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Review

Evaluating the Safety and Conservation of Medicinal Plants: A Review

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The use of medicinal plants as raw materials in the production of new drugs is ever increasing because of their potentials in combating the problem of drug resistance in micro-organisms. Demand for medicinal plants is increasing in both developing and developed countries. Research on medicinal plants is one of the leading areas of research globally. However, there is a need to pay closer attention to the issue of bioactivity-safety evaluation and conservation of medicinal plants. Although some of the screening tests on medicinal plants are performed *in vitro*, the fact still remains that the ultimate aim of the researcher is to use the medicinal plants to treat diseases in humans and animals, who has to take the product orally or through other means into the system. There is also the need to conserve the medicinal plants to prevent their total extinction from the natural flora. This is because the expanding trade in medicinal plants has serious implications on the survival of several plant species, with many under serious threat to become extinct. The aim of this review is to justify and emphasize the need for the bioactivity-safety evaluation and conservation of the medicinal plants.

Key words: Biosafety, evaluation, conservation, medicinal plants.

INTRODUCTION

Medicinal plants are plants containing inherent active ingredients used to cure disease or relieve pain (Okigbo et al., 2008). The use of traditional medicines and medici- nal plants in most developing countries as therapeutic agents for the maintenance of good health has been widely observed (UNESCO, 1996). The World Health Organization estimated that 80% of the populations of developing countries rely on traditional medicines, mostly plant drugs, for their primary health care needs (Schmincke, 2003). Medicinal plants represent a consis- tent part of the natural biodiversity endowment of many countries in Africa (Okigbo et al., 2008). Also, modern pharmacopoeia still contains at least 25% drugs derived from plants and many others which are synthetic analo- gues built on prototype compounds isolated from plants. Interest in medicinal plants as a re-emerging health aid has been fuelled by the rising costs of prescription drugs in the maintenance of personal health and well being and the bioprospecting of new plant-derived drugs (Lucy and Edgar, 1999). Furthermore, an increasing reliance on the use of medicinal plants in the industrialized societies has been traced to the extraction and development of several drugs and chemotherapeutics from these plants as well as from traditionally used herbal remedies (UNESCO, 1998). The medicinal properties of plants could be based on the antioxidant, antimicrobial antipyretic effects of the phytochemicals in them (Cowman, 1999; Adesokan et al., 2008).

Injuries to the liver associated with marked alteration in liver chemistry have been treated at various times using crude extracts of plants (Bhandarkar and Khan, 2004; Raja et al., 2007). In the absence of reliable liver protect- tive drugs in allopathic medical practices, herbs play an important role in the management of various liver dis- orders (Sadeghi et al., 2008). A number of plants have shown hepatoprotective property (Scott- Luper, 1998; Ulican et al., 2003; Sethuraman et al., 2003; Hewawasam et al., 2004; Aniya et al., 2005).

Traditionally, herbs have been considered to be non- toxic and have been used for treating various problems by the general public ‘‘and/or’’ traditional medicine doc- tors worldwide (Oduola et al., 2007). Although, the litera- ture has documented several toxicity resulting from the use of herbs on many occasions, still the potential toxicity of herbs has not been recognized by the general public or by professional groups of traditional medicine (Jou-fang, 1994; O’Hara et al., 1998). The use of medicinal plants

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as raw materials in the production of drugs is again gaining popularity (Olaleye, 2007). Okigbo et al. (2008) reported the need for effective conservative strategies for medicinal plants.

The aim of this review is to emphasize the need to pay closer attention to two key and vital issues of bioactivity-safety evaluation and conservation of medicinal plants due to increase in their use as potential alternatives to combat the problem of drug resistance by micro-organi- sms and as cheaper and safer alternatives to chemical drugs.

PHYTOCHEMICAL SCREENING OF MEDICINAL PLANTS

Phytochemical progress has been aided enormously by the development of rapid and accurate methods of screening plants for particular chemicals (Banso and Adeyemo, 2007). These procedures have shown that many substances originally thought to be rather rare in occurrence are of almost universal distribution in the plant kingdom. Medicinal plants contain physiologically active principles that over the years have been exploited in traditional medicine for the treatment of various ail- ments (Adebajo et al., 1983). The drugs contained in medicinal plants are known as active principles. Cow- mann, (1999) and Banso and Olutimayin, (2001) reported that plants contain a wide variety of active principles. There is a reasonable likelihood that medicinal plants with a long history of human use will ultimately yield novel drug prototypes (Eshrat and Hussain, 2002).

There are several standard methods used for the phytochemical screening of medicinal plants. They are as described for alkaloids (Harborne, 1973), steroids and phlobatannins (Trease and Evans, 1989), phenolics and flavonoids (Awe and Sodipo, 2001), saponins and cardiac glycosides (Sofowora, 1993), tannins (Odebiyi and Sofowora, 1978). Methods for quantitative analysis of phytochemicals are as described for phenolics (Edeoga et al., 2005), flavonoids (Boham and Kocipal-Abyazan, 1974), alkaloid (Harborne, 1973), saponins (Obadoni and Ochuko, 2001) and glycosides (El-Olemy et al., 1994).

