Therapeutic Utility, Constituents and Toxicity of Some Medicinal Plants: A Review

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ABSTRACT. Man has always made use of flora to alleviate suffering and disease. This review presents information on the various therapeutic applications of plants used in traditional medicine, their active principles and observed side effects in animals and human beings. We also focus on the gaps in our knowledge about plant toxicoses that require scientific investigations and offer some logical conclusions.

There is a growing awareness by scientific and medical communities of the importance of medicinal plants in the health care systems of many developing countries. Scientific projects have been launched to explain the curative phenomena associated with traditional herbal remedies and to identify simple technology that could produce drugs and therapeutic agents at a low cost to alleviate suffering and disease. Plants contain a number of chemical constituents and are employed for different medicinal purposes; however, over-dosage of plant products containing medicinal compounds may cause toxic reactions when introduced into animals or human beings.

CARDIOVASCULAR AND NERVOUS ACTIVITY

Rauvolfia vomitoria (Apocynaceae) contains the hypotensive alkaloids raumitorine, reserpine and reserviline (1,2). The alkaloid reserpine possesses hypotensive effects in cases of hypertension and sedative and tranquillizing effects, but it is not hypnotic (3). It has been suggested that the alkaloid acts through the central nervous system as an anti-metabolite of serotonin and catecholamines, decreasing considerably the serotonin contents of the nerve centers. This explains why next to its use as a hypotensive agent in arterial hypertension reserpine is currently used as a tranquillizer in anxiety states and in psychosis with hallucinations and delirium (2,4).

The root of Cryptolepis sanguinolenta (Periplocaceae) contains a quinoline-derived indole alkaloid, cryptolepine, which has a marked hypothermic effect and induces prolonged and important vasodilatation causing marked and durable hypotension (5-7).

Morinda lucida (Rubiaceae) contains tannins, methylanthraquinones, and a heteroside, morindin. It is used for the treatment and prevention of hypertension and its cerebral complications (8,9).

The seeds of Pergularia daemia (Asclepiadaceae) contain uzarigenin, coroglaucigenin, calactin, calotropin, other cardenolides, and a bitter resin, pergularin, and have a cardiotoxic action (10,11). It has been suggested that the plant seed action on the uterus is similar to that of pituitrin and is not inhibited by progesterone (12,13).

Many cultivated plants, such as Citrus limonum, C decumana and C aurantium (Rutaceae), are extensively used for promoting vascular resistance (vitamin-P action) due to their content of citroflavanoids, mixtures of hesperidoside, naringoside and eryodictyoside (13,14). The peel also contains essential oils and vitamin C. Citroflavanoids control the permeability of blood vessels by decreasing the porosity of their walls and thus improving the exchange of liquids and the diffusion of proteins. They are used in the treatment of varicose veins, hemorrhoids and edema (15,16).

Lawsonia inermis (Lytthraceae) contains lawsone, a 2-hydroxy-1,4-naphthoquinone, resin and hennatannin. It has slight vitamin-K action and powerful bactericidal effects comparable to those of penicillin and sulphonamides (17,18).

Certain plant species, such as Strophanthus hispidus, S gracilis and S gratus (Apocynaceae), are important cardiotonics by virtue of their content of steroid heteroside. Strophanthin and ouabain were isolated and used in the treatment of cardiac insufficiencies in preference to digitalis when a more rapid action was required (19,20). The toxicity of ouabain in dogs is characterized by hypertension, tachycardia and heart arrest (2).

Anti-arrhythmic agents or cardiac depressants are present in some species of plants in the families Papaveraceae, Rutaceae and Apocynaceae. For example, Argemone mexicana (Papaveraceae) is an important African plant and is used by Nigerians and Senegalese for its diuretic, sedative and cholagogic properties (21). The seeds have a cannabis-like effect, and the plant juice and flowers are famous for their narcotic properties (1,22). Numerous alkaloids, such as berberine, protopine, coptisine, chelerythrine, sanguinarine and argemonine, were isolated from different parts of the plant (1,23). Berberine is relatively non-toxic to cats and dogs and has a depressant and vasodilating action on the heart and is a hypnotic and sedative for convulsions and spasmodic conditions (24,25).

Allium sativum, Garlic (Lilaceae) contains allicin, a hypotensive diallyl disulphide oxide, and is used as an anti-diabetic agent and for its bacteriostatic action (21, 26,27).

Solanum nigrum and Withania somnifera, both of the family Solanaceae, have anti-neuralgic

and slight narcotic actions due to their content of the alkaloids solanine and withasomnine, respectively (13,28). In West Africa and India, the berries of S nigrum are used in the treatment of fever, diarrhea and eye diseases, and the leaves or their decoctions are diuretic with anti-epileptic actions. The juice is said to be diuretic and emmenagogic in addition to being useful in local application to painful swellings, abscesses and ulcers (1,21,29).

