



HERBAL MEDICINE

Pesticides and Chinese Herbs: Understanding the Issues

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Medical professionals the world over are familiar with the ancient saying that a physician should "first, do no harm." As practitioners of Chinese medicine depend upon natural materials derived from plants, making sure that patients receive high-quality herbs that are untainted by excessive pesticide residues is thus an essential aspect of following this timeless advice. However, many modern day practitioners have an incomplete understanding of the cultivation conditions that affect Chinese herbs, and increased awareness of this crucial topic is necessary so that we can accurately address our patients' concerns.

All too often, we see media reports that exaggerate and simplify the complex issues involved with pesticides and Chinese herbs. For example, last year Greenpeace issued a report that grossly exaggerated the prevalence of pesticides in the Chinese herbal supply chain, causing widespread patient alarm. In an apparent quest for publicity, Greenpeace cherry-picked a short list of the most commonly contaminated Chinese herbs and published alarming data that showed that a large percentage of the samples were contaminated. Despite the obvious flaws in their research and its inconsistency with the peer-reviewed scientific research on the topic, the Greenpeace article got tremendous press exposure that shook public confidence in Chinese herbal products. Consequently, many practitioners and patients were left wondering what the true situation is with pesticides and Chinese herbal products.

If we look at research that meets the scientific criteria for peer-review publication, we find that there is a huge gap between the conclusions inferred by Greenpeace and the real situation on the ground. For example, according to NIH-funded research conducted by a team from Harvard, excessive pesticide contamination was found in fewer than 5% of the tested samples of nearly 300 commonly used Chinese herbs. However, only 64% of the Chinese herbs tested in the Harvard research were shown to be completely free of detectable pesticides, indicating that significant progress can still be made.



Although a number of Chinese herbs have been cultivated with organic methods for centuries, many herbs have been historically wild-crafted up to the modern day. Over the past few decades, the Chinese herbal industry has changed rapidly as wild resources decline, global and domestic demand increases, new players enter the industry, and a market driven economy has exponentially expanded the production of common herbs such as goji berries. Given the complexity of the supply chain and the genuine, valid concerns that exist with excessive pesticide use worldwide, it is essential for practitioners to understand why pesticides are used, which crops they affect and how they can be minimized for maximum herbal quality and ecology.

Beyond this, it is important for practitioners to understand the ways in which FDA regulations affect Chinese herbs regarding pesticides. In the U.S., pesticide residue limits are crop-specific and virtually no Chinese herbs have any pesticide tolerances established under FDA law. Since there is neither consideration of dosage nor any tolerance established for these crops, any Chinese herb with detectable pesticides is generally refused entry by the FDA. This creates bizarre situations wherein FDA enforcement appears arbitrary and ethnocentric (in one recent case, a Chinese herbal berry product was rejected for trace levels of a pesticide that is permitted in U.S. fruit crops such as cherries and apples; in that particular case, the rejected herb would have needed to be ingested daily at a high strength dose for more than 10 years to accumulate the level of the pesticide that the FDA permits in a single glass of cherry juice).

Although the prevalence of pesticides in Chinese herbs remains minimal compared to the vegetable section of a typical U.S. grocery store, the issue of pesticides is a particularly sensitive topic for many practitioners and their patients. While conventional foods are ingested in much higher quantities than herbs and remain the main source of consumer exposure to pesticides, herbs are very different than vegetables, posing a different range of challenges that must be considered.

Unlike Chinese herbs, the vegetables we buy at the grocery store are generally all derived from cultivated rather than wild plants. Most vegetables at the supermarket come from plants that are

fast and easy to grow, whereas many Chinese herbs must grow for years before they can be harvested. There are relatively few common vegetables that cannot be grown organically, and the main incentive for pesticide application in fruits and vegetables is typically to increase yields and decrease the financial risks to the farmer rather than to ensure the fundamental viability of the crop.

By contrast, Chinese herbs are chosen for specific traditional actions rather than ease of cultivation and taste, so the market cannot easily eliminate items that are hard to grow or poorly adapted to different ecosystems. Ginseng, for example, is a plant that is very difficult to cultivate because it takes more than 10 years to reach a viable size when it is grown on the natural forest floor without the application of fertilizers or chemicals (and once it is harvested, the next crop is another 10 years away).

