

# **How healthy are botanical supplements? A brief exploration of sustainability, supply chains and quality issues in the herbal medicine and food supplements industry**

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## Introduction

### Who we are

**Rebecca Lazarou** completed a degree in biomedical science- human biology always with the intention of going into plant medicine research. She then completed a masters in medicinal natural products and phytochemistry from UCL, and is now a researcher at Kew Gardens, an editor for the Journal of Herbal Medicine, teacher and founder of the wellness brand **Laz The Plant Scientist**.

**Zack Bellman's** academic background is in biological neuroscience from the University of Sussex and a masters in Drug Sciences (specialising in the ethnopharmacy of cannabis) from the University College London School of Pharmacy. Currently a PhD candidate in Drug Sciences, topics of research include quality control and assurance, blockchain and supply-chains, medical cannabis, and psychoactive plants. As well as an interest in science communication, education, drug policies and the implementation and ethics surrounding new technologies and botanical supply-chain chains.

### Our aims and what this resource provides

A mutual love for plant medicines and horror at the state of the supplements and herbal industry inspired this project. The poor quality of botanicals in the herbal remedies and food supplements industry is shocking however it is an issue many well intentioned botanical brands are unaware of, as well as the vast majority of the public. Despite exponential growth in the interest of natural health and wellbeing, the attention to sourcing medicinal grade ingredients that actually work has not matched that. There are an array of problems making this area particularly hard to navigate. So, we have teamed up to make an educational resource to firstly teach people about what to expect so they can identify problems when they arise. It is our hope that sharing knowledge will help empower people to make more informed decisions, better medicinal products and help to dismantle some of the poor practises that are all too common in industry.





We also aim to raise awareness around some of the un-sustainable practices and history in the herbal medicine sector, and drive consumers attention towards schemes to improve the ecological status of the wider industry.

Below you can find the issues we delve into grouped into sections:

## Quality

How do we define good quality?

Quality (Oxford Dictionary)

noun: quality; plural noun: qualities

- **the standard of something as measured against other things of a similar kind; the degree of excellence of something.**
- **a distinctive attribute or characteristic possessed by someone or something.**

Good quality is subjective and changes in different contexts. Quality is dependent on the aims of a particular company and what they claim the product should do. For example turmeric powder that is destined for use as a decorative yellow powder for during the festival of colour (e.g. Holi festival) may be defined as good quality for that specific purpose if it contains lead chromate dyes (not suitable for human consumption), however the same product deemed poor quality if it is intended for human consumption (supply-chains of the same nature can give rise to similar products with many different types of end-users).

When it comes to medicinal plants, the plant parts and chemical constituents of the plant (or extract) will vary depending on the ailment one is trying to treat. Good quality will be in-line defined with the efficacy and safety of a substance, and how that relates to the particular medical model in which the botanical product is being used e.g. in western phytomedicine the definition of good quality ginseng may differ from a particular Traditional Chinese Medicine (TCM) practitioner. The western herbalist may be looking at the characteristics of ginsenosides and active compounds whereas the TCM practitioner may be looking at the characteristics of the root itself and the shape or quality of heat, wind and terminology used in that medical doctrine.

Therefore, when discussing quality here we have to acknowledge that we are writing about good quality from the perspective of western phytomedicine when talking about medicinal herbs. When speaking about food standards the same is true in that we are mostly drawing upon examples where the end-users reside in the US and Europe. Many botanical suppliers based in Asia (e.g India and China) base quality standards on these principles too. However, different methods and approaches that exist elsewhere are not covered here (for example in traditional texts and contemporary commentary[1]).

### Poor botanical identification

One of the issues with quality is the lack of access to quality botanical identification. This is partially because when companies receive their material it has already been processed into powder or extract, which makes it nearly impossible for botanists to correctly identify. Suppliers are not obliged to provide botanical identification certificates, and do not often match up their plants with botanical specification sheets which describe the botany of the plant as well as photographic evidence.

### Often times people are delivered the wrong botanical and remain unaware, leading to mislabelled and potentially dangerous products.