In some African countries, including the Sudan, Datura species such as D stramonium, D metel and D innoxia (Solanaceae) are used in native beer, palm wine or "Sudanese merrisa" to add a narcotic or stupefying effect, and the decoction of the seeds is used as a remedy for ocular conditions due to the presence of the parasympathetic alkaloids, atropine, hyoscine and hyoscyamine (30,31). The alkaloids cause pronounced mydriasis due to paralysis of the circular muscles of the eye and were added to asthma powders and sea sickness and anti-chronic bronchitis preparations (2,32). The toxicity of D stramonium to young ruminants has been described (33).

The use of plants for producing central nervous system stimulation is well known and is attributed to the presence of active constituents, such as caffeine, theobromine and theophylline in Cola nitida and C acuminata (Sterculiaceae), camphor in Ocimum canum (Labiatae), and the alkaloids dihydrodioscorine in Dioscorea dumetorum (Dioscoreaceae) and ellipticine and strychnine in the loganiaceous Strychnos spinosa (3,34,35).

ANTI-BACTERIAL, ANTI-PROTOZOAL AND ANTI-MYCOTIC ACTIVITY

A concise summary of the anti-bacterial, anti-protozoal and anti-fungal plants has been written (2). The major compounds in these plants are phenols from Anacardium occidentale (Anacardiaceae), quinones from Drosera indica (Droseraceae), acids from Acacia farnesiana (Mimoscaceae), alkaloids from Argemone mexicana (Papaveraceae), flavanoids from Canscora decussta (Gentianaceae), terpenoids from Borreria verticillata (Rubiaceae), and proteolytic enzymes from Calotropis procera (Asclepiadaceae).

The anti-fungal and anti-bacterial properties of Cassia species towards Aspergillus niger, A flavus, Trichophyton mentagrophytes, Penicillium chrysogenum, Staphylococcus aureus, Bacillus subtlis, B proteus and Vibrio cholerae has been reported (36-40). The toxic effects of C senna, C italica and C occidentalis in small ruminants has also been described (41-43).

ANTHELMINTIC ACTIVITY

Oliver-Bever (2) have a brief account of West Africa medicinal plants that can destroy helminthic parasites through lysis; for example, those containing proteolytic enzymes like bromelain from Ananas comosus (Bromeliaceae), calotropain from Calotropis procera, and papain from Carica papaya (Caricaceae) can digest worms. The same author also indicated that other plants act specifically on cestodes; for example, those containing cucurbitine from Cucurbita pepo (Cucurbitaceae), saponins from Opilia celtidifolia (Opiliaceae), and embelin from Embelia schimperi (Myrsinaceae).

ESTROGENIC ACTIVITY

A number of medicinal plants--Phoenix dactylifera (Palmae), Triticum aestivum (Gramineae), Phaseolus vulgaris (Fabaceae), and Cyperus esculentus (Cyperaceae)--contain estrone and 17α estradiol (44-46).

GALACTAGOGIC ACTIVITY

Some plants can act as galactagogues for women and cows. Those containing the glycoside aucubin from Verbena officinalis (Verbenaceae), dihydroacetone from Sarcostemma viminale (Asclepiadaceae) and the hydroxybenzoic ester agnûside from the verbenaceous plant Vitex agnus castus (1,47) are examples.

EFFECTS ON THYROID GLAND

Certain plants can reduce hyperactivity of the thyroid gland. Some of these are those containing the glycoside of 1,5-vinyl-2-thio-oxazolidone from Brassica oleraceae and B napa (Cruciferae), arachidoside and glycosides from Arachis hypogaea (Fabaceae), and thiocyanates from linamarin in the euphorbiaceous plant, Manihot esculenta, Cassava (48-51). Consumption of millet (Pennisetum typhoides) by inhabitants of Southern Darfur State in the Sudan leads to the development of goiter, but this has not been confirmed by experiments with animals in close association with human beings.

ANTI-DIABETIC ACTIVITY

Momordica charantia and M faetida (Cucurbitaceae), Catharanthus roseus (Apocynaceae) and Allium cepa, onion (Liliaceae) are used in African countries as a remedy for diabetes mellitus by virtue of their contents of the phytosterin glucoside, leurosine, vindoline and vendolinine alkaloids, and organic sulphur compounds (52-55).

INSECTICIDAL, CUTANEOUS AND OTHER ACTIVITY

Azadirachta indica A Juss (Meliaceae) is locally known as Neem tree and its products are extensively used by Africans, Asians and South Americans to alleviate suffering and disease. The seed is used as an insecticide in buildings and stored cereal grains and as a detergent for the removal of lice from the head (56-58).

