019). A large Congolese trial claiming the tea beat standard treatment was later retracted after critics questioned its data and ethics (Munyangi and others 2019, Retraction Watch 2020). A parent who gives tea instead of an artemisinin combination tablet is betting a child's life on odds nobody has measured.

2.7 Money and interest

US retail sales of herbal supplements were about 12.55 billion dollars in 2023 (some reports give 15.55 billion, which does not fit the stated growth) and a record 13.23 billion in 2024 (American Botanical Council reports, trade press). The Saper papers ended with calls to reform the 1994 US law that lets supplements be sold without proof of safety or efficacy (Saper and others 2004). The tainted-products database shows part of the industry putting drugs into "herbal" products because the drugs work and the herbs, for those uses, do not (Tucker and others 2018). The tradition has interests too: a healer's standing and income rest on belief in the remedy. And interests run the other way as well. The retracted barcoding paper shows that sensational findings against herbs can bring their own rewards.

2.8 The rhetoric of "natural"

People prefer what they call natural, and the preference survives when its reasons are removed. In Rozin's experiments Americans preferred natural foods and medicines even when told the two versions were chemically identical, for reasons more moral and aesthetic than medical (Rozin and others 2004, journal [VERIFY]). Aconite, foxglove, autumn crocus, birthwort and heliotrope are all natural.

A related myth is that 80 per cent of the world relies on traditional medicine. The figure traces to a 1983 WHO textbook chapter whose data are lost (Africa Check 2013). A WHO survey of 35,334 people in six middle-income countries found traditional medicine the most frequent source of care for 11.7 per cent in India and under 3 per cent in China, Ghana, Mexico, Russia and South Africa (Oyebode and others 2016, secondary summary). The book must not use the 80 per cent figure.

3. Testing the sceptic's case

3.1 The drugs that came from plants

The strongest counter-case is that much of pharmacy began as plant medicine. Of small-molecule cancer drugs approved since 1981, 33.5 per cent were natural products or their derivatives, and 64.9 per cent if synthetic drugs built on a natural structure are included. For 1946 to 1980 the share was 53.3 per cent (Newman and Cragg 2020). These counts include microbial products as well as plants.

Artemisinin is the clearest case of a traditional text guiding discovery. Tu Youyou's team in Beijing found *Artemisia annua* active against malaria in mice but with inconsistent results. Ge Hong's handbook of about 340 CE told the reader to soak a handful of qinghao in water, wring out the juice and drink it. Tu reasoned that boiling destroyed the active compound and switched to low-temperature ether extraction. Sample 191 cured malaria in mice on 4 October 1971, and she shared the 2015 Nobel Prize (secondary accounts). The tradition pointed to the right plant and even the right method. It did not supply a reliable dose, which is why the WHO still advises against the tea.

Willow salicin is the chemical ancestor of aspirin, senna remains a first-line laxative (Rao and Brenner 2021), and foxglove gave digoxin (FO-03). The sceptic denies none of this. His point is that the purified, dosed drug replaced the plant, and that the plant is the inferior form.

3.2 Absence of trials is not absence of effect

Most herbal claims are untested, not disproved. Davidson and colleagues argue that herbal Cochrane reviews are a weaker gold standard than they look, because products are poorly described, most trials are small and exploratory, and few are confirmatory (Davidson and others 2013). A review that finds "insufficient evidence" has found nothing either way, and the book must then grade the use on convergent tradition, pharmacology and harm. That is what grade C is for.

The reverse also holds. The peppermint trials used capsules that release oil in the small intestine, which a village cannot make, and even their benefit looks smaller after the PERSUADE trial (Weerts and others 2020). The willow trial used an extract of measured salicin (Chrubasik and others 2000). Where extract and household preparation differ, the book prints two grades.

3.3 Harm by delay assumes a hospital

Johnson's patients died because they refused surgery, radiotherapy and chemotherapy that would probably have cured them. After the Fall none of these exists, so the cancer comparison does not apply to a village without a surgeon.

The principle survives in a new form. Delay now means delay to what the village can still do: oral rehydration, a midwife's skill, a salvaged antibiotic, splinting, draining an abscess, the walk to the district infirmary. A remedy that takes the place of any of these repeats the South African error on a small scale. The test for every remedy is not "is it better than nothing?" but "is it being used instead of something that works?". Expect the reverse delay too: a healer who keeps a dying patient on herbs to protect her reputation instead of sending them on.

