

## Phytotoxicity in Herbal Medicine: A Review

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**Abstract:** In spite of the increasing popularity of medicinal plants the world over, phytotoxicity remains an issue of major concern in herbal medicine. Historically, phytotoxic plants have been useful in the development of important drugs used in western medicine, and are still used in modern times by herbal medicinal practitioners. The continuous usage is due to the precautionary measures taken by people using the phytotoxic plants. The measures include avoidance of the entire or parts of known toxic plants, cooking the plant materials to denature toxic compounds and charring to convert organic material into inorganic residues. The fact that toxicity tests are increasingly conducted and the knowledge of phytotoxic plants is advanced, serves as an encouragement that phytotoxicity should not be a negative factor in herbal medicine.

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### 1. Introduction

There has been a re-surgence of interest in the use of herbal medicine all over the world. This is apparently due to the appreciation of people that synthetic and or allopathic drugs have serious side effects. According to Okpako (1999) one aim of drug therapy in modern western medicine is to poison the causes of disease selectively. As an example, antacids used in easing the pain of ulcer may eventually cause kidney stones, coordination and concentration problems as side effects when used excessively. Similarly antiulcer drugs such as Tagamet and Zantac give side effects of nausea, vomiting, headache, confusion and sexual dysfunction (White and Foster, 2000). These authors also stated that the use of antidiabetic drug, Glucophage brings about loss of appetite, nausea and abdominal discomfort. Anti-hypertensive drugs generally result in the loss of libido in men with continued usage. Owing to these problems people now look for safe, effective and time proven alternatives to orthodox medicine which employs largely synthetic drugs. Also, the idea that herbs are synonymous with everything natural and healthy is well established. McIntyre (1992) was of the view that herbal medicine should be encouraged because humans and plants have always existed together in the same ecosystems and human bodies are well adapted to metabolize plant constituents as they occur in nature.

Plants generally produce essential compounds such as amino acids, sugars, fatty acids and polymers, through primary metabolism. Secondary metabolites which depend upon the genetic make-up of the plant are derived from other metabolic pathways of synthesis which constitute secondary metabolism. Although secondary metabolites such as alkaloids,

terpenoids, steroids, flavonoids, tannins and anthraquinones have been generally found to be useful to humans, some medicinal plants may produce active principles that elicit pharmacological responses in humans and therefore influence his health. Medicinal plants which have undesirable pharmacological effects are considered toxic. The biologically active principles which produce toxic effects may be produced alongside others which are medicinal in some plants. For example *Ricinus communis* (Castor oil) contains ricinoleic acid which stimulates intestinal peristalsis hence purgative in action. Alongside, the seeds also contain two highly toxic substances, an alkaloid, ricine and a lectin ricin which is among the most toxic compounds known and two seeds may cause fatal poisoning in humans (Van Wyk *et al.*, 1997).

In other cases, excessive consumption of the medicinal principle becomes toxic after consumption. In some plants, toxicity may be enhanced only by certain prevailing conditions in human beings at particular times or stages, e.g. contraindications in breastfeeding or pregnancy. As an example licorice (*Glycyrrhiza glabra*) used by ulcer patients in Europe, should not be used during pregnancy or by persons with diabetes, glaucoma or high blood pressure (Balch and Balch, 2000). Another condition is that in some plants, medicinal principles are synthesized in certain parts of the plant while the toxic ones are synthesized or stored in other part of the same plant. This is exemplified by the leaf of *Telfaria occidentalis* which is non-toxic and has haematinic activity but the root is so toxic that it is used as a rodenticide in Nigeria.

Ross and Brain (1977) stated that there are some medicinal plants which must be used when fresh or

when dry in order to avoid the presence or the formation of toxic substances.