When ginseng is grown in a field, it can be harvested in only 5 to 6 years, but field-grown ginseng is prone to fungal infections that affect its quality and yield. While alternatives exist such as forest-grown ginseng and certified organic ginseng, these premium items are too expensive for many patients and have very weak market demand due to their high price. Consequently, conventional ginseng makes up the bulk of the market and many ginseng growers apply fungicides to reduce the risk of losing a six-year income cycle due to fungal infections of the roots. As a result, there is little alternative other than to pay a premium for products that are grown under certified GAP (Good Agricultural Practices) or organic conditions.

Ultimately, pesticide applications affect a larger percentage of food crops than herbal crops because many herbs are rugged, hardy plants with natural chemical defenses that thrive in a specific ecosystem, while many vegetables are tender plants that are prone to pest damage. However, avoiding pesticides in food crops as a consumer is comparatively easy because the huge market demand for vegetables supports a robust infrastructure of organic certification, and many vegetable crops have become key foods because they can be readily grown across a wide geographic range. With Chinese herbs, the situation is more nuanced and requires a deeper investigation into specific plants and their natural resources.

Cultivated vs. Wild Herbs

Many Chinese herbs have been cultivated for centuries, such as *di huang* (*rehmannia*), *huang lian* (*coptis*), *bai zhi* (*Dahurican angelica*), and *bai shao* (white peony), while other herbs such as *dang shen* (*codonopsis*) have only begun to be cultivated in the modern era. Other Chinese herbs remain primarily wild-crafted up to the present day, such as *yin yang huo* (*epimedium*) and *shi wei* (*pyrrosia*). Each herb has its own background story and different herbs vary widely in their annual output and market demand because some clinical conditions are more commonly encountered than others.

When we discuss the environmental conditions surrounding Chinese herbs, we are talking about hundreds of plants with a wide range of circumstances. Some herbs are inherently abundant in certain ecosystems while others are scarce; some thrive in cultivation and others are incredibly difficult to cultivate. Many herbs that are commonly used require large-scale cultivation, while other herbs have important properties, but have relatively narrow clinical indications, resulting in a much smaller overall demand.

Herbs primarily came from the wild in ancient times, and the widespread cultivation of medicinal herbs did not pick up momentum until the Ming Dynasty about 500 years ago. In the early days, the human population was relatively small and wild plant resources were comparatively abundant. Following a period of prolonged wartime conditions that inhibited farming in the central plains of

China, the Ming Dynasty government instituted immigration policies to promote the development of agriculture, including that of medicinal herbs. After this period, the concept of *daodi* medicinal material became more developed in the literature and knowledge about growing regions, processing and quality identification became more advanced.

In modern times, herbal cultivation has advanced considerably; today, more than 150 commonly used Chinese herbs are primarily sourced from cultivated plants, accounting for at least 50% of the herbs traded by weight. Certain herbs that traditionally came from the wild, such as ginseng, *asarum*, *gastrodia* and *cistanches* are now primarily derived from cultivated sources. In some situations, the wild product is virtually non-existent on the market, as in the case of *ginseng*, *gastrodia*, and *notoginseng*. Some herbs, such as *astragalus* and *codonopsis*, now primarily come from cultivated products, though their wild forms remain on the market in limited quantities.

While many specific medicinal plants are now scarce in the wild, over-collection and scarcity also affected practitioners in previous eras. For example, Asian ginseng once had a wide geographic range in China but it was picked to extinction in many areas, which led to abundant historical adulteration as well as the first documented use of *codonopsis* as a substitute in the *Qing* Dynasty. *Codonopsis* itself continued to be primarily wild-crafted until a few decades ago, now most of the material that is used clinically comes from cultivated sources. Similarly, *gastrodia* became incredibly expensive and rare a few decades ago, then cultivation technology advanced and it became abundant through cultivation but remains depleted in the wild. A few herbs, such as *notoginseng*, may already be extinct in the wild, while others (such as licorice and ephedra) still come from both wild and cultivated sources.