3.4 Grades belong to uses

The sceptics' own data show that one plant can earn opposite grades. St John's wort extract earns an A for depression and an X for anyone relying on a contraceptive pill. Willow bark extract earns an A for short-term back pain. Comfrey ointment appears in the same Cochrane review of back pain with evidence of moderate quality at best (Oltean and others 2014), while comfrey taken by mouth is an X. Senna earns an A for constipation and is among the four herbs with serious adverse effects in the Posadzki overview when misused (Posadzki, Watson and Ernst 2013a). A herbal that lists "comfrey: grade B" without the route, part and use would be dangerous.

3.5 A trial or a tradition

Europe already has a legal model. Under Directive 2004/24/EC a herbal product can be registered as a traditional herbal medicinal product without trials if it has been used for at least 30 years, 15 of them in the EU, with adequate safety data and plausible efficacy, and only for conditions that need no doctor's supervision. Products with trial support can be authorised for well-established use instead (EMA overview). This matches the book's split between grades A and C, with a useful limit: traditional evidence covers only minor, self-limiting conditions. The book adopts the same limit. Convergent tradition may justify a remedy for a cough, a sprain or constipation, never for a condition that kills.

4. Rules for how the book writes about plants

Rules of claim. 1. Every plant entry names the Latin binomial, part used, preparation, dose with tolerance, use, and one grade for that use. A plant without a use has no grade. 2. Where a trial tested an extract and the book gives a household preparation, print both grades: "extract A, decoction C". 3. Say separately what the tradition says, what the record shows and what science infers. 4. Give effect sizes in plain numbers ("about 1 in 3 more people improved"), not "effective". 5. Name every dangerous lookalike and how to tell it apart in the season of harvest. 6. Give the harm before the benefit for any plant with a known serious harm. 7. Never cite an unchecked figure. Cite a retracted paper only as a warning. 8. Grade C or D evidence may support remedies only for minor, self-limiting conditions, as the EU allows. For anything on the red-flag list, the proven treatment comes first and plants only as comfort. 9. Write "not tested" where a use is untested and "tested and failed" where it failed. Never write "may help" for a use that failed.

The warning list. Never by mouth, or only as stated: - Any *Aristolochia*, in any amount. Clean grain of its seed. - Comfrey, coltsfoot, ragwort (*Senecio*), heliotrope, rattlebox (*Crotalaria*). Clean grain of heliotrope and ragwort seed. - Pennyroyal oil, at any dose. - Aconite, foxglove and autumn crocus, except under a trained healer for a named purpose, and foxglove only with a scale and a pulse watch (cardiac chapter). - Apricot and bitter almond kernels as medicine. - Ephedra as a stimulant or for weight loss. - Kava beyond short use, and never with alcohol or in liver disease [VERIFY: the alcohol caution is not from a source read]. - St John's wort with a contraceptive pill, ciclosporin, warfarin or another salvaged drug. - Any herb, tea or oil to a baby under three months, star anise included. - Any bought or salvaged remedy of unknown origin, especially Ayurvedic or Chinese patent medicines and products sold for sex, slimming or strength.

What the book must never claim. - That any plant cures cancer, HIV, tuberculosis, malaria, sepsis, tetanus or rabies. - That a plant can replace oral rehydration, antibiotics, insulin, contraceptives or surgery where these exist. - That "natural" means safe, or that long use proves safety. - That a plant works because a molecule in it works, or that a trial grade for an extract transfers to a tea. - That 80 per cent of the world relies on traditional medicine.

Evidence grades

Remedy, preparation, use	Tradition says	Record shows	Science infers	Grade
St John's wort extract, depression	Lifts melancholy	Cochrane positive	Reuptake effects	A extract, D home tea
St John's wort with the pill or ciclosporin	Silent	Bleeding, rejection	CYP3A induction	X

