Animal self-medication through natural sources

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Received 8 January 2007; Accepted 12 July 2007

Abstract

The term 'Zoopharmacognosy' was coined to describe the process by which wild animals select and use specific plants with medicinal properties against ailments and prevention of diseases. Early studies of zoopharmacognosy focused on the interactions between plants and the herbivores that consume them. The study of animal self-medication and ethno-medicinal practices may provide important leads to future sources of medicine. This paper highlights the existence, efficiency and self-medication in wild animals.

Keywords: Animal self-medication, Zoopharmacognosy, Dirt, Insects, Medicinal plants.

IPC code; Int. cl.[8]— A61K 35/64, A61K 36/00

Introduction

Animal self-medication is a rapidly growing topic of interest in pharmacist, physicians, enthnobotanist, parasitologist, conservationist, and ecologist for research and development. Animals use plants, soil, insects and fungi both as preventive medicine and/or relieve unpleasant symptoms (curative or therapeutic medicine).

Self-medication strategies are survival skills honed by natural selection. In most cases self-medication may be motivated by a desire to immediately reduce unpleasant sensations[1]. Since ancient times people have observed that animals apparently heal themselves with natural medicines. According to Chinese folklore, a farmer in the Yunnan district found a snake near his hut and he beat it senseless and left it for dead but after few days the same snake returned. Searching the reason for snake's healing revealed that the snake had fed onto the clump of weeds called as ***Panax notoginseng* (Burkill) Chen ex Yunnan** and thereby rapidly cured its injuries. This weed is used as main ingredient in the herbal formulation[2]. In another case chimpanzees practiced curative self-medication using certain leaves in 'non-nutritional' ways indicative of self-medicative behaviour, they swallow leaves as mechanical source to expel intestinal worms[3].

Natural sources of medicines used by animals

Dirt, insects and plants are commonly used by animals as self-medication to treat their illness. Some of them utilized by animals as medicines are described below and also summarized in Table 1.

Dirt as medicine

Many species of mammals, birds, reptiles and even insects, in all parts of the world, eat dirt, known as 'geophagy', this behaviour has long been assumed to be an attempt to rectify mineral deficiencies in their diet[4]. However, new evidence suggests that this is not always the case. It has become apparent that the clay content is often the most important ingredient of selected soils. It has been found that cattle, chimpanzees, giraffes, elephants, gorillas, rhinoceros, and in rain forests of New Guinea parrots, pigeons and crows eat regularly mouthfuls of clay-rich termite mound soil. Clay is an effective binding agent and deactivator of toxins from diet or pathogens and is the primary ingredient of the kaolin found in many over-the counter treatments for gastrointestinal malaise in humans. Kaolinite has been reported pure pharmaceutical than plants which sometimes contain toxins for self protection from predators and pathogens. This suggests that these animals take advantage of newly disturbed earth and selecting soil of just the right properties to bind and deactivate plant toxins[5, 6].

Insects as medicine

Many insects synthesize defensive toxins or take toxins from their diet to store in their bodies where they deter predators and combat infection and parasites. They may therefore contain strong bioactive compounds that are potentially medicinal to other animals[2].

More than 200 species of song birds wipe ants through their plumage[7]

Table 1: Various source materials used by animals for self-medication

Source of medicine	Name of the material used by animals	Description of medicine
Dirt	Clay-rich termite mound soil	Clay is an effective binding agent as its chemical structure allows other chemicals to bond with it and thus lose their reactivity. Clay is an effective deactivator of toxins from diet or pathogens and is the primary ingredient of the kaolin found in many over-the counter treatments for gastrointestinal malaise in humans.
	Clay-rich volcanic rock	Contain fewer minerals than the surrounding top soil but the clay content is high and found to be more effective at binding alkaloids and tannins than pure pharmaceutical kaolinite.
	Japan soil	Soil has predominantly higher levels of the clay minerals and can absorb dietary toxins, present in the plant diet or those produced by microorganisms.
Insects	Ants that spray formic acid	They control parasitic mites.
Plants	***Clematis dioica* Linn., *Piper marginatum* Jacq., *Sloanea terniflora* Standl.**	These three plants are used to treat skin irritations or repel insects.
	***Ligusticum porteri* J. M. Coult. & Rose**	Contains coumarins-fragrant organic compounds which may repel insects when topically applied.
	***Daucus carota* Linn.**	The plants are highly aromatic and contain monoterpenes and sesquiterpenes that are harmful to bacteria, mites and lice. Particularly effective against the bacteria, *Staphylococcus aureus*, *S. epidermidis* and *Psuedomonas aeruginosa*.
	***Azadirachta indica* A. Juss.**	Powerful insecticide.
	***Caesalpinia pulcherrima* (Linn.) Sw.**	Useful in outbreak of malaria.
	***Vernonia amygdalina* Delile**	Used to treat malarial fever, schistosomiasis, amoebic dysentery and other intestinal parasites and stomach disorders.
	***Aspilia* sp.**	Used in treating stomach upset and cough.
	***Aspilia mossambicensis* (Oliv.) Wild**	This plant contains, thiarubrin-A which is known to be antibacterial, antifungal and anthelmintic.
	***Apuleia leiocarpa* J. F. Macbr.** and ***Platypodium elegans* Vog.**	Ingesting its leaves may increase estrogen levels in the body, thereby decreasing fertility.
	***Enterolobium contortisiliqua* (Vell.) Morong**	Increase the monkey's chances of becoming pregnant because the plant contains a precursor to progesterone (pregnancy hormone) called stigmasterol.

by spraying formic acid. In laboratory tests formic acid is found damaging to feather lice and its vapour alone is enough to kill the lice[8]. The medicinal benefits of formic acid are to control parasitic mites of honey bees[9]. Squirrels, cats and monkeys for similar relief also seek ant nests[10]. The insect secretions contain benzoquinones, which are powerful insect repellents[11].