Additionally, there is a serious lack of botany training in the UK particularly. There are no longer any degrees for botany, as the last one was completed at Bristol university in 2013. Some plant science degrees are still available, however they focus more on molecular studies, biotechnology and genetics with little or no focus on traditional taxonomy and nomenclature. In short it is hard to source the expertise to identify a plant, and it is even more difficult to identify a plant which has already been processed even if a botanist is found.

Another major problem with botanical identification is plant nomenclature. For example, a vast majority of plants have synonyms (multiple names), however many also have homonyms (where one name can be for multiple species). An example of this is “Ginseng” a name used in pharmacopoeias and legislation but which can imply a variety of 16 different species.

Taxonomy can be a very perplexing space, as one plant can have multiple latin binomials as well as a multitude of common names. This complicates supply chains even further and can lead to devastating effects. For example, the name “Fang ji” in the Chinese pharmacopoeia can be for the species *Stephania tetrandra* or *Aristolochia fang ji*. *Stephania tetrandra* is often adulterated *Aristolochia fang ji*, which is highly nephrotoxic. This happened in 2008 in a Belgian weight loss clinic and it led to a cumulative 116 cases of renal failure, cancer and death [2].

### Solutions:

- If appropriate request botanical specification sheets (we understand that small farms often may not offer these, but larger suppliers with laboratory tests for other results (e.g heavy metals and microbial count) should be able to. In fact, some do regular testing for botanical identification of plants.
- Get well acquainted with what the whole plant or dried plant should smell and taste like so you can do your own macroscopic examination.
- Use MPNS to check for botanical nomenclature. This is a fantastic database from Kew gardens that gives a list of the common names, pharmaceutical names and latin binomials of a plant. As mentioned before a single plant has multiple names so this database collates them all for you, so you can help ensure you are buying the correct plant.





## Adulteration and contamination

Perhaps two of the most disappointing factors of poor-quality botanicals is adulteration and contamination. This is when a product is mixed with other ingredients which are not supposed to be there, for example other plants or synthetic materials. It is a very serious and common problem. For example, a ginkgo product could be adulterated with other plants that look similar to ginkgo, but are a different species. Besides other species, products can also contain harmful contaminants such as illegal or prescription drugs, pesticides, toxic heavy metals, radioactivity, insects, microbes, fungi, molds, mycotoxins, polychlorinated biphenyls, solvent residues, dust, pollen and parasites. Shockingly it is common that products do not contain any of the plant stated on the label. A study that analysed nearly 6,000 herbal products sold across 37 countries using DNA testing concluded that on average 27% did not contain what was stated on the product [3]. Further, in Europe this percentage was higher at 47% but that was lower than Australia where 79% of products were found to be adulterated and in North America it was 33% and in Asia 23%[3].

### **Out of 35 ginkgo biloba products bought in the UK, 33 of them had been adulterated either intentionally or by accident.**

Many had low or non-existent ginkgo metabolite content which is important for a product's medicinal value, reflecting poor extraction techniques. Overall only 2 products bought and lab-tested were of medicinal quality [27].

Whilst it is evident that herbal products can contain filler and substitute species, undeclared contaminants, or just lack the plant on the label completely, there are different motives for these poor manufacturing processes. They can be accidental, as it is the common assumption from brands that there is legal coverage to ensure that what they are buying is legitimate. However sometimes the motivation is intentional, in order to enhance the efficacy of a product by mixing it with pharmaceuticals. For example in weight loss supplements there has been adulteration with ribonabant, gylbenclamide, clenbuterol, sibutramine, nicotinamide and youhimbine [4]–[8]

### **There is also economic incentive to be fraudulent as substituting species with cheaper more widely accessible “filler” plants means a higher profit margin for brands.**

In October, 2011 the FDA notified consumers that the “P57 Hoodia” product marketed by Huikng Pharmaceutical was found to contain sibutramine, a controlled substance that was removed from the U.S. market in October 2010 for safety reasons. Sibutramine may substantially increase blood pressure and/or pulse rate in some patients and may present a significant risk for patients with a history of coronary artery disease, congestive heart failure, arrhythmia, or stroke. This product may also interact in life threatening ways with other medications a consumer may be taking. This resource [9] shows some products that have been exposed as adulterated, but is not an extensive list as many are still on the market.