Remedy, preparation, use	Tradition says	Record shows	Science infers	Grade
Willow bark, 120 to 240 mg salicin a day, back pain up to 6 weeks	Eases pain and fever	Moderate evidence	Salicin becomes salicylate	A extract, C decoction
Devil's claw extract, back pain	Southern African pain remedy	Low-quality evidence	Uncertain	B
Cayenne plaster, chronic back pain	Warms	Moderate evidence	Capsaicin acts on pain fibres	A plaster, D home poultice
Capsaicin cream below 1 per cent, nerve pain	Warms	No better than placebo	Dose too low	X for that use
Comfrey ointment, back pain or bruise	Knits bone	Some trial evidence	Uncertain	B, skin only
Comfrey by mouth	Heals inside	Veno-occlusive disease	Pyrrolizidine alkaloids	X
Senna, constipation, short use	Purges	Strong review	Anthraquinones	A
Psyllium, constipation	Softens stool	Moderate evidence	Bulk fibre	A bought husk, C home seed
Peppermint oil capsules, irritable bowel	Calms the gut	Positive, latest trial mixed	Relaxes smooth muscle	A capsule with doubt, D tea
Cranberry, recurrent urinary infection in women and children	Folk use	Cochrane positive	Anti-adhesion proposed	A
Kava extract, anxiety	Pacific calm	Small effect	Kavalactones	B, liver warning
Echinacea, colds	Plains peoples' remedy	Not shown	Uncertain	D
Ginkgo, preventing dementia	Leaf extract use	Large trial negative	None	X for that use
Saw palmetto, prostate symptoms	Native American use	Negative	None	X
Artemisia annua tea, malaria	Ge Hong, about 340 CE	Large trial retracted	Content variable	D, WHO advises against
Artemisinin combination tablets, malaria	From the above	Trials	Proven drug	A
Laetrile, cancer	20th-century invention	Trial negative	Cyanide	X
Pennyroyal, abortion	European and American folk use	Liver failure, death	Pulegone	X
Aristolochia, any use	Birthwort for childbirth, slimming	Kidney failure, cancer	DNA adducts	X
Ephedra, weight loss	Chinese asthma remedy	Strokes, deaths	Sympathomimetic	X

Remedy, preparation, use	Tradition says	Record shows	Science infers	Grade
Individualised mixtures	Tailored to constitution	No convincing trials	Untestable as prescribed	D

Means ledger

Rung	What it adds	What it changes
Hands and knowledge	Recognising and refusing the deadly plants, telling foxglove from comfrey and autumn crocus from wild garlic, knowing which illnesses no plant treats	Prevents most deaths from herbal poisoning. Matters more than any remedy
Hearth	Teas and decoctions of willow bark, senna, psyllium. Salt-sugar rehydration first for diarrhoea. Hand-picking weed seed from grain	Rough relief of pain and constipation, with the dose uncertain up to tenfold
Garden and still	Grown, labelled plants of known species, drying and storage, a scale for bark and leaf, tinctures, beeswax ointments	Ends misidentification. Dose fixed by weight, though content still varies. Ointments allow skin-only use of plants that poison by mouth
Village dispensary of 300	A trained lay healer with a remedy register (FO-03). Salvaged standardised tablets and capsules. A microscope for malaria films	The village learns which remedies help and which harm. Malaria diagnosed rather than guessed, so plants are not used in place of drugs
District infirmary of 3,000	A nurse or doctor, pulse, blood pressure and fluid monitoring, any surviving urine and blood tests, beds	Supportive care for foxglove, colchicine or aconite poisoning. Earlier detection of liver and kidney harm [VERIFY: depends on surviving reagents]
Hospital before the Fall	Standardised extracts, purified drugs, antidotes such as digoxin antibody fragments and N-acetylcysteine, dialysis, transplant, laboratory checks for metals and adulterants	Many herbal poisonings become survivable. Most plant remedies are replaced by purified drugs of known dose

Knowledge, the first rung, prevents more harm than any later rung adds in benefit. The garden is where a village moves from foraged plants of uncertain identity to grown plants of known species, the largest single gain in safety. Nothing below the hospital can treat established aristolochic acid nephropathy, veno-occlusive disease or colchicine poisoning.

