Pharmacology and Toxicology in Ancient India

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The relationship between humans and medicine is very ancient and must have started from the very advent of the first humans on this planet. The early humans used plants, plant products, minerals, animal products, etc. against diseases. This knowledge about medicine was gathered empirically through trial and error and compiled verbally and passed on orally from generation to generation. Much later, some of this information was codified into treatise form in the *Rgveda*, *Yajurveda*, *Charak Samhita*, *Sushrut Samhita, Astanganighantu*, etc. Out of these treatises *Rgveda* is the most ancient document with some portions about medical knowledge. The *Rgveda* describes the preparation of *soma-rasa* and the information about an instrument (*trikadruka*) for extracting Soma juice.

In the following pages we give a brief glimpse of ancient Indian pharmacology and toxicology based on secondary sources mentioned below. One is struck with the rigour of scientific procedures of pharmacology and their systemization even in the First Millennium BC, which indicate that there must have been a long period of development preceding these great medical works. Even the extensive use of poisons in medical therapy (toxicology) was quite advanced at this stage.

In ancient literature it is clearly mentioned that any patient can be cured with the help of herbs and other natural things present in one's surroundings. There is no need to go far in search of medicines. But the question is: how did the ancient people identify various medicines and their effects? The answer is that the ancient people must have observed the ambient flora and flora minutely. It seems that the ancient people at some stage also believed that the shape and size of different parts of plants resembling different human organs could be effectively used in treatment of the diseases related to that particular organ. For example, Karela (*Momordica charantia*) fruits look like the human pancreas and ancient literature mentions that Karela is the best remedy for diabetes mellitus. Now modern scientists have proved that diabetes is a result of disturbed activities of pancreas. Similarly, the kernel of Akhrot (*Juglans regia*) resembles the structure of human brain and ancient Indian herbalists used walnut as brain tonic. Twisted fruits of (*Marod fali*) *Helicteres isora* are used in twisting pain in the abdomen. There are numerous such examples mentioned in ancient literature.

From ancient times the Indian knowledge about pharmacy had also attracted researchers, herbalists, scientists etc. from around the world. And they visited India in search of this valuable knowledge. In 1703 A.D. Kavi Tanang wrote, "A Persian physician came to India to confer with the Hindu pundits. Together they studied the *Carak Samhita* and all other medical texts. They realized that the medical texts are like an ocean and they were like pearl divers who plunged into the ocean to grasp the pearls."

PHARMACOLOGY

From the Neolithic times the early humans used stone slabs to crush drugs and extracted juice or made powder. Sometime later, after they learnt the control of fire, they could heat and boil solutions and made preparations called *phanta* and *kvatha*. So juice, paste (or powder), cold infusion, hot infusion and decoction, these five are the basic pharmaceutical preparations coming down since antiquity in some form or the other. The literary treatises like the *Rgveda*, *Atharvaveda*, *Samhitas*, *Nighantu*, etc. give a clearer picture of the extant pharmaceutical practices, preparation of drugs and their applications.

Actually in the Ayurvedic tradition, the literature on pharmacology (*Dravyaguna)* is generally known as *Nighantu*. Its origin goes back to Vedic *Nighantu*, which was explained and annotated in the *Nirukta*, one of the six *angas* (part) of Veda. In *Charak Samhita*, there is no *Nighantu* portion present and the drugs and food substances are dealt mainly in *bhesajacatuska* and *aharacatuska*, respectively. But *Susruta* had some portion of *Nighantu*. On the drugs mentioned in *Astangahrdaya*, a separate *Nighantu* named *Astanganighantu* by Vagbhata came into existence. This tradition continued further and *Nighantus* like *Siddhasaranighantu*, *Paryayaratnamala*, *Dravyavali*, *Madanadinighantu*, *Sabdacandrika*, *Nighantusesa*, *Hrdayadipaka* and *Sivakosa*, etc were composed on these lines.

Basics of Ancient Indian Pharmacology

The first systematic knowledge of pharmacalogy is found in *Caraka Samhita*. In his *Samhita*, Caraka discussed this subject in a separate section named *Kalpopanisad* or *Kalpasthana*. According to Caraka, "medicines are derived from three sources - animal, mineral and vegetal. Animals, honey, milk and milk products, bile, fat, bone-marrow, blood, flesh, excreta, urine, skin (including membranes), semen, bone, tendon, horn, claw, hoof, hair, down and gall-stone are also used in medicines."

In *Caraka Samhita*, the word *Kalpa* is used for 'preparations' and *tihara-kalpa*, *bhesaja-kalpa* and *bahu-kalpa* denote various pharmaceutical preparations.