## Solutions:

A short and traceable supply chain is the best way to be able to monitor that a product is not being tampered with. If a company is not able to tell you where the plant was grown or the steps of the supply chain then this is a red flag. It is likely that people bulk selling white label plant products with no acknowledgement of the steps that came before it are less inclined to be attentive to risks of adulteration and contamination beforehand.

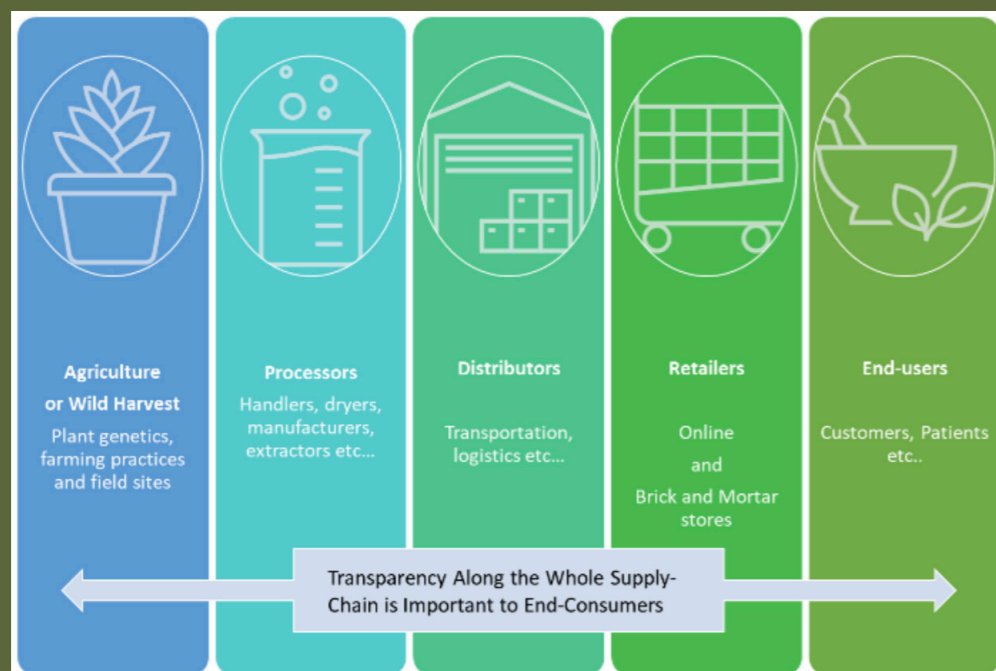
Get your products lab tested especially if they have been processed (e.g. made into an extract). You can also test your product for botanical identification. There are commercial labs available that test for adulterants and contaminants as well as other markers of quality.

### Post-harvest processing

Post-harvest processing include plants drying, drying techniques, extraction, storage and transport. This is a very important phase of production as microbes and mycotoxins can breed and poor hygiene standards will affect the product. Sometimes even rodents have been known to run over plant material. The same factors then apply for any transport and further processing, e.g. chopping, polishing, and extracting of the herbs from all the points post-harvest.

## The way plants are processed after they are harvested makes a huge difference on quality and efficacy of medicine.

For example, turmeric *Curcuma longa* L. has seen a surge in popularity as a foodstuff and supplement. Post-harvest processes such as polishing roots to make them 'sellable' to future buyers, and other processes have been observed and adulterants such as food-dyes enter into the supply-chain [10]–[12].



## Solutions:

- Manufacturers and producers should be aware of any post-harvest processing practices and take this into account during sourcing and acquisition of herbs and test batches frequently to ensure no samples are adulterated or contaminated.

It is also recommended that people learn about the traditional post-harvest methods of a plant used as well as modern day practices, in order to gain as much knowledge.