## 2. Types of phytotoxins

Phytotoxins are of two major types; (a) Ingestion toxins and (b) Contact toxins. Ingestion phytotoxins or poisons cause physiological disturbance or even death when eaten. It is met quite frequently and is of the more common causes of health problems. Example of this is the toxic mushrooms like *Amanita spp.* which cause death soon after consumption. A secondary type of phytotoxin may be described as the inherent type. In this case, the active material is produced by the causal organism itself. Also, the secondary type of toxin may be produced by the plant which passes from it up the food chain to other organisms ingested by the victim (Ross and Brain, 1977). An example of this is seen in some algae which contain toxin and pass it on to other organism higher up in the food chain when ingested.

Most contact phytotoxins produce allergic reactions or dermatitis. Allergy can be defined as a condition of particular sensitivity which some individuals have or develop to substances that are harmless to the majority of other people. The sensitizing substances, which provoke allergic responses, are called allergens. Allergic reactions caused by contact phytotoxins may be painful inflammation with blisters which may last for weeks. However the severity of the action depends on the plants in question and the degree of susceptibility of the person affected. The most severe type of allergic contact dermatitis is that produced by touching poison ivy, *Toxicodendron radicans* or other *Toxicodendron spp.* known as poison oak. The allergen in this plant is a toxic mixture or catechols designated urushiol. Following initial sensitization, it produces an acute contact dermatitis characterized by weeping, vesicular lesions with oedema as well as severe itching (Robbers and Tyler, 1998).

### Toxicity in some Angiosperm families

Phytochemical studies are revealing how safe or toxic plants are. As reported by Gaignault and Bider (1988), cardenolides are common constituents of toxic plants belonging to the families Apocynaceae, Asclepiadaceae, Liliaceae, Moraceae and Scrophulariaceae. At lower dose, cardenolide – bearing plants have been used traditionally as tonic, emetic and diuretic purposes: Rasoanaivo *et al* (1992) reporting on toxic and poisonous plants of Madagascar observed that the highest number of toxic species was found in the family Euphorbiaceae. Some of the plants in this group have been used as ordeal poison, rat poison, fish poison or ingredients of criminal poisoning. The plants show various symptoms of toxicity; neurotoxicity, hemorrhagic

diarrhea if overdosed as laxative and cause stomach as well as liver disturbances.

Robbers and Tyler (1998) reported that the families Euphorbiaceae and Thymelacaceae have many species that contain diterpene esters. These chemicals do not themselves cause tumors but increase the incidence of tumours caused by exposure to a carcinogen. Similarly hepatotoxic pyrrolizidine alkaloids occur in many plants but are found in commonly used herbs belonging to the Boraginaceae and Asteraceae families (Huxtable, 1980). Medicinal herbal teas prepared from the flowers or flower tips with their associated pollen grains may also produce allergic reactions in some sensitive individuals. Thus teas made from chamomilla (*Matricaria chamomilla*) yarrow (*Achilea millefolium*) and marigold (*Calendula officinalis*) all members of Asteraceae may cause contact dermatitis and hypersensitivity reactions in allergic persons (Abramowicz, 1979).

Some medicinal plants require ultraviolet radiation to activate the toxicity in them since not all of them cause malignances, they are more properly classified as photosensitizers. Psoralens have been implicated in such plants which act as potent phototoxic or photomutagenic agents when materials containing them are ingested or contacted (Kornhauser *et al.*, 1982). Psoralens are abundant in members of the Apiaceae and Rutaceae.

In spite of the foregoing examples of the occurrence of toxic chemicals in medicinal plants, this cannot detract from the increasing use and awareness of herbs in parts of the world. This is due to the fact that despite the serious side effects of synthetic drugs they are still prescribed by orthodox physicians.

It is the opinion of Murray (1995) that as a rule, herbal preparations are generally less toxic than their synthetic counterparts and offer less risk of side effects. Although, there are exceptions to this rule, he argued that since the use of herb is often to correct the underlying cause of a health problem, it is more advantageous to humans than the synthetic drug often designed to alleviate the underlying cause. Additionally, it has been demonstrated with many plants that the whole plant or crude extract is much more effective than isolated constituents. Murray (1995) gave the example of *Digitalis purpurea* from which the pure drug ‘Digoxine’ is produced as a cardiotoxic. According to him, toxicity and death in *Digitalis* have increased as a result of purification and that toxicity was less of a factor when using the crude herb. The explanation of this was because overconsumption of potentially toxic doses resulted in vomiting or diarrhea, thus avoiding the heart disturbance and deaths that occur, now with pure digitalis cardiac glycoside drugs.