According to Caraka the primary pharmaceutical preparations were of five types: (1) *Svarasa* (expressed juice), (2) *Kalka* (paste or powder), (3) *Srta* (decoction), (4) *Sita* (cold infusion), and (5) *Phanta* (hot infusion).

Svarasa: The juice which was extracted by mechanical processes is called *svarasa*. This is the pure essence of the material and very heavy in assimilation and not to be used for weak patients or for mild disorders. This method was used for only fresh drugs. But for dry and hard drugs another method was used known as *putapaka* (closed heating) and *nirdaha* (open heating). In *putapaka* method, drug is covered with earthen pastes and heated on the fire and then pressed. And in *nirdaha* method, the root or the branch is cut at the lower end and fire is put on the upper end. So the juice coming out is collected in a vessel. *Caraka Samhita* also describes another method for extracting juice form dry drug. The dry powder of the drug is kept in water for 24 hours and then pressed and filtered.

***Kalka*:** A drug when ground with water and made into pulp or paste form is called *kalka*. And when the water is not added it is called *curana* (powder). Kalka when applied as a paste is known as *pralepana*. Other categories of *kalka* are the following:

(a) *Vari:* when pulp is rolled and made into a wick-shaped stick.
(b) *Varnaka:* when paste is used as cosmetics to improve the lustre of the face and the complexion of skin.

According to the mode of application the *curanas* (powders) are used in the following ways:

(a) *Curnapradeha:* when *curana* (powder) is mixed with the oil and applied for skin diseases.
(b) *Avacurnana:* when *curana* (powder) used as dusting powder on wounds.
(c) *Uddharsa:* when *curana* is used as rubbing powder.

Srta: It is a preparation made by cooking (*pakya*) and the following preparations come under these categories:

(a) *Paniya* (Medicated water): water boiled with some drugs and used in fever, etc.
(b) *Kvatha* (Decoction): when drug is boiled in sufficient water till water is reduced to one-fourth or more. The *Kvatha* has the following categories:
    (1) *Ksirapaka* (Milk decoction): when drug is boiled in milk with water till water is evaporated completely.
    (2) *Panaka* (Syrup): concentrated juice of drugs.
    (3) (a) *Leha* or *Avaleha* (Linctus): juice or decoction is cooked till it becomes semi-solid.
    (b) *Modaka* (Bolus): *leha* further condenses to become *modaka*. The base of *modaka* is sugar; sometimes sugar is coated on the outside of *modaka*.
    (c) *Vataka, Guda, Gudaka* (Big piles): decoction is cooked till it becomes solid.
    (d) *Gudika* (Piles): when the *vataka* is reduced in size.
    (4) *Abhisava* (Fermented preparation): when liquid is kept for certain periods mixed with yeast. It undergoes the process of fermentation. Fermented decoction or juice is called *abhisava*.
    (5) *Snehakalpa* (Fatty preparation): when oil and ghee are cooked with decoction and paste of drugs.

Sita: When the extract comes out on keeping the drugs in water for the whole night.

Phanta: When extract comes out by the process of pressing and filtering of the drug which is kept in hot water for some time.

Other Preparations:
Bhasma: Fine ash of drug is called *Bhasma.*

Ksara* (Caustic alkali)*: When the ash of plants is dissolved in water and decanted a number of times.

Ayaskrti: When sheets of metals are heated and dipped in liquids. The process is repeated till metals are transformed into fine powders.

Pisti: Fine powders of pearl, coral, etc are prepared without heating they are called *pisti.*

Indian Philosophy of Drugs

According to P. V. Sharma, the ancient literature describes that the effectiveness of a drug depends on *virya,* which is defined as the power by which a drug acts. Hence to maintain the affectivity of the drug during pharmaceutical processing one requires to extract the *virya* in the product in the best possible way, because if the *virya* does not come or comes out incompletely, the product would not be capable to produce the desired effect.

In order to increase or decrease the potency of a drug or a formulation, the following methods are suggested:
(1) A drug may be further potentiated by impregnating it with its own juice or the juice of a drug similar in *virya*.
(2) Potency of a drug may be modified from lower to higher level and vice versa by combination, elimination, timing, processing and mode of administration.

Only qualified physicians were allowed to prepare drugs. The rules for drug usages depended on sex, age, the strength of a sick person and also the condition of *vata*, gall, mucus, inner heat, etc.

Drug Substances

The materia medica of Ayurveda is very comprehensive and includes most of drugs from vegetable origins. Susruta has described the properties of 760 drugs of the vegetable kingdom. But also includes animal-origin substances, minerals, etc.