Harm test

Remedy or plant	How it harms, and at what dose	Never give to	Signs it is going wrong	What to do
Aristolochia, any species	Kidney scarring, later urothelial cancer. Any repeated dose, and over 200 g in total raised cancer risk	Anyone	Tiredness, swelling, less urine, years later blood in the urine	Stop. Irreversible without dialysis
Pyrrolizidine plants, comfrey by mouth, contaminated grain	Liver vein blockage after weeks of bread or tea	Anyone, infants most	Sudden swollen belly with fluid, pain under the right ribs, jaundice	Stop the grain or tea, find the weed, rest
Foxglove taken for comfrey or borage	Heart rhythm poisoning from a few leaves	Anyone	Vomiting, dizziness, slow or irregular pulse, yellow vision (see FO-03)	Stop, keep lying down, watch the pulse, carry to the infirmary
Autumn crocus taken for wild garlic	Multi-organ failure from one or two plants	Anyone	Vomiting and diarrhoea about 12 hours after wild greens, collapse at 2 to 3 days	No antidote. Fluids, rest, infirmary
Pennyroyal	Liver failure from about 10 mL of oil	Anyone, pregnant women above all	Vomiting, belly pain, confusion, bleeding	Stop. N-acetylcysteine where it exists
Kava	Rare liver injury with high doses, long use, solvent extracts, other drugs	Anyone with liver disease	Dark urine, yellow eyes, pale stools	Stop
Ephedra	Stroke, fits, heatstroke at stimulant doses	High blood pressure, heart disease	Pounding heart, headache, fever	Stop, cool, rest
St John's wort	Defeats other drugs at usual doses	Anyone on contraceptives, ciclosporin or warfarin	Breakthrough bleeding, pregnancy, rejection	Stop, use barrier contraception
Senna	Cramps and salt loss above 30 mg sennosides a day or beyond 1 to 2 weeks	Under 12, blocked bowel	Cramping, watery stools, weakness	Stop, give fluids
Psyllium	Choking or gut blockage if taken with too little water	Anyone with swallowing difficulty	Choking or chest pain after a dose	Never take dry
Star anise and other teas in infants	Fits	Babies under three months	Jitters, fits, vomiting	Stop, keep warm and fed
Bought Ayurvedic or Chinese products	Lead, mercury, arsenic, hidden drugs over months	Children and pregnant women above all	Colic, anaemia, change in behaviour	Stop all such products

Remedy or plant	How it harms, and at what dose	Never give to	Signs it is going wrong	What to do
Apricot kernels	Cyanide from one small kernel in a toddler, three in an adult	Anyone	Headache, breathlessness, collapse	Stop, fresh air, rest
Aconite	Heart and nerve poison. Fuzi above the recommended 4.5 g	Anyone without a trained healer	Tingling of mouth and limbs, vomiting, irregular pulse	Infirmary

Red flags

Each sign below means the patient may die or be disabled without what the village cannot give, and no plant will change that. Before the Fall each meant hospital. After it: stop the herbs, give what proven care the village has, send to the district if it can be reached, and if not, prepare the family honestly.

1. Fever with shivering, drowsiness or fits in a malarial area. Use any artemisinin combination tablets held, never tea instead.
2. Fever with confusion, fast breathing, cold hands or a spreading hot red swelling. Antibiotic, drainage and fluids come first.
3. Diarrhoea with sunken eyes, no tears or little urine. Salt-sugar solution, and keep giving it.
4. A lump that grows over weeks, especially in the breast. A district surgeon may still remove it early.
5. Massive swelling of the belly in someone eating home-grown grain or herbal tea. Suspect pyrrolizidine poisoning and warn the village.
6. Slow or irregular pulse, vomiting and yellow or blurred vision after a home tea. Suspect foxglove.
7. Vomiting about 12 hours after a spring meal of wild greens. Suspect autumn crocus and expect collapse at 2 to 3 days.
8. Tingling lips and limbs and an irregular pulse after a decoction. Suspect aconite.
9. Yellow eyes, dark urine or pale stools in anyone taking a herbal product.
10. Falling urine or swollen legs in a long-term herbal user.
11. A baby who stops feeding, fits or goes limp after any home remedy.
12. A woman seeking abortion by herbs. Pennyroyal and its kind kill the mother before they reliably end the pregnancy. See the midwifery chapter.

When nothing else can be done: stop remedies that cause vomiting or purging, keep the patient warm, clean and with water at hand, ease mild pain with what is held (willow bark tea is reasonable, Protocol 3), and tell the family plainly that the herbs will not cure the illness and that their presence matters more now than any medicine. Never sell hope in a bottle.

The case against

Against the sceptics. Herbalists reply that Ernst's line between rational phytotherapy and traditional herbalism is a false choice, since many individual prescriptions are built from herbs with evidence, and that three trials are too few to condemn a practice (comments under Ernst 2013). Davidson, Chrubasik and colleagues argue that herbal Cochrane reviews pool products that are not comparable and can produce false negatives as easily as false positives (Davidson and others 2013). Kava shows regulators overstating harm: 26 attributed cases shrank to three probable or highly probable ones (Teschke and others 2008). The Newmaster retraction shows that a famous attack on herbal products

could itself be fabricated. Some researchers dispute the WHO line on *Artemisia* tea where tablets are unaffordable (weak sources, search summaries only). And harm by delay, as section 3.3 showed, mostly assumes a hospital.