### Usefulness of phytotoxic plants to modern medicine

The toxicity of many plants has been ascribed to the fact related to their survival in their environments. According to Rasoanaivo *et al.*, (1992), toxic and poisonous plants especially those growing in the wild must have in their evolutionary history, developed complex chemicals as survival mechanism to protect themselves from their predators. The authors were of the opinion that some of the plant chemical compounds may be effective in attacking cancer cells or inactivating eukaryotic ribosomes. Similarly Elgorashi *et al.*, (2002) reported that *Antidesma venosum*, *Balanites maughamii*, *Chaetacme aristata*, *Croton sylvaticus*, *Gardenia volkensii*, *Plumbago auriculata* and *Spirostachys africana* - all medicinal plants commonly used in South Africa showed mutagenicity of DNA damage in at least one test of

four kinds of genotoxicity tests. Dichloromethane and methanol extracts of different parts of the plants were used on *Salmonella typhimurium* and mammalian cells *in vitro*. Based on these results, Elgorashi *et al.*, (2002) expressed the view that the medicinal plants were potential good candidates for anticancer drug research. Many cancer chemotherapeutic agents have been shown to be mutagenic in *Salmonella* microsome test (Benedict *et al.*, 1977, Senio *et al.*, 1978).

According to Okpako (1999), since drug therapy in modern medicine aims at poisoning causes of diseases selectively, poisonous and toxic plants have therefore been the major sources of drugs throughout the history of pharmacology. Table 1 shows a list of historically important molecules with drug-like properties derived from toxic and poisonous plants.

**Table 1: Historically important molecules with drug-like properties derived from toxic plants**

Drug-like molecule	Plant source	Historical background
Picrotoxin	<i>Anamirta cocculus</i> (Menispermaceae)	Fish poison
d-tubocurarine	<i>Conrodendron tomentosum</i> (Menispermaceae)	Arrow poison
Atropine	<i>Datura stramonium</i> (Solanaceae)	Used as poison since ancient times
$\beta$ -erythroidine (muscle relaxant)	<i>Erythrina senegalensis</i> (Fabaceae)	Arrow poison
Ouabain	<i>Strophanthus gratus</i> (Apocynaceae)	Arrow poison
Strychnine	<i>Strychnos nux-vomica</i> (Loganiaceae)	Vermin poison
Physostigmine	<i>Physostigma venenosum</i> (Fabaceae)	Ordeal poison
Bishydroxycoumarin	Badly stored sweet clover- <i>Trifolium pratense</i> (Fabaceae)	A cause of haemorrhagic disease in cattle
Ergot alkaloids	<i>Claviceps purpurea</i> (Fungus)	A cause of gangrene (St. Anthony's fire) in humans

Source: Okpako (1999)

Rasoanaivo *et al.*, (1992) reported the occurrence of 186 toxic and poisonous plants of Madagascar representing 91 genera and 46 families. They stated that although the plants have been used for different things such as ordeal poisons, poison baits to kill undesirable animals and as ingredients in criminal poisonings, the same plants were ethnomedicinally useful (Table 2).