Generally speaking, when herbs are cheaper to cultivate than they are to collect in the wild, people cultivate them. Some herbs are common weeds, such as *Artemisia* plants like *ai ye*, *yin chen*, and *qing hao*; these are common in the wild but are extremely easy to cultivate, producing more yield for less effort than wild-crafting. Other herbs such as *tu si zi* are weeds in the wild but require farm-level production to achieve an efficient yield, harvesting the seeds like tiny grains of wheat.

A few herbs are particularly hard to cultivate using traditional methods of vegetative or sexual propagation, so wild products were the only sources for these items until the modern era. Now, some of the items that were once difficult or impossible to grow in ancient times can be cultivated by cell culture, using glass jars to grow plants from cells removed from the growing tip of a mother plant. Several herbs, such as *gastrodia*, *dendrobium*, and *bletilla* are grown using cell culture to propagate viable small plants that can be transplanted to other conventional growing mediums.

Ultimately, selecting high quality herbs is more complicated than a simple question of an organic label. Evaluating quality involves a comprehensive assessment of macroscopic features (and sometimes additional microscopic or chemical testing), and each herb has its own background story. For example, *dang gui* that is very large and moist looks desirable to the uninformed consumer, but the best *dang gui* is small, with a dull brown surface, an oily nature, and a potent aroma- the fat roots are often sulfured and over-fertilized. Serious buyers that buy herbs in multi-ton quantities, such as granule companies, thus often inspect the growing region and soil conditions and buy at the farm level to avoid these issues, and compare constituent profiles from year-to-year. There are many issues to be aware of in quality control, and effective quality control on issues such as botanical identity, growing region, potency, purity and *pao zhi* methods arguably have an even greater impact on herbal quality than appropriately used pesticides.

Chinese herbs are graded based on traditional methods akin to other old-world industries such as wine or tea. Pesticides are a known concern in both wine and tea and both involve complex supply chains that are hard to standardize, as well as established high-end producers that effortlessly sell

all they produce without bothering with extra tiers of certification for the needs of a distant, low-volume export market like the U.S.

Most people likely encounter more pesticides in wine and tea over their life than they will ever encounter by consuming Chinese herbs, and completely eliminating pesticides in all these products is very difficult. Wine, tea and herbs all share the feature of coming from multiple fields, often involving multiple growers and regions and the items from different farms are mixed together, processed and sold. The finished products are graded based on quality using traditional parameters and only a small number of new generation producers pursue organic certification.

By limiting oneself to only the small new growers that choose organic certification, one misses out on much of what the high-end world of tea, wine or herbs have to offer. High-end tea, herbs and wine do not necessarily have levels of pesticides harmful to health; they simply haven't been tested because their traditional sales channel is based on a comprehensive traditional concept of quality rather than organic certification.

Beyond these limiting factors, ensuring that no pesticides have ever been used is not always feasible from a technical standpoint. There are hundreds of pesticides in use in the world and even the most expensive tests cannot test for every possibility. If pesticides are used correctly, they may be completely eliminated and non-detectable when the finished product is tested, but testing cannot guarantee that the growing period was 100% pesticide-free.

On the whole, the issue of pesticides in Chinese herbs should not be blown out of proportion. For most herbs, vendors that do systematic testing on hundreds of products very rarely find pesticide residue levels that surpass safe limits and the majority of Chinese herbs have no detected pesticides at all. Pesticides require attention and remain a significant concern, but the problems are case-by-case and are primarily focused on specific crops.

Resources

- www.ilaom.org/images/_Newsletter_08.13-web-MR.pdf
- www.ncbi.nlm.nih.gov/pmc/articles/PMC3163780/
- www.sciencedirect.com/science/article/pii/S0378874111000195
- www.sciencedirect.com/science/article/pii/S037887411200061X
- www.gpo.gov/fdsys/pkg/CFR-2011-title40-vol24/pdf/CFR-2011-title40-vol24-sec180-371.pdf
- www.fda.gov/downloads/food/foodborneillnesscontaminants/pesticides/ucm352872.pdf

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