The impediments preventing India from becoming a herbal giant

India is on the threshold of a herbal revolution. With the rich wealth of herbs, we can command the world herbal scene. But there are so many obstacles we have to cross before we become a superpower in the herbal scene.

The chemistry of medicinal plants assumes great significance these days. When one wants to elevate the complementary alternative medicine (CAM) to the level of tested-proved Western medicine, the most important single component coming to the fore is the active principle. The knowledge of active components, their chemical nature, mode of action, limitations, etc. will reveal the properties of the drugs and elevate CAM to a legitimate branch of science.

Every part of plant exhibits one or more medicinal properties, same or different from the action of other parts of the same plant. But the data available may only be of a single part of the plant, may be of the root, leaves or fruits. For certain plants, nothing is known about their chemical constituents. Another problem lies in the pharmacological activity of the identified compound. The major compound, rather the identified compound, need not be the active compound. For example, vincristine/vinblastine forms a minor component of the alkaloids of *Catharanthus roseus*. It is also to be noted that the original extract of *C. roseus* never exhibited any antileukaemic property. In my opinion, each and every component in an extract may have a role (major/minor) in drug action. To support this let me state a few facts. An aqueous extract may contain hundreds of compounds, including many sugars, oligosaccharides, alcohols, etc., which are essentially the raw materials with which our body is made of. When we take a decoction as medicine our body is provided with a plethora of compounds, useful for repair and maintenance of its many systems. All metabolic pathways get a boost by this supply of chemicals. Some of the phenols are excellent antioxidants. The antimicrobials (most of the phenolics, sulphides, etc.) may provide a microbe-free environment within the body, so that the tissues are protected from invaders. It is interesting to note that it is the polysaccharide fraction of Calendula which showed anti-tumour and *in vitro* immunostimulating activity[1]. Therefore, with a continuous dosage of large amounts of raw materials/antioxidants/antimicrobials for a long period (all herbal medicines need a longer span than their allopathic counterparts), all the functions/pathways of the body are set on track once again. Thus after herbal treatment the patient comes out healthier, in sharp contrast with other acclaimed systems of medicine.

Chemical literature on medicinal plants shows that every plant, for which data are available, contains some alkaloid, saponin or steroid. There is widespread assumption that only these compounds are 'active'. Though certain other compounds are reported, they are only cursorily mentioned. Phenolics are the most despised group. I had analysed more than 200 medicinal plants for their leaf phenolics in various chemotaxonomic programmes. Only a few of them have been cited in books. This is due to the age-old concept that phenolics are waste products. But in plants phenolics are the best survival tools, and contribute greatly to the success of the plant in an ecosystem. These compounds may exert similar roles in the animal system also. Emphasis of antioxidants in the system (all the phenols and polyphenols are excellent antioxidants) and the emerging data on the healing property of various phenolics such as their antitumour (quercetin and genistein), anti-inflammatory (syringic and sinapic acids); cardiotonic, increasing vision and cataract-delaying (anthocyanins); blood thinning (procyanidins and tannins); wound-healing (phenolics); antiarthritic properties (gingerols)[2] to cite a few, coupled with their antimicrobial and antioxidant properties, elevate these compounds as the most highly active compounds in the human body. As recent researches advocate enriching the body with antioxidants for a healthy life[3], these compounds in medicinal plants assume a greater role. And there is no plant/plant part without phenolics! By ignoring them we are closing our eyes to one of the most beneficial groups of compounds in nature. Less than 2% of our medicinal plants are studied for their phenolic constituents, which are invariably present in all medicinal plants and are taken by all patients who undergo herbal therapy.

A lacuna in medicinal plant research is data on constituents. Most of the data published before 1980 were by organic chemists who did not realize the necessity of authentic plant specimens. A guestimate says that more than 60% of these reports are based on wrong specimens/adulterated specimens procured from the market (Chopra[4] confirms that more than 80% of plant material available as drug is fake). Hence when we see chemical reports of the same plant from two sources, they vary greatly. In 1975, asiaticoside was the major compound in *Centella*, but in 1998 it was madecassocide. Same is the case with *Asparagus*, *Garlic*, *Alangium*, *Datura*, etc. Changes due to geographical region were not assessed. Only recently, reputed journals insist on referring to the authentic herbarium specimen of the plant screened. It is now necessary that all our medicinal plants are to be screened afresh to assertain their chemical content.