**Table 2: Selected toxic and/or poisonous Madagascar plants and their ethnomedicinal uses**

Family and Botanical Name	Toxic Effect	Ethnomedicinal Uses
Agavaceae <i>Dracaena reflexa</i> Lamarck	Abortifacient	Antidysentery, diuretic
Amaryllidaceae <i>Crinum asiaticum</i> L.	Toxic bulb if used without caution	Emetic, diaphoretic
Apocynaceae <i>Catharanthus coriaceus</i> Mrkgf. <i>Roupellina boivini</i> Pichon	Ordeal poison Cardiotoxic	At lower dose, for heart, liver diseases Antipyretic, febrifuge
Araceae <i>Amorphophallus hildebrandtii</i> Engels & Geh.	Toxic tuber if eaten uncooked	Stimulant, aphrodisiac
Asclepidiaceae <i>Calotropis procera</i> Brown <i>Toxicarpus tomentosus</i> J. & Per.	Cardiotoxic Cardiotoxic	Powerful diuretic Cough, sore throat
Boraginaceae <i>Heliotropium indicum</i> L.	Liver disturbances	Haemorrhoids, pile

Combretaceae <i>Combretum coccinea</i> DC,	Spasm and hiccup	Anthelmintic
Crassulaceae <i>Kalanchoe schizophylla</i> Baillon	Highly toxic	Antisymphilitic
Dioscoreaceae <i>Dioscorea antaly</i> J. & Per. <i>Dioscorea hoffa</i> Cordemoy	Toxic if eaten uncooked Toxic if eaten uncooked	Tonic Treatment of ulcer
Euphorbiaceae <i>Acalypha decaryana</i> Leandri <i>Croton barorum</i> Leandri <i>Croton catatii</i> Borteau <i>Euphorbia mainty</i> Denis <i>Euphorbia tirucali</i> L. <i>Jatropha curcas</i> L.	Toxic to livestock Toxic Toxic Hemorrhagic diarrhea Toxic if overdosed Hemorrhagic diarrhea if overdosed	Laxative Breast cancer and leukemia Antimalaria Drastic laxative Emetic Antiblennorrhagia, emetic
Leguminosae <i>Erythrophleum couminga</i> Baillon <i>Arachis hypogea</i> Person	Extremely toxic, vomiting trachycardia and death Toxic	Emetic at very low dose Aphrodisiac, emmenagogue
Moringaceae <i>Moringa oleifera</i> Gaertn.	Root is toxic	Pulmonary disease
Polygonaceae <i>Drymoglossum niphoboloides</i> Baker	Toxic at higher dose	Diuretic
Solanaceae <i>Whitania somnifera</i> Dunal	Toxic	Rheumatoid arthritis

**Source:** Rasoanaivo *et al.*, (1992)

As observed by Rasoanaivo *et al.*, (1992) highly toxic Madagascar plants such as *Tanghinia venenifera* and *Erythrophleum couminga* contain highly cardioactive diterpene alkaloids while *Menabea venenata* contained cardenolides. Although cardenolides are common constituents of toxic plants, cardenolide-bearing plants have been used traditionally as emetic, diuretic and tonic albeit at lower doses. Boiteau (1974) reported that some Italian pharmaceutical firms used to exploit *E. couminga* commercially as a non-steroid cardioactive drug but abandoned the project because of the shortage of plant material from Madagascar.

Kapitanyan (2006) stated that cardiac glycosides are found in a diverse group of plants including *Digitalis purpurea*, *D. lanata* (foxgloves), *Nerium oleander* (common oleander), *Thevetia peruviana* (yellow oleander), *Urginea indica* (squills), *Strophanthus graus* (Oubain) and *Apocynum cannabinum* (dogbane). Ancient Egyptians and Romans first used plants containing cardiac glycosides medicinally as emetics and for heart ailments. Therapeutic use of herbal cardiac glycosides continues to be a source of toxicity today. Kapitanyan (2006) reported that recently *D. lanata* was mistakenly substituted for plantain (*Plantago major* and *P. lanceolata*) in herbal products marketed to cleanse the bowel, thus resulting in human toxicity caused by human error. Wagner (1988) reported that toxic plants

are a good source of antitumor compounds, as well as steroid and non-steroid cardioactive drugs.

#### **Precautionary measures on phytotoxicity**

Okpako (2015) stated that indigenous African communities knew poisonous plants which they used as arrow poison, fish poisons, ordeal poisons (for witchcraft detection), or poisons to dispose of the enemy.