BIOLOGICAL ACTIVITIES OF PHYTOCHEMICALS - AN OVERVIEW

The most commonly encountered secondary metabolites of plants (phytochemicals) are saponins, tannins, flavornoids, alkaloids, anthraquinones, cardiac glycosides and cyanogenic glycosides. The pharmacological and other beneficial effects of antinutritional factors in plants have been reviewed by Soetan (2008). The presence of these secondary metabolites in plants probably explains the various uses of plants for traditional medicine.

Saponins are glycosides of both triterpenes and steroids having hypotensive and cardiac depressant properties (Olaleye, 2007). Saponins bind to cholesterol to form insoluble complexes. Dietary saponins in the gut of monogastric combine with endogenous cholesterol excreted via the bile. This prevents cholesterol reabsorption and results in a reduction of serum cholesterol (Cheeke, 1971). Saponins have been found to be potentially useful for the treatment of hypercholesterolaemia which sug- gests that saponins might be acting by interfering with intestinal absorption of cholesterol (Malinow et al., 1977a, b).

Tannins are complex phenolic polymers which can bind to proteins and carbohydrates resulting in reduction in digestibility of these macromolecules and thus inhibition of microbial growth (Nwogu et al., 2008; Bulter, 1989). Tannins from the bark, roots and other parts of many plants especially Euphorbiaceae are used to treat cells that have gone neoplastic (Duke and Wain, 1981). Tan- nins are reported to have astringent properties on mu- cous membranes (Egunyomi et al., 2009).

Flavonoids are a group of phytochemicals found in varying amounts in foods and medicinal plants which have been shown to exert potent anti-oxidant activity against the superoxide radical (Hertog et al., 1993). Its consumption has been documented not to be associated with mortality due to coronary heart disease. This may be as a result of its antioxidant activity and subsequent inhi- bitions of low density lipoproteins (LDL) oxidation known to have been attributed to the dietary and supplemental intake of flavonoids and other micronutrients. Epidemio- logic studies indicate an inverse relationship between intake of dietary flavonoids and coronary artherosclerotic disease (Knekt et al., 1996).

Alkaloids are basic natural products occurring primarily in many plants. They are generally found in the form of salts with organic acids and they are haemolytically active and are also toxic to micro-organisms (Cheese, 1989). Alkaloids, comprising a large group of nitrogenous compounds are widely used as therapeutic agents in the management of cancer (Caner and Horwitz, 1990; Noble, 1990). Alkaloids also interfere with cell division. Chewonarin et al. (1999), isolated an alkaloid from *Hibiscus sabdariffa* and demonstrated its ability to prevent mutagenesis.

Cardiac glycosides are cardioactive compounds belonging to triterpenoids class of compounds (Brian et al., 1985). Their inherent activity resides in the aglycone portions of their sugar attachment. Their clinical effects in cases of congestive heart failure are to increase the force of myocardiac contraction (Brian et al., 1985). They exert their hypotensive effect by inhibiting Na^+-K^+ ATPase. They also act directly on the smooth muscle of the vas- cular system. They exert a number of effects on neural tissue and thus indirectly influence the mechanical and electrical activities of the heart and modify vascular resistance and capacitance (Olaleye, 2007).

THE NEED FOR BIOACTIVITY-SAFETY EVALUATION OF MEDICINAL PLANTS

The incidence of renal disease is increasing dramatically

and has become a significant public health problem both economically and medically (Salako, 2005). Several studies (Bwititi et al., 2000; Ijeh and Agbo, 2006) have indicated the possibility that the use of plant extracts in high doses could lead to toxic injury to the kidneys which interfere with renal tubular functions and induce acute renal failure. Folkloric history has indicated attempts made by inhabitants using plant-derived recipes in parts of Nigeria to treat what they described as ‘‘fever of crisis’’, shifting joint pains, exacerbations especially during rainy seasons and ‘‘constant abnormality of the blood’’ though relatively few have been validated scientifically (Egunyomi et al., 2009). This calls for a need to further investigate safer concentration of ethnomedicinal preparations in view of the increasing reports of acute renal failure (Ijeh and Ukweni, 2007).

The liver plays a significant role in the body as the organ responsible for metabolism of toxic substances that enter the body (Alisi et al., 2008). The major functions of the liver can be detrimentally altered by liver injury result- ing from acute or chronic exposure to toxicants or by situations affecting both ß-oxidation and the respiratory chain enzymes (Alisi et al., 2008). Serum enzyme active- ties are used as indicators of chemically-induced liver da- mage (Drotman and Lawhorn, 1978). Hepatotoxicity has been viewed as liver injury associated with impaired liver function caused by exposure to drug or other noninfectious agents (Navarro, 2006).

