

ZOO PHARMACOGNOSY: ANIMAL SELF-MEDICATION

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ABSTRACT

The consumption of plants, insects, dirt and microbes by animals for prophylactic or therapeutic use by themselves in illness or to improve their own health is termed as Zoo Pharmacognosy or animal self-medication. Different species of animals use different substances derived from nature which possesses therapeutic properties. Zoo Pharmacognosy can show us the solutions quicker. We must now take responsibility of our mismanagement, overuse and disregard of the species of this world. Once we are able to unlock all the potential benefits of Zoo Pharmacognosy and its positive implications for conservation, then and only then, can we revolutionize our world. The mechanism underlying the selection by animals of specific plants during illness is still unclear. The reasons of self-medication by animals include parasitism, indigestion, stomach upset, infections, neutralize toxins, *etc.* This particular behavior of animal self-medication like fur rubbing with plants, resins, citrus fruits, ant-eating, eating dirt, *etc* has driven attention to study further in order to discover new drugs. This paper describes various types, methods and reasons of Zoo Pharmacognosy by various animals.

Keywords: Zoo Pharmacognosy, Animal self-medicating behavior, Prophylactic, Therapeutic

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INTRODUCTION

Zooparmacognosy is a behavior in which non-human animals apparently self-medicate by selecting and ingesting (or) by topically applying plants, soils, insects and psychoactive drugs to treat and prevent diseases. The term zoo pharmacognosy was derived from the words zoo ("animal"), pharma ("drug") and gnosy ("knowing") [14]. The concept of self-medication or zoo pharmacognosy in non-human vertebrates was first proposed [3]. Animals can use plant secondary metabolites as stimulants, laxatives, anti-parasitic and antibiotics or as antidotes for previously consumed toxins [3]. A well-known example of zoo pharmacognosy occurs when dogs eat grass to induce vomiting. However, the behavior is more diverse. Animals ingest non-foods such as soil, clay, charcoal and even toxic plants to prevent parasitic infection or poisoning. Beyond Zoopharmacognosy's obvious benefits, it also helps in the potential discovery of new medical cures. The methods by which animals self-medicate vary, but can be classified according to function as prophylactic (preventative, before infection or poisoning) or therapeutic (after infection, to combat the pathogen or poisoning) [2].

Types of zoo pharmacognosy

In general, animal self-medication has been classified into two types.

Preventative

Prophylactic—act of using medicinal plants without any symptoms of infection or before infection.

Curative

Therapeutic—act of using medicinal plants only after infection or illness [7].

Methods of self-medicating behaviors by animals

Ingestional plant medicine (internal use)

Secondary metabolites are part of plant's defense mechanism which protects from disease-causing microorganisms.

Ingestion of anti-parasitic plants

Parasitism

Parasites can weaken the host's immune system by either of the two following ways. The hematophagous parasites directly reduce host fitness by continuously sucking blood and nutrients from the body, or

parasites can be reservoirs for many deadly transmittable diseases and can act as disease carriers (vectors) among host populations.

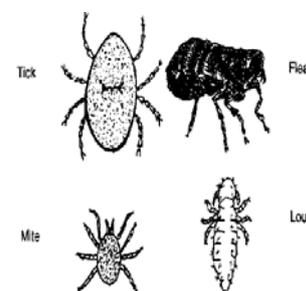


Fig. 1: Parasites

(<http://www.fao.org/docrep/t0690e/t0690e21.gif>)

Table 1: Various source materials used by animals for self-medication [10]

Source of medicine	Name of the material used by animals	Description of medicine
Din	las. 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 b an effective deacfnaror of toxins from diet or pathogens and is the primary ingredient of the kaolin found in many over-the-counter treatments for the 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	The 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	<i>Clematis dthica</i> Linn. <i>Piper marginatum</i> Jacq., <i>Sloanea terniflora</i> Standl	These three plants are used to treat skin irritations or repel insects.
	<i>Lipusticum porterij</i> . Al. Cook. & Rose	The contains coumarins-fragrant organic compounds winch may repel insects when topically applied.
	<i>Daunts carom</i> Linn.	The plants are highly aromatic and contain monoterpenes and sesquiterpenes that are harmful to bacteria. mites and lice. Particularly effective against the bacteria. <i>Staphylococcus aureus</i> , <i>S. epidermal</i> : and <i>Psuedomonas aentginosa</i> . Powerful insecticide.
	<i>Azadirachta indica</i> A. Juss.	Useful in an outbreak of malaria.
	<i>Caesalphda pulcherrima</i> (Linn.) Svc	Used to treat malarial fever. schistosomiasis. amoebic dysentery and other intestinal parasites and stomach disorders.
	<i>Vernonia anogdalina</i> Dellie	Used in treating stomach upset and cough.
	<i>Aspilia</i> sp.	This plant contains. thiarubrin-A which is known to be antibacterial. antifungal and andiehmimic.
	<i>Aspilia mossambicensis</i> (011v.) Wild	Ingesting its leaves may increase estrogen levels in the body. thereby decreasing fertility
	<i>Apuleia leiocarpa</i> J. F. Alactr. and <i>Platypodium elegem</i> Vog.	
	<i>Enterolobium tontortisiliqua</i> (Veil.) Aforong	Increase the monkey's chances of becoming pregnant because the plant contains a precursor to progesterone (pregnancy hormone) called stigmaterol.