Against using plants after the Fall at all. The opposite case is as strong. Without laboratories a village cannot measure dose, detect contamination, confirm identity chemically or watch the liver and kidney. Every positive trial in this chapter used a product the village cannot make. The harms concentrate in exactly the conditions of the Fall: inexperienced foraging, home-milled grain with weed seed, self-treatment of illnesses once treated in hospital, and pressure on the healer to be seen to act. On this view the pharmacopoeia should be short, built mainly from grade A or B plants for minor illness, and spend more pages on what not to take than on what to take.

The book's position. Both critiques are right about something. The book keeps a pharmacopoeia because a village without one will use plants anyway, and badly. It keeps it short, graded by use, with harm first and the deadly lookalikes named.

Plants named in this chapter

Plant	Part	Lookalikes or confusions
Hypericum perforatum, St John's wort	Flowering tops	Other *Hypericum* species of unknown content [VERIFY]
Salix alba and other willows	Bark of young branches	Low-salicin willows. No deadly lookalike in sources read
Harpagophytum procumbens, devil's claw	Secondary root	Not established
Capsicum frutescens, cayenne	Fruit	None dangerous
Symphytum officinale, comfrey	Leaf and root, skin only	Foxglove and borage before flowering
Senna alexandrina, senna	Leaf, pod	Not established
Plantago ovata, ispaghula	Seed, husk	Other *Plantago* seed is not the tested product [VERIFY]
Mentha × *piperita*, peppermint	Leaf, oil	Pennyroyal
Vaccinium macrocarpon, cranberry	Fruit	Not established
Piper methysticum (kava, root), *Echinacea* spp. (root, herb), *Ginkgo biloba* (leaf), *Serenoa repens* (saw palmetto, fruit), *Ephedra sinica* (ma huang, stem)	As stated	Imported products, no lookalike issue in sources read
Artemisia annua, sweet wormwood	Leaf	Other *Artemisia* with little artemisinin [VERIFY]
Aristolochia clematitis, birthwort, and *A. fangchi*	Whole plant, root, seed in grain	*Stephania tetrandra*, which shares the trade name fang ji
Heliotropium popovii and other heliotropes	Seed in grain	Weed seed in wheat
Mentha pulegium and *Hedeoma pulegioides*, pennyroyal	Leaf, oil	Garden mints
Digitalis purpurea, foxglove	Leaf	Taken for comfrey and borage
Colchicum autumnale, autumn crocus	Leaf, corm	Taken for *Allium ursinum*, wild garlic, which smells of garlic when crushed

Plant	Part	Lookalikes or confusions
Illicium verum, Chinese star anise	Fruit	*Illicium anisatum*, Japanese star anise
Aconitum spp., aconite, fuzi	Root	Processed and raw roots look alike [VERIFY]
Prunus armeniaca, apricot	Kernel	Bitter almond

10-line summary

1. Few single-plant extracts have trial support: St John's wort for depression, willow and devil's claw for back pain, topical cayenne, senna and psyllium for constipation, peppermint oil capsules for irritable bowel, cranberry for recurrent urinary infection.
2. Ginkgo for dementia, saw palmetto for the prostate, low-dose capsaicin cream, laetrile and individualised herbal mixtures have been tested and failed, and echinacea and ginseng have not been shown to work.
3. Most herbal uses are untested, not disproved, and must be graded on tradition and pharmacology, for minor illness only.
4. Trial results for standardised extracts do not transfer to village teas, where the dose can vary tenfold.
5. Serious harms are rare but severe and concentrated: aristolochic acid, pyrrolizidine alkaloids, pennyroyal, ephedra, aconite, kava, and interactions of St John's wort.
6. Misidentification kills: foxglove for comfrey, autumn crocus for wild garlic, Japanese for Chinese star anise.
7. Weed seed in home-grown grain caused the worst recorded plant poisonings: about 1,600 dead in one Afghan outbreak.
8. About one bought Ayurvedic product in five contained toxic metals, and hundreds of "herbal" supplements contained hidden drugs.
9. Choosing alternative medicine alone for curable cancer carried 2.5 times the risk of death, and the harm came through refusal of treatment, not the herbs.
10. After the Fall, harm by delay means using a plant instead of rehydration, a salvaged drug, a midwife or a walk to the infirmary.