According to P. P. Denisenko, the substances of animal origin include:

(a) Skin, nails and hair for fumigation and for curing intermittent fever etc.
(b) Meat with oils and vegetables for combating malnutrition, consumption and nervous diseases
(c) Bones in the form of ashes with other drugs for curing children of nervous diseases and for fumigation
(d) Fats and oils externally and internally for embrocation
(e) Hair externally for embrocation and internally for combating malnutrition
(f) Gall used for treating fever and eye diseases
(g) Milk for nutritive substances and also with different broths for the nutrition of child and curing nervous diseases
(h) Urine for diseases caused by mucous and polluted air, for eradicating, worms and poisoning, leprosy, dropsy and dyspepsia
(i) Honey, eggs, Spanish flies and leeches were also used.

The substances of mineral origin:

(a) Precious stones like diamond, pearls, corals, etc. used as nourishing substances

(b) Salts like saltpeter, sodium black salt, borax, ammonium salt and sulphur
(c) Metals like mercury. Mercury is the symbol of Lord Siva and there are 18 *samskaras* (processing) of mercury and the main steps are *sodhana* (purification) and *marana* (killing). According to Ayurveda, without processing any metals and minerals can't be assimilated in the body.

For preparation of drugs many instruments (*yantras*) and equipment were used like: furnace (*angaraculli*), iron plate (*ayahstali*), iron vessel (*ayasa bhanda*), water pot (*acamaniya*), water jar (*udakumbha*), water-reservoir (*udakostha*), mortar (*udukhala*), pitcher (*kalasa*), jar (*kumbha*), grinder (*kurcana*), ghee container (*ghrtabhajana*), weighing scale (*tula*), tub (*droni*), etc.

Collection of Vegetable Drugs

According to *Caraka Samhita*, to prepare drugs those plants should be collected which are grown in time (proper season), mature with taste, potency and aroma, unaffected by time, sun, fire, water, air and insects and are fresh. Susruta says, *saumya* (*sitavirya*) plants should be collected in *asumya* seasons (rains, early and late winter) while the *agneya* (*usnavirya*) ones in *agneya* season (autumn, spring and summer) and the quality of the soil on which the plant grows must be neither dry, nor sandy, nor uneven and rocky, nor salty, but soft, succulent and damp, of black, yellow or red colour and situated near water and beautiful blossoming trees. The best plants were obtained from the Himalayas.

Storage of Drugs

Ancient medical literature also describes the rules and conditions of the drug storage. Caraka says, after collection the drug should be kept in suitable and good containers and stored in a room facing eastward or northward, devoid of wind but well ventilated, daily ritualized with offering of flower etc., holding them up in a swing or rope well covered and making them unapproachable for fire, water, humidity, smoke, dust, rats and insects. Susruta says that drug store should be located in clean surroundings and auspicious direction and the drug should be placed in cloth bag, earthen jars, wooden planks and hooks.

TOXICOLOGY

According to the Ayurveda, a physician should have deep knowledge of poisons and their antidotes. The book, *Mitaksara* gives detailed instructions about poisons. Susruta mentions a kind of *antiditum universale*, from asafetida, *Citrus decumanus* and so on, in combination with salt, pepper, ginger, used against vegetal, animal and mineral poisons.

According to P. P. Denisenko, the use of poisons as drugs is also a very remarkable feature of Ayurveda. These include *datura*, *Aconitum* spp. *(amrta),* opium *(Aiphena), Nerium indicum (Karabira), Calotropis gigantea (arka), Gloriosa superba (langllia),* to be boiled with milk or water infusion of cow dung, which served as a narcotic and stimulant. Seeds of *crotonis,* prepared in the same way were given in small doses at the onset of fever, as well as *Euphorbiumu uleandrum, Hellaeborus* and different kinds of aconites. The dried gall of fish, goats, buffaloes, wild bears, peacocks were considered to

be a stimulant. *Nux vomica* was administered internally, and externally for leprosy; bitumen externally for rheumatic fever, falling sickness, hysteria and paralysis. Poisons were applied internally in the following order: first day - a dose in a size of mustard grain, adding daily the same quantity for 7 days, reducing such quantity in the following 7 days; the third week the dose equalled barley grain, then daily adding the same quantity, in the 4th week reducing this quantity. Generally, these drugs were given with milk.

Conclusions

The Western pharmacology is just a few centuries old. But in India we have used these herbal products and minerals etc against diseases since pre-historic times. Recently someone in the USA was granted a patent for a process involving Neem extract. This is a big joke because people in India have been using all these plants, plant products, minerals, etc. in all possible ways and processes, for the past thousands of years. Systematized pharmacalogy in India was established long before Buddha was born (6^{th} century BC) which is evident from its clear and exhaustive description in ancient *Ayurvedic Samhitas* composed even before the Buddha.

[This is an introductory essay (and not a research article) to give a glimpse about pharmacology and toxicology in ancient India based on the following sources]

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