

Zoopharmacognosy: The Importance of Animal Self-Medication

By Alexa Swinhoe

Zoopharmacognosy is a behaviour in which non-human animals use natural resources to self-medicate. The study of this fascinating phenomenon has the potential to impact a host of vital areas, from cancer treatment to sustainability. In this article, I will delve into the mechanisms, causes of and evidence for zoopharmacognosy, as well as how it is significant to humans.

Animal self-medication may be prophylactic (to prevent infection) or therapeutic (to treat infection or illness), and can be in the form of deglutition (swallowing whole), ingestion (chewing and swallowing) or topical application (whole or as pastes) of plants, soils and even insects with medicinal properties. Animals primarily use topical application to treat infections, wounds and pain, and repel insects. It is commonly done by chewing leaves and rubbing them onto fur or skin, releasing compounds that are analgesic (pain-relieving) or antibacterial. Additionally, some animals select plants with secondary metabolites (compounds produced by the plant that make them competitive in their own environment) that deter herbivores and insects from eating the plant so they can act as olfactory cues for insects to avoid the animals. Self-medication for anti-parasitic purposes is also common. Animals may do this by swallowing whole plants with trichomes (fine appendages on the plant surface) that can attach to parasites and dislodge them from the intestine. Alternatively, the material ingested may contain antiparasitic compounds like phytochemicals (chemicals produced by plants to help resist a variety of infections) which can decrease the ability of worms to attach to the lining of the intestine.

Certain criteria have been established for judging whether a behaviour displayed is truly an act of self-medication, allowing us to distinguish it from other behaviours like ordinary eating! Firstly, the plant must be intentionally sought out for its medicinal properties - it can not hold nutritional value or be part of the animal's normal diet. Plants used preventatively against parasitic infection should be consumed during times of the year when parasites are more likely to cause infection, like the rainy season. Other animals in the group should not also participate in therapeutic behaviours. Additionally, there should be a plausible explanation as to why the substance has been selected (e.g. evidence of the medicinal properties and effects of the plant, and evidence of the effectiveness of the treatment).

There have been many theories proposed about how animals learn to heal themselves with natural resources. It is thought that self-medication in animals can be due to either learned or innate responses. Animals may have learned what plants have healing properties from watching other animals, or may have themselves learned through trial and error. Scientists have proposed that this also leads to the behaviour becoming an instinct through evolution - animals who learn these behaviours survive to pass them on until it becomes an innate response in the species. While zoopharmacognosy is not necessarily an indicator of intelligence if it is an instinct due to evolution, an animal exhibiting a behaviour for the first time may suggest a level of conscious decision and thought. However, much more research is necessary before any conclusion can be drawn in this area.

Although the term zoopharmacognosy was coined in 1987, the study of animal self-medication can be traced back to as early as 300 BC. In Ancient Greece, Aristotle documented how dogs eat grass when affected by stomach problems, as they lack the

enzymes needed to digest the grass fibres so it acts as an emetic. Although much of what was recorded in this period was purely observational (as opposed to being scientifically tested), it demonstrates that this has been an area of scientific interest for thousands of years.

Over recent years, evidence has accumulated pointing towards zoopharmacognosy being a very widespread phenomenon within the animal kingdom. Research has largely been carried out on primates, but self-medicating behaviours extend to birds, bears, elephants and even ants. Ants infected with the fungus *Beauveria bassiana* selectively consume harmful substances, like reactive oxygen species, which can damage DNA, RNA and proteins and can cause cell death upon exposure to the pathogen, yet avoid these when not infected. Bonobos have been observed to swallow unchewed stemstrips of *M. fulvum*, an action termed stemstrip-swallowing, to treat parasitic infestation. As it was only ingested at certain times, in small amounts and by a low proportion of the group, it was determined to be an instance of self-medication. Chimpanzees chew the pith of *Vernonia amygdalina* to treat worm infections, often having to actively change their travel routes to find it. It was mostly observed being consumed during peak rainy season when such infections are more common, despite the year-round availability of the plant, again indicating self-medication.