Jane, a woolly monkey, eating *Artemisia vulgaris* flowers

Plants as medicine

Plants synthesize many compounds, which are bioactive and can be medicinal, intoxicating or toxic to protect themselves from disease and predators (fungi, bacteria and parasites) depending on circumstances. Many insects are pharmacophagous — that is, they eat non-nutritive substances that may serve as 'drugs'. For example, the woolly caterpillar when infested with internal parasites eats highly toxic hemlock and its chances of surviving the normally lethal parasite infestation increase significantly[12].

Self-medicating behaviour among white-faced capuchin monkeys (*Cebus capucinus*) was witnessed when they were breaking open the fruits of certain species of ***Citrus*** plants and rubbing the pulp and juice into their fur. They also tore stems, leaves, pods and seeds from ***Clematis dioica* Linn., *Piper marginatum* Jacq.** and ***Sloanea terniflora* Standl**. and mixed these pungent plants with saliva and vigorously rubbed them in as well; so as to treat skin irritations or repel insects. Indeed, these plants contain secondary compounds with healing and insect-repelling characteristics[13].

Many birds bring fresh green plant material to their nests, during nesting, and continue to replace and replenish it with wild carrot **(*Daucus carota* Linn.)**, yarrow **(*Achillea millefolium* Linn.)**, agrimony **(*Agrimonia parviflora* Aiton)**, elm-leaved and rough golden rod (***Solidago*** sp.), and fleabane (***Erigeron*** sp.),[14] which are highly aromatic and contain volatile oils. When fresh plants are removed from nests, chicks in these nests suffered greater mite infestations than those in which the herbs remained. Furthermore, chicks in nests containing wild carrot had higher haemoglobin levels than those in nests without it[15]. The preferred plants contain monoterpenes and sesquiterpenes that are harmful to bacteria, mites and lice in the laboratory[14]. In particular, they are effective against the bacteria *Staphylococcus aureus, S. epidermidis* and *Psuedomonas aeruginosa* but not against *Escherichia coli*[16].

Starlings have ability to detect volatile oils, which varies seasonally, being most acute at the time of reproduction when medication is so important[14]. Starlings are able to discriminate between a preferred plant (wild carrot) and a less preferred plant (red dead nettle) in April (at the beginning of breeding season) but not in September (outside the breeding season). This suggests that the seasonal changes in male testosterone levels influence their ability to detect the important plant odours[17].

For skin problems such as ulcers, sores and eczema herbalists commonly use the plants chosen by starlings externally,whose volatile chemicals help with the symptoms of ectoparasite infestation; namely scabs, sores and itches[18]. Nestlings in certain herb nests have greater mass and higher blood iron levels at fledging than those in grass nests. Wood storks also reuse old nests and show the same behaviour as the starlings suggesting that medication may be about treating the symptoms of mites and bites rather than impacting directly on the ectoparasites[19].

In Gombe, July 1972, Richard Wrangham noticed a wild chimpanzee feeding on a ***Aspilia*** spp. leaves which were greedily stuffed into the mouth. They seemed to be kept in the mouth for some time before being swallowed and the leaves weren't palatable because often the chimpanzee wrinkled his nose when swallowed them[20]. It is the mechanical action by which the gut is cleared due to the passage of the leaves. ***Aspilia*** plants are commonly used in traditional African medicine for treating upset stomach and coughs, as they contain the chemical, Thiarubrin-A, which is known to be antibacterial, antifungal and anthelmintic[21]. It became increasingly evident to researchers that the only thing these leaves had in common was their rough texture causing the mechanical action on parasites to get rid off[22].

Leaf swallowing is seen mostly at the beginning of the rainy season when

nodular worm infestation starts to increase and many leaf-swallowing apes suffer from the diarrhoea, malaise and abdominal pain. Mechanical expulsion (scouring) could be particularly effective at reducing nodule worm infestation as they move around freely in the large intestine looking for food and mates and have no permanent attachment to the intestinal wall[23]. In addition to hooking out loose worms, the rough leaves stimulate diarrhoea and increase gut motility, which also help shed worms and possibly their toxins from the body. Furthermore, when adult worms are removed from the gut, rapid relief of more general feelings of malaise is observed. It is this rapid relief that most likely motivates leaf swallowing 'self-medication' behaviour[24].

Conclusion

Early studies of zoopharmacognosy focused on the interactions between plants and the herbivores that consume them. We need more definitive studies like those of Huffman[22], with actual proof that particular plants are effective against particular illnesses. Further exploration in the field of zoopharmacognosy would highlight more about behaviour, botany and medicine.

Although the potential plant pharmacy is vast, insects too are a source of potential medicines for other animals. Soil often contains microbial organisms which secrete bioactive compounds. The study of animal self-medication and ethno-medicinal practices may provide important leads to future sources of medicine. Further field and laboratory research on self-medication behaviour of wild animals is definitely needed. In this paper we have thrown some light on the adaptive significance of self-medication and its widespread existence but the challenge exists in finding the immediate threats to health and survival in a population.

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