In ethnomedicine, Rasoanaivo *et al.*, (1992) reported that by living in permanent symbiosis with their surroundings, the indigenous people of Madagascar have learnt to distinguish plants to be used as herbal remedies or foods from those having toxic or poisonous effects. The traditional knowledge has been handed down from generation to generation either orally or in written form. The authors further observed that the Madagascar population removed toxic constituents of plant materials before using them as food or medicine. As reported by Okpako (2015) in traditional African medicine, indigenous people found ways to remove the poison or nasty taste of plant materials. He gave examples of *Manihot esculenta* (cassava) and *Alocasia macrorrhizos*, both staple foods of sub-Saharan Africa that are specially processed to remove the poison before their use as food. Among the Yoruba herbal practitioners of southwestern Nigeria, the knowledge of toxic plants is extensive. Such plants are either avoided in herbal preparations or used in small quantities if they must be used at all. As an example *Euphorbia lateriflora* known to have

toxic latex is collected in the morning and not afternoon (when metabolism is highest) so that the latex will not splash into their eyes. The latex of *E. lateriflora* can cause serious eye problems leading to blindness in case of accidental contact with the eyes. The plant is usually charred before use thus turning the toxic organic materials into inorganic substances. Egunyomi *et al.*, (2005) reported that charring is a method of phytomedicinal preparation in southwestern Nigeria.

In South Africa, *Erythroleum lasianthum* stem bark is known to be highly toxic hence, decoctions of the material is used in small amounts for intestinal spasms (Pujol, 1990). Similarly, *Strychnos henningsii*, which contains strychnine and is highly toxic, is usually taken in small doses for stomach complaints and as a bitter tonic (Watt and Breyer-Brandwijk, 1962, Hutchings, 1996). *Arnica montana* which grows in the mountain regions of Europe and Siberia has been used externally for centuries in parts of the world for aches and rheumatism. However, the internal use to control bleeding is restricted to homeopathy dosages as the plant is potentially toxic (Shealy, 1998).

Although *Parkia biglobosa* is useful to humans both for food and medicine, many authors have reported that the pods contain agents with piscicidal effects (Kela *et al.*, 1989; Abbiw, 1990). According to Campbell-Platt (1980), if green pods rich in the toxic compound, parkine, are crushed and added to water containing fish in the morning by midday, the river will be filled with stunned fish easily caught by hand. The use of *P. biglobosa* greenpods to kill fish does not adversely affect their nutritional value, as both cooking and drying deactivate the poison. An example of unripe fruit being highly toxic is *Blighia sapida*. The fruit is eaten only when ripe, but if the unripe fruit is eaten there is risk of poisoning (Irvine, 1961).

**Detoxification by cooking** - Some plant toxins can be denatured or removed by cooking. Seeds of cotton (*Gossypium barbadense*) are toxic when fresh and used as male contraceptive because they have spermicidal effect. However, the toxicity is removed by cooking so that the cottonseed oil is good for consumption. *Dioscorea antaly*, *D. bulbifera* and *D. hoffa* have edible tubers, but must not be eaten or used medicinally if uncooked, because they are toxic. As reported by Rasoanaivo (1992), the tubers must first be washed thoroughly by repeated maceration and boiled with water before eating.

Castor oil (*Ricinus communis*) seeds are useful for the oil is commercially sold and used as purgatives. Although the fresh seeds contain two highly toxic substances, an alkaloid; ricinine and a lectin, ricin (Merck, 1989, Bruneton, 1995) these are

not present in the oil due to the effect of heat when extracting the oil.

*Jatropha curcas* is a very toxic plant especially if taken in fresh preparations without boiling (Iwu, 1993). Cyanic acid has also been detected in the fruits, roots and bark (Watt and Breyer-Brandwijk, 1962). Since the leaves, bark and root are components of decoctions, cooking must be a factor in removing or reducing the toxicity. Owing to the poisonous nature of the seeds, they have ceased to be used as purgatives. Roasted seeds are however mixed with pepper and Shea butter for the external treatment of guinea worm infestation.