## Social and economic issues

### Problems with a rapid rise in popularity

When a plant becomes very popular quickly, it becomes at high risk of quality issues. For example maca also known as *Lepidium meyenii* L. is a plant native from Peru and which grows across South America, and whilst it's usage as a traditional food-stuff and medicine has been documented for hundreds of years it's recent surge in popularity has lead to issues amongst it's supply-chain. For instance, over the past decade it's usage as an 'adaptogen' and sexual libido enhancer has led to a massive increase in a western consumer base. The users are consuming maca in a variety of products from extracts through to powdered roots sometimes added to smoothies or dietary supplement regimens. The rapid increase in demand for maca has not been good for consumers however, with major issues arising about the adulteration and contamination of products arising from various issues along the supply-chain that involve biopiracy, local power issues with regard to market control (access and benefit sharing) and general issues with respect to sustainable supply. The story of maca is complex and covered elsewhere in more detail [13]but is worth bringing to attention in the context of this article [14], [15].

## The corona virus pandemic has seen a huge surge in the use of health supplements and botanicals which has had vast impacts on the quality of products available.

More information on this problem specifically has been written by Rebecca on page 18 of the Society of Economic Botany's newsletter for autumn 2020 here [16].

Unsustainable overharvesting of medicinal plants in the wild also becomes common practise. This has been observed to have a devastating effect and usually comes about when a plant gets popular without effective conservation needs, regulations and communities to protect the plants in. This can happen on many scales ranging from its use in the supply-chain of another product (e.g. cortisone and Yams [17]), it's popularity as a food-stuff/supplement, medicine or through tourism examples include Shatavari root [18], Rhodiola[19], Peyote [20], [21], Ayahuasca [22], [23]

Overharvesting of wild-plants is an issue especially with the increasing importance of environmental, social and governance around medicinal herbs and commercial companies. This is particularly true for plants listed as endangered or threatened in the CITES and in similar schemes, or if they are deemed valuable and needing protection by local communities (e.g. Peyote with the Wixarika Huciholes). It usually happens when the plant part needed affects the life cycle of the plant. For instance by harvesting barks, or extremely slow growing herbs in which the whole plant is harvested it can cause the plant to become endangered more easily than something which grows fast and abundantly.

One example is that of Peyote cactii which are slow growing, and over-harvested in areas of Mexico, and other regions in which the plants growing are in danger because of nearby mining companies. For example there was a legal battle between the silver mining company First Majestic Silver and local indigenous people and environmentalists who wanted to protect the land and the peyote growing.

Similarly, plants such as *Prunus africana* (Hook.f.) Kalkman (the African plum cherry) were being employed as an effective herbal medicine in western territories (outside of Africa) for treating benign prostate hyperplasia. Due to this it was overharvested in the wild, and collection of medicinal material involved stripping the tree of its bark therefore killing the tree. This led to local governments banning the harvest of *Prunus africana* and the tree is now on the endangered list, ultimately it also led to a major shortage of medicines with producers and consumers having to adapt and find alternative medicines. The tree is now being incorporated into cultivation programs and practices are being employed to reforest areas and create a sustainable supply of *Prunus africana* [24], [25].