a) Self-medicative behaviour in African apes

Observations of the great apes provide the clearest scientific evidence to date for direct forms of self-medication in animals. The hypothesis currently developing is that these behaviors aid in the control of intestinal nematodes and tapeworms or provide relief from related gastrointestinal upset, or both.

b) Great ape self-medicative behaviour and parasite infection

Mahale chimpanzees are naturally infected by numerous parasite species. *Vero commonia amygdalina* of *Compositae* i.e. bitter pith contains anti-parasitic steroidal glycosides vernonioside as an active chemical constituent.

c) Wild chimpanzees self-medicating behavior

Wild chimpanzees eat leaves from the genus *Aspilia* (*Compositae*) provide the most convincing evidence for self-medication in a nonhuman animal. Janzen A Huffman was the first to suggest that the incidental ingestion of plant secondary compounds by non-human primates and other animals may help to combat parasites [6]. It contains alkaloids, tannins, flavonoids, saponins, and phenols. *Aspilia* also may have some anti-bacterial effect and is very useful against tumors.

d) Anubis baboons & hamadryas baboons self-medication for schistosomiasis

The Anubis baboons and hamadryas baboons in Ethiopia use fruits and leaves of *Balanites aegyptica* to control schistosomiasis. It consists of Ethanol which shows antimicrobial & antitumor activity.



Fig. 2: Hamadryas baboons eating desert date fruits (http://www.westafricanplants.de/balanites_aegyptica_ms_10627_182_e064ba.jpg)

e) In dogs and cats

Dogs and cats are believed to eat grass to make them vomit. Dogs do not have the means to digest grass, as they lack the enzymes needed to break down the fibers. One reason for eating grass may be due to a feeling of nausea. It is possible that dogs learn this is a temporary solution for stomach irritation.



Fig. 3: Dog eating grass (http://www.techietonics.com/wp-content/uploads/2014/12/dog_eating_grass.jpg)

Ingestion of plants for stimulant activity

Chacma baboons in South Africa are known to consume each day a little quantity of leaves of specific plants, which are well known for their stimulant property. It consists of tropane alkaloids. They are

Croton megalobotrys of *Euphorbiaceae*, *Datura innoxia* and *D. stramonium* of *Solanaceae* [4].

Eating bacteria for digestion

The folivorous, or leaf-eating, hoatzin, however, uses specialized phenol bacteria in the crop to break down hard-to-digest leafy plant material. Research indicates that the bird's gut bacteria also neutralize toxic secondary compounds found in the plants it eats [8].

Reproductive remedies

a) In muriqui monkeys

Female Muriqui monkeys from Brazil, just before the mating period, prepare themselves to that occasion by eating the leaves of Brazilian ash tree and Carcuera tree and the fruits of Monkey's ear tree. The first two plants contain isoflavonoids, which are compounds similar to estrogen. These chemicals may increase estrogen levels in the body, thereby decreasing fertility. The latter plant contains a precursor to progesterone called stigmasterol, which increases the monkey's chance of becoming pregnant [1].



Fig. 4: Monkey's ear tree seeds

(<http://woodpops.com/wp-content/uploads/2011/03/ears.jpg>)

b) In african elephant

An African elephant walked 17 miles in one day many more than her usual three and ate a tree of the Boraginaceae family from leaves to trunk! Four days later she gave birth to a healthy calf.



Fig. 5: *Lithodora diffusa*, *Boraginaceae*

(https://upload.wikimedia.org/wikipedia/commons/3/36/lithodora_diffusa_Heavenly_Blue5.jpg)

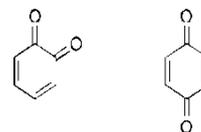
Anti-venoms

In Brazilian folklore peasant communities tell about how some lizard species fight against venomous snakes and beat them without suffering from their venom. The presence of fatty acids, sugars, alkaloids, amino acids, coumarins, steroids, flavonoids, lignans, proteins, saponins, tannins, and terpenoids can be seen. People use *Jatropha elliptica* (*Euphorbiaceae*) plant as medicine for the treatment of snake bites, rheumatism, venereal diseases, as well as anti-inflammatory, fortifier and anti-syphilis [15].