*A bonobo female selects stem of a *M. fulvum* plant for stripping in an act of self-medication.*

The most recent, topical and, some may say, exciting evidence of zoopharmacognosy is the first systematically documented report of active wound treatment in an animal using a plant with known medicinal effects. A male Sumatran orangutan known to researchers as Rakus sustained a facial wound, likely from a fight with another male, on June 22nd 2022. On June 25th, after feeding on the stem and leaves of *Fibraurea tinctoria*, which these orangutans rarely consume, he began to apply the juice from chewed leaves onto his wound with his finger. This was repeated several times. Rakus then applied plant pulp onto the wound until it was fully covered. By June 30th the wound was closed, and by July 19th it was fully healed. *Fibraurea tinctoria* has since been pharmacologically tested and has been found to

have analgesic (pain-relieving) and antipyretic (fever-reducing) properties. It contains furanoditerpenoids, a group of compounds reported to have antibacterial, anti-inflammatory, anti-fungal, and anticarcinogenic biological effects. It also contains a high concentration of protoberberine alkaloids, which have a huge range of medicinal properties, including being anti-inflammatory, analgesic, anticonvulsant, antiarrhythmic, antihemorrhagic, and antitumoral among other things. As Rakus only applied the pulp and juice of the plant to the wounded area, and he selected such a medically beneficial plant, scientists have agreed that it is safe to assume that this was an intentional act of wound treatment.



Left: Pictures of *Fibraurea tinctoria* leaves. Right: Rakus feeding on *Fibraurea tinctoria* leaves.

So, how can animals like Rakus and their unique knowledge be used to improve human medicine? Throughout history, observing the self-medicating behaviours of animals has led humans to discover plants with medicinal properties. Pliny, an Ancient Roman naturalist, credited the discovery of wild oregano (dittany) as a treatment for arrow wounds to watching wounded deer graze on the herb; Aristotle credited the same discovery to observing wild goats. It is now known that wild garlic has many phytochemical compounds that provide antiseptic, anti-inflammatory and coagulating effects, and it is hence recognised as a medicinal plant.



Depiction from English Medieval Bestiary of wounded deer grazing on dittany

In the 1970s, anthropologist Wrangham observed chimpanzees swallowing *Aspilia* leaves whole. After testing these leaves, scientists managed to extract thiarubrine-A. This compound was able to kill a variety of worms, fungi and viruses. It was then found to be an excellent antitumoral drug, able to kill cancer cells of solid tumours in the colon and lung. Evidently, studying what animals consume or use as medicine can lead us to the discovery of bioactive compounds with therapeutic potential that inspire the development of new drugs for humanity.

As a result, zoopharmacognosy highlights the importance of protecting biodiversity. Due to deforestation and climate change, 40% of plants are now threatened with extinction, especially in the tropical rainforest where so many medicinal plants are found - 25% of all modern Western drugs are derived from rainforest plants. Knowledge and awareness of the value of these plants promotes the need to protect them, and should inspire more serious conservation efforts. Furthermore, it emphasises the need to protect habitats so we can continue to study animal behaviours that lead us to new treatments. Imagine how many undiscovered revolutionary treatments we could lose if we continue to stand by while so many diverse ecosystems are destroyed.



Deforestation of the Amazon rainforest

Zoopharmacognosy also provides valuable insight into the cognitive processes of animals, shedding light on how they learn and process information, as well as highlighting the evolutionary processes behind animal behaviour. It also connects modern and traditional medical knowledge. Indigenous communities have long observed animals to identify medicinal plants. Integrating this with scientific research validates these ancient practices, allowing scientists to understand the mechanisms behind them. Also, incorporating zoopharmacognosy into conservation efforts can benefit local communities economically as it allows medicinal plants to be harvested and sold while protecting the environment.

Thus, the study of zoopharmacognosy should not be underestimated for its potential to improve our understanding of the natural world and the way we interact with it. As this

discipline continues to develop, and as society continues down a path of environmental destruction, I am certain that its importance will only become clearer.