In Asia Neem seed oil is used as a repellent against insect pests in animal sheds in form of a fumigant or smear on wooden fences (59), as an anthelmintic and parasiticide for scabies, ringworm and other skin conditions, and in the treatment of rheumatism and malaria (60-62). The A indica bark product decoction is used in the treatment

pyrexia and influenza to relieve muscular pains (63). The major active principles in Neem seeds are azadirachtin, vepaol, isovepaol, nimbin, nimbidin and gedunin (64-68).

Brown Hisex chicks fed Azadirachta indica fruits or leaves at 5 or 10% of the basic ration for 4 w developed yellow discoloration of the shanks and combs, depressions in body weight gain and efficiency of food utilization, hepatonephropathy, increased serum lactic dehydrogenase, aspartate transaminase, alkaline phosphatase and uric acid concentrations, and decreased total serum protein levels (69).

The fruit of Balanites aegyptiaca (Balanitaceae), locally known as Higlig tree or La lobe, is used as a purgative in native medicines and as a remedy for colds in Chad. The fruit and bark are a fish poison and molluscicide in Tanganyika and the oil is used as a remedy for syphilis and sleeping sickness in Uganda (1,70). Abu El Futuh (71) reported the healing of lesions caused by cutaneous Leishmaniasis in the Sudan following the topical application of Balanites saponins in the form of a cream.

Dawidar and Fayez (72) and Varshney and Vyas (73) investigated the saponin content of the fruit pulp, seed kernel, root wood and stem wood of B aegyptiaca and B roxburghii and were able to isolate a number of diosgenin saponins in a pure state. In addition to the balanitisins A, B, C, D and E being isolated from the fruit pulp, balanitisins F and G were isolated from the seed, and balanitisin 1 was isolated from the stem wood. A detailed description of the effects of B aegyptiaca kernel saponin given by different routes of administration to chicks was reported by Nakhla, Mohamed, Abu El Futuh and Adam (74).

The biological activity of Cassia italica, a member of the family Caesalpiniaceae, is comparable to that of the medicinal Cassia species, such as C senna, C alata, C occidentalis and C tora. The leaf, seed and fruit are used as a purgative, diuretic and febrifuge and also as an eye lotion and remedy for skin conditions (38,40,75,76). The medicinal Cassia species contain rhein, aloe-emodin, the chrysophanic acid anthrone, free kaempferol, physcion, α-3-sitosterol and a xanthone (1,2,42).

CONCLUSIONS

The knowledge of the properties of medicinal plants has likely been passed on to natives by their elders or is based on experience. Efforts could be constructively exerted to make Third World countries self-supporting by encouraging the production, collection and manufacture of local materia medica. However, many cases of poisoning by medicinal plants result from over-dosage because, in general, there is no standardized dosage system in traditional medical practice. Some plants used in folk medicine have such narrow therapeutic indices that their use is dangerous and should be carefully researched.

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DRUGS AND BREASTFEEDING: A RISK/BENEFIT EVALUATION

This publication documents the extent to which more than 200 drugs pass into the mother's breast milk and are ingested by the breastfed infant. It is a compilation of current data in the medical literature.

The decision whether or not a breast-feeding mother should take a certain medication is very complicated. An important aspect of the updated publication is the clinical evaluation process devised and adapted by the author. The process provides a step-by-step method to individualize each case, thus allowing the physician to provide the mother with a desired therapeutic effect while exposing the baby to the least possible risk.

The document is available from **Veterinary and Human Toxicology** as Supplement 1 to Volume 36, 1994 for $20.00 per copy, prepaid. Orders should be sent to Veterinary and Human Toxicology, Comparative Toxicology Laboratories, Kansas State University-VCS, Manhattan, KS 66506-5606 USA. Postage and handling costs will be added to orders not accompanied by payment.

PESTICIDE ILLNESSES MORE COMMON OUTSIDE AGRICULTURE

Although most pesticide use is in agriculture, more than two-thirds of occupational pesticide illness cases in California during 1991 were from nonagricultural uses, according to a report released in May by the Cal/EPA Department of Pesticide Regulation. Of the 1,804 reported illnesses with a confirmed or potential link to pesticide use that year, 1,675 occurred on the job. Illnesses occurring outside the workplace, however, are probably more seriously under reported. Nonagricultural pesticide illnesses typically were caused by exposure to disinfectants in restaurants, janitorial companies, municipal water treatment plants, swimming pools, and hospitals. The two deaths in 1991 related to pesticide exposure were both cases in which the victims entered locked buildings where signs had been posted warning that the structure was being fumigated with methyl bromide.

Pesticide Coordinator Report,
Washington, DC