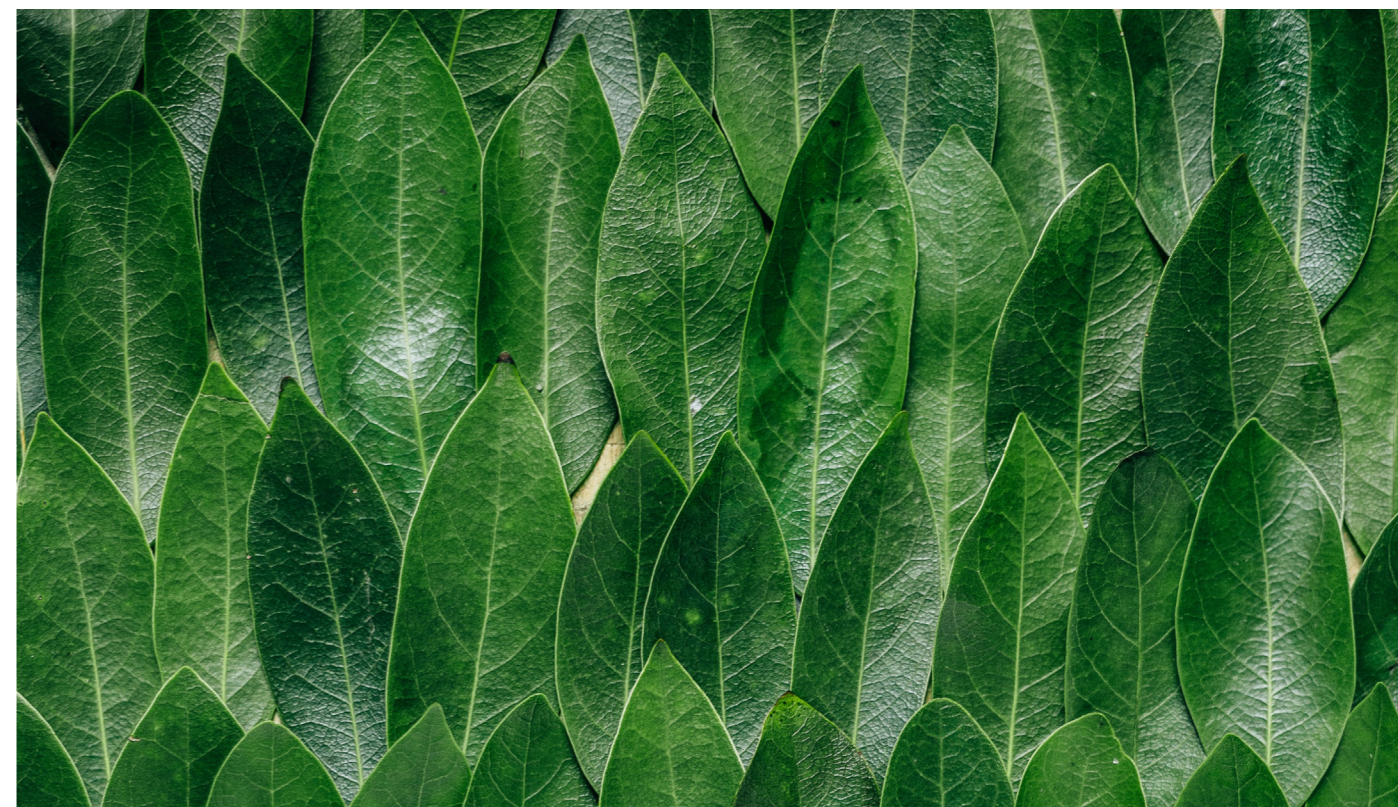
### Equity for growers and people along the supply chain

Fairness along the supply-chain of medicinal plants is difficult to measure and track. Medicinal plants in particular have an extra-layer of politics as medicine is such a fundamental concept to human existence but has legal, medical, historical and cultural complexities (for example the colonial roots of medicine and academia).

### Often times growers do not receive fair payment for their crops and the industry is rife with exploitation of farmers.

A common problem also is Biopiracy. This is considered to be a type of bioprospecting where essentially a company or person “discovers” a plant, exploits the knowledge and resources and original knowledge keepers and growers of the plant (e.g indigenous people) are not rewarded. It is a case in which one or more parties are not rewarded by any of the assets, proceeds and income which they rightfully own or should be rewarded from. These topics are immense and we do not have the scope to speak of deeply in this resource, nonetheless we believe it is important and should be mentioned.