#### **Phytotoxicity tests**

The safety or otherwise of a proven efficacious medicinal plant is ascertained by conducting phytotoxicity tests. Such tests are varied and may be carried out using experimental animals or in mammalian cells or tissues *in vitro*. The literature of medicinal plants has many safety evaluation tests, which have been reported.

Sirajudeen *et al.*, (2006) determined the toxic side effects of aqueous extract of leaves of *Phyllanthus amarus* grown in Malaysia, following oral administration in rats. They reported that acute administration of *P. amarus* extract at a dose of 5g/kg body weight did not produce any signs of toxicity or mortality. The non-toxic nature of *P. amarus* extract administration was confirmed by histological studies (light microscopy, proliferative cell nuclear antigen study and apoptotic study). Thus, no observable changes were found between control and *P. amarus* extract administered rats. The results show that *P. amarus* widely used for varying health problems such as jaundice, malaria, asthenia and appendicitis is non-toxic.

Egunyomi *et al.*, (2011) determined the anti-hyperglycaemic effect of the ethanolic extract of *Ageratum conyzoides* using alloxan-induced diabetic rats. The plant extract had anti-hyperglycaemic effect on each group of diabetic rats as it lowered their Fasting Blood Sugar levels, thus confirming the anti-hyperglycaemic potential of the plant. The pancreas, liver and kidney of the experimental animals were examined histologically to know the effect of the extract on the animals. Although diabetic condition produced necrotic pancreatitis in the pancreas, necrosis in the liver and inflammation in the kidney, the plant extract reduced the level of damage to organs of the treated animals and had no adverse effect on normal animals.

In another study on *Andrographis paniculata*, Umotok (2001) reported the hypoglycaemic activity of the plant using alloxan-induced diabetic rats. The liver, kidney and pancreas of the experimental animals were examined histologically to ascertain if 400mg/kg

of the plant extract was toxic to the organs or not. Although diabetic condition produced nephritis in the kidney, severe necrosis in the pancreas, and cellular congestion of the liver; the plant extract had no adverse effect when administered on normal animals. The extract in fact reduced the level of damage to kidney, liver and pancreas tissues when administered on diabetic rats.

*Persia americana* (avocado) seed derivatives have been reported to display anti-tumour properties in rodents. Avocado possesses antioxidant hepatoprotective and hypo-lipidemic properties. However, the seed and leaves are toxic. At a concentration of 50% dried seed powder killed all the mice used in a study while the leaves caused the death of all the fish in a pond (Wolters Kluwer Health, 2009).

Adedapo *et al.*, (2013) studied the anti-inflammatory and analgesic activities of the aqueous leaf extract of *Lagenaria breviflora* in experimental animals. The fruit of this plant is widely used in West Africa as herbal remedy for digestive disorders, wound antiseptics and human measles. The study validated the basis for traditional use against inflamed purulent wounds swelling and bruises seen in some infectious wounds. Although acute toxicity test revealed that no death was recorded in the control, 200 and 400mg/kg dose animal groups, all mice that received from 800mg/kg dose died. The study was suggestive that the leaves of *L. breviflora* are toxic, hence caution must be exercised in using it as a phytomedicine.

The work of Azuzu and Chineme (1988) on acute toxicity and gastrointestinal irritant effect of *Croton penduliflorus* seed oil in mice is quite informative. *C. penduliflorus* seeds are very effective as purgatives when ingested in a morsel of 'fufu' – a Nigerian dish.

The effect of three dosage levels (250 mg/kg, 600 mg/kg, 800 mg/kg per os) of *C. penduliflorus* seed oil was studied in mice. Histopathological examination of the sacrificed mice revealed that *C. penduliflorus* oil initiated hypersecretions in all segments of the gastro-intestinal tract. It also produced oedema in the stomach and mild inflammatory reactions in the jejunum, ileum and colon. The liver, lung and myocardium were the most affected of the visceral organs when mice were dosed with high levels (600 mg/kg and 800 mg/kg) of *Croton* oil.