Another peculiar feature of medicinal plants is that different parts of a single plant, say bark (root or stem), leaves, flowers, fruits or seeds are used to cure different ailments. In *C. roseus*, leaves are said to be hypoglycemic, flowers are considered hypotensive and roots are said to be anticancerous. Few medicinal plants are studied for their chemical spectra in various organs. Different organs of the same plant may have some common entites, but they may have specific chemical identities also. In cases where different plants are used as ayurvedic drugs in various parts of the country, all the plants are to be studied for their chemical and pharmacognostic characters. There are at least four plants used as 'shankhapushpi' in various parts of the country; *Canscora decurrens* (central India), *Convolvulus prostratus* (western India), *Clitoria ternatea* (eastern India) and *Evolvulus alsinoides* (western and northern India). There are places where *Cheilanthes farinosa*, a fern, is used as shankhapushpi. It is to be remembered that, barring one, others are genuine drugs. Same is the case for 'ananthamool' (*Hemidesmus indicus*, *Cryptolepis buchanani*, *Decalepis hamiltonii* and *Ichnocarpus frutescens*).

Absence of biomarkers in the commercial scene and shelf-life of compounds are other problems to be tackled.

Confusion regarding botanical names (the botanical name is the legal name of a plant on which patenting has to be done) is another daunting problem. The multiplicity of names for a single plant also confuses people. In such instances the correct name is judged by the 'rule of priority' of International Code of Botanical Nomenclature, accepted by all the countries of the world. Thus *Hydrocotyle asiatica* is now *Centella asiatica* and *Hygrophila spinosa* is *Asteracantha longifolia*. If we do not know the correct legal name, we may lose a number of patents.

Much is to be desired regarding the harvesting, storage and extraction of medicinal plants. A recent controversy on kava-kava needs to be cited. Kava-kava is a traditional beverage in the South Pacific prepared by fermenting the roots of *Piper methysticum* in water. Since the active components are kava lactones, standardized extracts of kava-kava are prepared in Europe by extracting the roots in acetone. These extracts also led to many serious health problems and even to death. It has now been found that glutathione (a tripeptide) which is also extracted with kava lactones in traditional aqueous preparations, reduces the toxicity of kava lactones by the Michael reaction in which the lactone ring is opened, rendering the kava extracts non toxic[5]. This clearly emphasizes the correct extraction procedures to be followed for a drug.

We have to take the medicinal plant scenario seriously in our country. With WTO regime around the corner, if we do not hurry, we may have no other option but to buy 'Chawanprash' from a licensed Korean/Japanese manufacturer, who is quick enough to patent the same at his own cost.

1. Varljen, K. *et al.*, *Phytochemistry*, 1989, **28**, 2379.
2. Duke, J. A., *Green Pharmacy*, Rodale Press, Pennsylvania, 1997.
3. Tiwari, A. K., *Curr. Sci.*, 2004, **86**, 1092–1102.
4. Chopra, R. N., *Indigenous Drugs of India*, Academic Publishers, Kolkata, 1933.
5. Whilton, P. *et al.*, *Phytochemisty*, 2003, **64**, 673–679.

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For whom the bells toll

Continuing with the already extensive correspondence on papers published from India, the recent NSF statistics provided in *Chemical & Engineering News* (14 June 2004, pp. 38–42) are both authoritative and instructive.

The general trends are as outlined previously by Arunachalam. For papers abstracted by CAS, the per cent growth between 1988 and 2001 is as follows: USA (31), Germany (45), Italy (92), Spain (127), Switzerland (73), UK (39), China (333), India (26), Japan (77), South Korea (591), Taiwan (330) and Brazil (395).

I have heard Arunachalam being debunked by some of our 'leading' scientists; they argue that Indian scientists might be publishing less, but the quality of their papers is so high that we do not have to worry about China. So, further statistics on papers published in ACS journals are pertinent. The corresponding per cent growth rates are: USA (31), Germany (231), Italy (149), Spain (558), Switzerland (126), UK (300), China (909), India (177), Japan (151), South Korea (1472), Taiwan (718) and Brazil (500).

Now, I wait for further arguments such as: (i) ACS journals are not of the best quality; yes, I know ours are much better. (ii) Chemistry is not such an important subject; this would be from biologists. (iii) We have a 177% increase, so why worry? This would be from chemists. (iv) The per cent increases for USA and Japan are lower than ours; they need to be told that the total number of papers in ACS journals in 2001 was: USA (9051), India (307) and Japan (2062).

More absurdly, in the same year, South Korea already had more papers (346) in ACS journals than India. The same was true of Taiwan (327). Spain is a country where salary increases are connected to impact factors. In Germany, the linking of these impact factors to research funding is more or less automatic. Amazingly, it has both a high growth rate and a large number of papers. Look at the numbers in the *C&EN* article. The numbers tell the story.

The alarm bells are ringing and have been ringing for some time. Only, no one is listening. Cultivated deafness, spooky logic and morbid obstinacy are truly prized assets in the Indian scientific community today.

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