The story of Yam *Dioscorea Sylvatica* L. and its overharvesting for the production of pharmaceutical cortisone from the 1950's onwards is a classic example of when uncontrolled collection practices for a desired medicinal plant can lead to major ecological impact (that almost drove this plant to extinction) and social exploitation. The British pharmaceutical company was producing cortisone in pharmaceutical form and was using the Yam, which grew in South Africa, as a source of the active pharmaceutical products for their supply-chain. However, indeterminate protocol to harvest the yam led to an overharvesting of the roots and the wild populations of the plant were drastically effected by it which ultimately led to local people banning the collection of



yam root on commercial scale for sale to export [17]. There are lots of examples of this happening and unfortunately at present these practices still exist, whilst there are legislations such as the Nagoya protocol in place in reality these are difficult to regulate and enforce with the need for integration of different stakeholders who all possess different interests and often live in different geographies. Manufacturers and producers would benefit greatly by adopting better practices of equity and benefit sharing when sourcing natural products whether for pharmaceutical supply-chains or plant medicines.

#### Solutions:

- There are schemes such as fair wild, fair trade which aim to increase social, economic and environmental sustainability.
- The Nagoya Protocol helps to ensure fair benefit sharing and equity of natural products, as well as supporting sustainable use and human-wellbeing.

## Regulation

### Problems with regulation

There is little regulation or quality control standards when it comes to food supplements. Things are classed as food supplements, herbal medicines, pharmaceuticals or homeopathy but many things that are herbal medicine ingredients are classed as food supplements.

In the UK there is no obligation to make sure that your plants are botanically identified, active compound levels are tested, or check that your product isn't adulterated.

There is also no obligation for retailers to check this. So where should the onus be placed, on the supplier, brand or retailer? Food supplements are regulated under food law but are not regulated for quality, and so poor quality products slip into the industry, especially as sales are so easily made online now. The Traditional Herbal Registration (THR) scheme was a valuable attempt to fix this issue, however it only regulates certain plants in the EU and the public are largely unaware of its existence[26]. It is also expensive for small companies, and so many do not register to get this license.

There is regulation when it comes to claims, for example you can not make any medicinal claims such as anxiety or inflammation. However, countries such as the USA are much more relaxed about this. Laws are in place but in truth the quality is not investigated frequently and so companies are not often held accountable. Additionally, people rely on laboratory tests and certificates of analysis from other people but do not send them to get lab tested themselves. Unfortunately, without external analysis results can be falsified and nobody is held accountable. Similar, to scientific publishing where articles must be peer reviewed and verified by other scientists before being published, botanical products should be checked by external suppliers to validate original reports and quality. Another issue however is that in the UK there are limited laboratories that offer these services and they need to be exported to Germany or Switzerland to get tested which can be expensive.

### Ignorance and wilful blindness

This section highlights various perspectives of consumers and stakeholders in the herbal medicines sectors. One of the main issues that perpetuates these problems is that both consumers and manufacturers are ignorant to these issues. Qualitative data shows that people who thought herbal medicines were safe were more likely to believe that there was regulation in place. Interviews showed that it is felt that Britain in general is a society that is stringent on regulation and so it is assumed that if a product was on sale in a shop that it was safe to assume the product had passed safeguarding from an authority, particularly in large well-known shops [28]. Additionally, though THR is in place, research shows that when choosing herbal products, products indicated by THR logo were the least popular (16.4%) and only 2.3% of people said they looked for certificates and marks [27].

## Conclusion

Perhaps more onus should be placed on suppliers to be more vigorous about ensuring that they are selling herbal medicinal products of quality, as informal interviews revealed that shop and brand recognition meant that people presumed the products were of good quality. However, this shift is unlikely to happen unless there is pressure from the public, and this will only come when the public is well informed. In fact a study shows that nearly three-quarters of participants believe herbal medicines should be regulated to the same degree as pharmaceuticals [27].

As well as compromising public safety, allowing inadequate products to the market only amplifies people's negative opinions and ignorance towards herbal medicines. A commonly held misconception is that herbal products simply will not work past placebo. This disempowers a vast source of medicine that could be invaluable to many. There, are of course companies as well who turn a willing blind eye to compromising quality for profit, however with increased education the benchmark of what will allowed to be sold and advocated will be raised.

We hope this resource will be a valuable part of peoples decision making when it comes to sourcing their own plant medicines, and will help shift the narrative of quality within the industry.



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