Open questions

- Does a household willow bark decoction deliver a useful dose of salicin, and how much bark is needed? No trial of the decoction was found.
- What is the artemisinin content of home-grown *Artemisia annua*, and is tea better than nothing where no tablets remain? The WHO says no, and the retracted trial cannot answer it.
- How common are the serious harms per thousand users? No population denominator exists for most herbs.
- Which local weeds carry pyrrolizidine alkaloids or aristolochic acid in amounts that could contaminate grain after the Fall?
- Does seed of *Plantago major* or *P. lanceolata* act like ispaghula, and does peppermint tea help irritable bowel? Not found.
- How should a village choose between a plant with convergent traditional use and a salvaged drug past its expiry date? Not found, see PH-10.

Sources to read in full

1. Linde, Berner and Kriston (2008), the Cochrane review of St John's wort.
2. Oltean and others (2014), the Cochrane review of herbs for low back pain.

3. Johnson and others (2018a, 2018b), the two papers on alternative and complementary medicine in curable cancer.
4. Posadzki, Watson and Ernst (2013a, 2013b), the overviews of adverse effects and of contamination.
5. Vanherweghem and others (1993) and Nortier and others (2000) on aristolochic acid.
6. Kakar and others (2010), the Gulran outbreak and its history.
7. Guo, Canter and Ernst (2007) with Davidson and others (2013), the two sides of the argument about trials.
8. Saper and others (2004, 2008) on metals in Ayurvedic medicines.
9. Ernst and Singh (2008), Trick or Treatment, the herbal chapter.
10. WHO (2019) on non-pharmaceutical forms of Artemisia.

At the bedside after the Fall

Household. Minimum viable version: know the ten deadly plants of the region and refuse them, never make tea from a plant not identified in flower, use salt-sugar solution for diarrhoea before anything else, and keep willow bark for mild pain and senna for occasional constipation. Needs: a printed sheet of local deadly plants and lookalikes, a cup and spoon of known size, a notebook. Skills: identification in all seasons, the red flags. First failure to expect: a tea from a plant picked before flowering that turns out to be foxglove or autumn crocus.

Village of 300. Minimum viable version: one trained lay healer with a physic garden of grown, labelled plants, a scale, and a register of every remedy given and its result (FO-03 Protocol 4). A short pharmacopoeia graded by use. Grain checked for weed seed before milling. Needs: willow, senna where it grows, ispaghula or plantain, peppermint, comfrey for ointment only, beeswax, a scale weighing to a gram or better, labelled jars, the register. Skills: identification, drying, dose by weight, the harm test, record keeping. First failure to expect: pressure on the healer to keep a dying patient on herbs rather than send them on, or a child given a herb instead of rehydration.

District of 3,000. Minimum viable version: an infirmary that can monitor pulse, fluids and urine and manage plant poisoning supportively, and a district register pooling village registers so harms show early. The district controls what is sold in its markets, refuses patent medicines of unknown origin and inspects grain. Needs: beds, a microscope, any surviving reagents. Skills: supportive care, comparing registers, enforcing the warning list. First failure to expect: a trader's "strong" imported remedy with a hidden drug or metal, or liver disease from contaminated grain mistaken for an infection.

Protocols

Protocol 1. Before anyone takes a plant by mouth

1. Name the plant by its Latin binomial. If you cannot, stop.
2. Was it identified in flower, or by someone who has identified it in flower in the same place? If not, stop.
3. Is it on the warning list (section 4)? Then not by mouth.
4. Is the patient a baby under three months, pregnant, very old, dehydrated or taking any salvaged drug? Then no herb unless a protocol names that group.
5. Is the illness on the red-flag list? Then proven treatment first, a plant only as comfort.
6. For wild garlic, crush a leaf. No strong garlic smell, discard it [VERIFY: general advice in sources read, not a tested rule].
7. Weigh the dose. Record plant, part, weight, preparation, patient, date and reason in the register.
8. Set a review time (3 days for constipation, 2 weeks for pain). No improvement by then, stop.

Protocol 2. Senna for constipation in an adult

1. Adults and children over 12 only. Not in pregnancy without the midwife [VERIFY: pregnancy rule not found in sources read]. Not with severe belly pain, vomiting or no wind passed.