*Crescentia cujete* (Calabash tree) is widely employed in the treatment of skin infections, having a rather limited medicinal use as an oral drug. In the Caribbean the fruit pulp is used as an analgesic anti-inflammatory, antitumour, purgative and haematoma (Weniger and Robineau (1988). The fruit pulp contains hydrocyanic acid hence considered

dangerous. Also the pulp has been shown to be carcinogenic in the rat by induction of neoplasms (Contreras and Zolla, 1982).

*Holarrhena floribunda* in parts of Africa, the stem bark macerated in palm wine is used in the treatment of dysentery and fever. Also leaf, bark and roots are used in the treatment of malaria. Conessine, an active constituent of the species was clinically tested on patients with intestinal and hepatic amebiasis and found to be good. However the use of conessine for treating dysentery was discontinued due to systemic toxicity causing neurological complications. Conessine has since been used externally in the treatment of *Ttichomonas vaginalis* (Godet, 1950).

*Morinda lucida* (Brimstone tree); All parts of this plant are used as laxative. A weak decoction of the stem bark is administered for treating severe jaundice. Ajaiyeoba *et al.*, (2006b), reported that the stem bark and leaf extracts of *M. lucida* a popular antimalarial remedy in southern Nigeria, displayed high cytotoxicity with LC<sub>50</sub> values of 1.1 and 2.6µg/mL respectively; using the brine shrimp lethality assay.

The examples of phytotoxicity tests reviewed above show that scientists and herbal practitioners continually investigate the safety of herbs found to have remedies for health problems. However, Treasure (2008) is of the view that scientific studies with isolated compounds from herbs, tests on non-human or even non-mammalian organisms or *in vitro*, with doses ten or even hundreds of times the equivalent medicinal dose have no arguable extrapolation to the clinical situation using whole herb at appropriate medicinal doses.

### 3. Conclusion

The definition of the word "toxic" is ultimately a matter of viewpoint. Many ordinary foods contain constituents that could be regarded as poisonous, e.g. alpha gliadin produced by gluten in wheat, oats and rye, the cyanogenic glycosides in many fruit seeds, the thiocyanates of the brassica vegetables, alkaloids of the solanaceae, and lectins of many pulses including soya and red kidney beans. Nonetheless these foods are generally regarded as safe. Similarly both water and oxygen can kill in excessive amounts, so quantity is often an important consideration. In practice however, three groups of herbs can be identified from a safety point of view.

First, there are a handful of herbs that contain near pharmaceutical concentrations of poisonous constituents, which should on no account be taken internally by unqualified persons except in homeopathic potencies i.e. very minute quantities. Examples are *Arnica spp.*, *Digitalis spp.* and *Atropa belladonna*. In many countries, availability of these herbs is limited by law. Secondly are herbs of

powerful actions often causing nausea or vomiting. They are perfectly safe when used under appropriate conditions. Some of these herbs are restricted in some countries but freely available in others. *Lobelia*, *Eonymus spp* and *Ephedra spp*. are examples.

The third group of herbs consists of medicinal plants, which have been alleged with some scientific support, to exhibit specific kinds of toxicity. The best known is the hepatotoxicity of pyrrolizidine alkaloid containing plants such as *Symphytum spp*, *Dryopteris*, *Viscum* and *Coryanthe (Pausynistalia johimbe)*. Although some of the evidences on these plants are contentious, lay users are advised to exercise caution in the consumption of the herbs.

Phytotoxic plants are good sources of antitumor compounds, immunotoxines, steroid and non-steroid cardioactive drugs. They are therefore useful to humankind. Herbal medicine practitioners and scientists are aware of the potential toxicity of some medicinal plants and they have devised various methods of eliminating the toxins or avoiding the toxic parts of the plants. Phytotoxicity tests are also conducted to ascertain the toxicity or otherwise of medicinal plants. In the light of this, phytotoxicity should not be a negative factor in herbal medicine. Rather, researchers should continue to study more plants for better understanding.

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