Plant medicine (external use)

Fur rubbing

'Fur rubbing' is a typical behaviour of rubbing masticated plant materials and other objects such as insects on the external surface of the body by animals. The Capuchin monkeys (*Cebus capucinus*) rub their fur with several species of Citrus fruits (*Rutaceae*) and leaves and stems of *Piper marginatum* and *Clematis dioica* (*Ranunculaceae*) [9]. It has been suggested that fur rubbing serves to repel or kill ectoparasites. Monkeys, bears, coats and many other animals rub citrus oils and pungent resins into their coats as insecticides and antiseptics to prevent insect bites.



o-Benzoquinone *p*-Benzoquinone

Fig. 6: Millipedes contains Benzoquinone
(<http://scitechdaily.com/images/Two-Millipede-Species-Appear-To-Have-A-Treaty.jpg>)

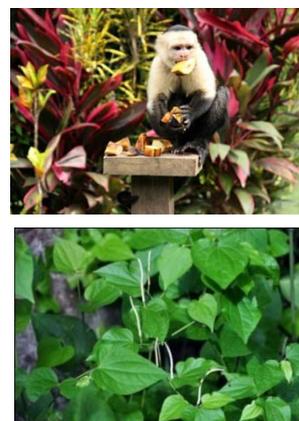


Fig. 7: *Piper marginatum*

<http://worldplantsfotorevista.com/Fotos/plantasespanol/Piperaceae/Piper/pipersp.1.jpg>

Dusky-footed woodrats

The dusky-footed wood rats place bay foliage around their sleeping nests, and it has been experimentally shown that the inclusion of bay foliage significantly reduces the flea larval survival [13].

Antimicrobial lining in nests

At least 50 species of birds are known to include fresh plant materials inside their nests. The plants are rich in volatile secondary compounds, and the birds use these plants to repel or kill ectoparasites [12]. The leaves of wild carrot (*Daucus carota*, *Umbelliferae*), a preferred species, significantly reduces the number of fowl mites in starling nests. A red-wattled lapwing *Vanellus indicus* drove away a venomous snake, which was after its nest, throwing small twigs of *Indoneesiella aechioides* (*Acanthaceae*) towards it. Thus, the antiophidic use of this plant was discovered [17].

Dirt medicine: geophagy

It is an act of consuming soil, stones, clay and rock by animals, birds, reptiles, and insects.



Fig. 8: Red clay

(<http://s3.amazonaws.com/rapgenius/Clay-MORO-S.jpg>)



Fig. 9: Activated charcoal

(<http://www.onegoodthingbyjillee.com/wp-content/uploads/2013/02/activated-charcoal-2.jpg>)

a) Red and green macaws

Parrots and macaws eat clay with higher levels of sodium from exposed river banks of Amazon Basin to neutralize toxins [5]. The clay is a source of cobalamin, otherwise known as vitamin B₁₂.



Fig. 10: Red and green macaws

(http://ibc.lynxeds.com/files/pictures/macow40_copy.jpg)



Fig. 11: Yellowstone grizzly bear

(http://1.bp.blogspot.com/_x29Pef-T4FQ/SEkbpilXtPI/AAAAAAAAE1A/OjRtA01Sh8k/s400/YS08+grizzly+bear+103_0345.jpg)

b) Yellowstone grizzly bears

They use clay with high concentrations of potassium, sulfur, and magnesium. It is used for anti-diarrheal purposes.

c) Red colobus monkeys

These on Zanzibar Island, Tanzania, prefer leaves of the exotic Indian almond and mango trees. They are high in secondary compounds called phenols. They counteract the toxicity of the leaves by consuming charcoal [16].



Fig. 12: Red colobus monkey

(https://pounmp13.files.wordpress.com/2014/04/red_colobus_monkey_uganda_kibale.jpg)

Insect medicine: anting

It is a self-anointing behavior during which birds rub insects, usually ants, on their feathers and skin. The insects secrete liquids containing chemicals such as formic acid, which can act as an insecticide, miticide, fungicide, or bactericide.

a) Active anting

The birds rub insects (ants) which secrete liquids containing chemicals such as formic acid. Eg:-Babblers and Weavers.



Fig. 13: Weavers anting

(<http://www.besgroup.org/wp-content/uploads/laughingthrushWC-anting-LeongTziMing-2.jpg>)

b) Passive anting

The bird may lie in an area of high density of the insects (ants). Eg:-The European jay, crows, and waxbills.



Fig. 14: European Jay

(<http://besgroup.org/wp-content/uploads/111101.jpg>)

Microbial medicine: inclusion or eating bacteria**Wood ants**

The wood ants, *Formica paralugubris* often incorporate large quantities of solidified conifer resins into their nests. The included resin inhibits the growth of pathogenic microorganisms inside ant nests [11].



Fig. 15: Wood ants

(https://cdn.dogomedia.com/system/ckeditor_assets/pictures/517187091860e02ff5002401/content_fire-ants.jpg)

CONCLUSION

The mechanism underlying the selection of specific plants by animals during illness is still unclear. The study of animal self-medication and ethnomedicinal practices may provide important leads to future sources of medicine.

CONFLICT OF INTERESTS

Declared none

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