Patients are often unaware of the important similarities and differences between medicinal herbs and approved medications (Oduola et al., 2007). Some mistakenly think of herbs as natural alternative to chemicals, failing to recognize that herbs are composed of bioactive chemicals some of which may be toxic. Also, patients are often unaware that about 25% of modern pharmaceutical drugs have botanical origins, such as digoxin from foxglove, morphine from poppies, aspirin from willow bark and tamoxifen from the pacific yew tree (Tyler, 1994). For example, *Allium* vegetables, including garlic are used throughout the world for their sensory characteristics as well as for their apparent health benefits (Sherine and Safinaz, 2008). However, high consumption of crushed raw garlic was reported to produce many undesirable clinical effects such as anaemia, weight loss, growth retardation and decrease of caecal microflora and serum protein (Moihara et al., 2006).

Some herbage species such as rhubarb, spinach and amaranthus specie contain high levels of oxalic acid (oxalates). Oxalic acid, like phytic acid (phytates), has the ability to bind some divalent metals such as calcium and magnesium thereby interfering with their metabolism. According to Blood and Henderson (1974), the ingestion of an excessive amount of oxalate could cause gastrointestinal irritation, blockage of the renal tubules by calcium oxalate crystals, development of urinary calculi, hypocalcaemia, muscular weakness or paralysis. Plants generally tend to accumulate high oxalate levels during the early stages of growth. Xerophytic plants often tend to have high concentrations of oxalates.

The adoption of crude extracts of plants, such as infusions, for self-medication by the general public (Houghton, 1995), has arisen in the possibility that the impact of several diseases may be either ameliorated or prevented by improving the dietary intake of natural nutrients (Haslam, 1996).

THE NEED FOR CONSERVATION OF MEDICINAL PLANTS

Demand for medicinal plants is increasing in both developing and developed countries and surprisingly, the bulk of the material traded is still from wild harvested sources on forest lands and only a very small number of species are cultivated (Schmincke, 2003). The expanding trade in medicinal plants has serious implications on the sur-vival of several plant species, with many under threat to become extinct. Okigbo et al., (2008) reported the need for effective conservation strategies for medicinal plants. They stated that saving Africa’s medicinal plant resources from extinction calls for intensive management and conservation through more research and increased level of public awareness about these vanishing heritage.

Many medicinal plants are fast disappearing and some are in danger of extinction. There is a great need to conserve medicinal plants because they contain highly bioactive components which can be developed into pharmacologically-active agents. Some of the pharmacological and other beneficial effects of anti-nutritional factors in plants have been reviewed by Soetan, (2008). Many signs reveal that medicinal plants are gradually facing extincttion. They are (i). People walk long distances to collect them. (ii).Some medicinal plants are no longer found. (iii). What used to be a thick forest of diverse plant species is reduced to bush and areas that have diverse floraare fast disappearing. (iv). Many medicinal plants are not maturing and seeding because the young plants are being harvested before they mature (ITDG and IIRR, 1996). The causes have been attributed to a number of factors like rising number of human and animal population which cause pressure on plant survival. Human agricultural activities result in clearing of natural habitats for farming and grazing, trees are felled for timber, charcoal and other commercial uses and lands are used in a way that are not sustainable. Others are inappropriate ways of harvesting medicinal plants, like removing all the bark or uprooting the whole plant without leaving part to regrow, bush burning and commercialization of plant sources, lack of awareness that plants are sources of the conventional medicine, povery in arid or semi-arid areas and religious factors. For example, some western religions view the use of traditional medicine as a form of evil worship or withcraft (ITDG and IIRR, 1996).

As a result of the numerous potentials of medicinal plants in the combating of drug resistance by micro-

organisms, strict conservation measures should be put in place to prevent the total extinction of the medicinal plants from the natural flora. They are medicinal plants should be harvested in the proper way to avoid serious damage. Control of overgrazing and deforestation. This could be done by practicing rotational grazing so as to allow plants to rejuvenate/regrow. The Government can reserve some areas strictly for medicinal plants and pre- vent encroachment by undesirable plant species. Indivi- dual small-scale cultivation of medicinal plants should also be encouraged as is done for tree planting that is, medicinal plants should be incorporated in agroforestry and reafforestation programmes. Mini-forests on indivi- dual farms should be maintained to increase biodiversity. Governments should also have reserve stocks of medicinal plants and encourage community actions to collect, retrieve and plant seeds of medicinal plants.

The removal and export of rare and scarce medicinal plants should be discouraged/prohibited by legislation. The intellectual property rights of practitioners with great discoveries in medicinal plants should be protected so as to encourage them. Scientists and toxicologists should investigate the active components of certain medicinal plants viz-a-viz their toxic potentials so as to determine their safe level of consumption. Public education on medicinal plants as a potential source of modern medicine should be promoted in schools and tertiary institutions of learning.

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