2. Try water, food fibre and movement for 3 days first.
3. Dose: 15 to 30 mg hydroxyanthracene derivatives once at night (EMA superseded monograph). The newer draft gives 10 to 30 mg.
4. The leaf weight for this dose depends on sennoside content, which a village cannot measure [VERIFY: a leaf weight with tolerance is needed before use].
5. Two or three doses a week are usually enough.
6. No more than 1 week without the healer's review (newer EMA draft), never more than 2 weeks.
7. Stop at severe cramping or watery stools and give fluids.

Protocol 3. Willow bark for pain in an adult

1. Not for children, in late pregnancy, with stomach ulcer or bleeding, or with aspirin allergy [VERIFY: standard salicylate cautions, not read in sources for this chapter].
2. Use dried bark of young branches from a known willow.
3. Tea (EMA traditional use): 1 to 3 g cut bark per cup, three to four times a day, 3 to 12 g a day.
4. Health Canada advises no more than 120 mg salicin per dose. At 1.5 to 15 per cent content, 3 g of bark holds 45 to 450 mg [VERIFY: own arithmetic]. Start low.
5. Trials ran up to 6 weeks. Review before going further.
6. Stop at stomach pain, black stools, ringing in the ears or rash.
7. Record which tree and what effect, so the village learns which bark helps.

Protocol 4. Psyllium or ispaghula for constipation

1. Adults: 8 to 40 g of seed a day in 2 or 3 doses (EMA draft seed monograph). Children 6 to 12: half to two-thirds of the adult dose.
2. Mix each 1 g with at least 30 mL of water. A 5 g dose needs at least 150 mL.
3. Drink at once, then another glass of water.
4. Never take dry. Never give to anyone with difficulty swallowing.
5. Expect effect in 1 to 3 days [VERIFY: onset not in sources read].
6. Stop and send to the healer if there is chest pain, choking or abdominal swelling.

Protocol 5. Suspected plant poisoning

1. Stop every remedy. Keep a sample of the plant, tea and any vomit.
2. Note the time, amount and who else ate it, and check them all.
3. Check the pulse every 15 minutes for the first hours [VERIFY: working rule]. Under 50 or irregular suggests foxglove or aconite.
4. Keep the patient lying down and warm, with small sips of water or rehydration solution if alert.
5. Never give more herbs to "counter" the poison.
6. Carry to the infirmary anyone with slow or irregular pulse, confusion, collapse, swollen belly, yellow eyes or no urine for 12 hours [VERIFY: working thresholds].
7. After a spring meal of wild greens with vomiting from about 12 hours, expect worsening at 2 to 3 days even if the patient seems better.
8. Record the case in the district register and warn the village about the lookalike.

Protocol 6. Clearing grain of toxic weed seed

1. Learn the weeds of the local fields that carry pyrrolizidine alkaloids or aristolochic acid (heliotrope, ragwort, rattlebox, birthwort) [VERIFY: local lists must be built for each region].
2. Weed them out of the field before they set seed.

3. Before milling, sieve and hand-pick a sample of 100 g of grain and count foreign seeds [VERIFY: sample size is a working rule].
4. If foreign seeds are found, clean the whole lot or feed it to no one.
5. If anyone develops a sudden swollen belly with fluid, stop eating that grain store at once and inspect it.

Numbers to carry

1. **2.5**: hazard ratio of death for curable cancer treated with alternative medicine alone (Johnson 2018a).
2. **About 1 in 5**: Ayurvedic products bought in the United States that contained lead, mercury or arsenic (Saper 2004, 2008).
3. **46 per cent**: urothelial cancer in Belgian patients with aristolochic acid kidney failure (Nortier 2000).
4. **1,600 dead of 7,800**: the Afghan heliotrope-in-wheat outbreak, 1974 to 1976. Clean the grain.
5. **10 mL**: pennyroyal oil at which moderate to severe poisoning was seen.
6. **240 mg salicin a day**: the willow bark dose that worked in a trial. Bark content varies tenfold.
7. **30 mg**: the most hydroxyanthracene derivatives of senna in a day, for no more than 1 to 2 weeks.
8. **30 mL of water per gram** of psyllium, never dry.
9. **One small kernel**: the apricot kernel dose that can exceed the safe cyanide limit for a toddler.
10. **Zero**: the number of plants that cure cancer, HIV, malaria or sepsis in this book.

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