Self-Medication Pharmacon

Evolutionary connections between plants and animals

Through evolution, animals have developed a relationship with medicinal plants, since it is in their interest to use a plant's resources as well as their own immune system to maintain health and speed up healing mechanisms. Animals requiring the plant's medicinal properties acquire a taste for them, while the plant's bitterness deters the healthy animal from eating it, thus the plant is protected from being regularly targeted for consumption, and the healthy animal is protected from ingesting possible plant toxins.

From elephants to caterpillars

Accounts of self-medicative behaviour have been published on a number of animals, including primates, mice, wood rats, sheep, goats, elephants, crows and parrots to name but a few. This behaviour has also been well documented in less cognitively complex animals, particularly caterpillars (where the term 'pharmacophagy' is sometimes used instead), as well as fruit flies and bees. Although self-medication has not been investigated in every animal, the fact that this behaviour has been observed in such a diverse range of distantly related species suggests that this ability has been conserved throughout the evolutionary history of the animal kingdom.

A study by Singer et al. (2009) has shown that caterpillars infected by parasitoid wasp larvae forage for alkaloid rich plants such as poison hemlock that weaken and ultimately destroy the larvae. Then a further study on self-meditative-behaviour in caterpillars (Smilanich et al. 2011) showed that different types and stages of infestation influenced the caterpillars' foraging strategies in different ways. Caterpillars with late-stage wasp larvae infestations preferred the alkaloid rich plant whilst those infested with fly larvae favoured plants rich in chemicals called iridoid glycosides. Early stage wasp-infested caterpillars preferred the antioxidant plant.

If we are to transulate this into what we see our animals, or even ourselves do, we would see those that are at later stages of illness seek out more potent remedies such as essential oils, while those that are at the early stages of desiese where symptoms are not always obvoius, nutrients would be the disered remedy, so the stimulate the imune ststem, stimulating the body to heal itself. Medicines and plant medicines do the work for the body.

Why do animals poison themselves?

Evolution would certainly have selected against a behaviour that causes animals to seek out poisonous plants. Between 1997-2006 a study (Berny et al. 2010) collating all the recorded poisonings in animals in five European countries, (France, Belgium, Italy, Spain and Greece) was carried out. They found no reported cases of plant poisoning with wild animals; and with companion animals only 3.9% were linked to toxic plant consumption, while the rest were due to artificial chemicals such as pesticides and antifreeze. It was also reported that in France, 95% of the 3.9% of the toxic plant poisonings were due to non-native ornamental house plants, which companion animals would not have been exposed to during their evolutionary history.

Poisonings can also be due to artificial content (anti freeze); accidental, prescribed overdose (not animal self-selection) and the inability to sequentially select, this is especially true when a herbivour is confined and cannot forage. Animals are generally good at adapting to their environment, for example, those that are exposed to plant toxins, such as tannins, start producing proteins in their saliva that bind to them, allowing the animal to tolerate more tannins next time.

Plants not encountered during an animals recent evolutionary history

One of the explanations for why many ornamental house plants are toxic to pets is that for tens of millions of years the ancestors of cats, dogs and horses have been isolated from tropical areas, where many exotic household plants originate. This isolation would mean that their ancestors would never have had the need to evolve the identification and detoxification mechanisms to deal with these toxins.

This theory would also apply when other poisonings occur due to an animal coming into contact with chemicals that they don't recognize; a dog may drink anti-freeze because it has not evolved the ability to identify artificial chemicals. In contrast, the vast majority of terpenes and terpenoids, which are the primary constituents of essential oils are widespread, so animals will have been exposed to these throughout their evolutionary history, therefore they are able to identify and avoid constituents that are not needed.

Animals can recognise the constituents in essential oils

Terpenes (volatiles found in essential oils), have global distributions that are found in hundreds of different plant species. Terpene synthases are pretty ancient; they first appeared around 360mya just before Pangea formed and must have spread throughout the super-continent, since they are present in all the continents today. Therefore the ancestors of today's animals would have all co-evolved with these constituents so can accurately select essential oils.

In contrast, alkaloids, which seem to be more toxic, have comparably limited global distributions. They first appeared around 130mya, just as the continents were beginning to separate. The comparative rarity and restricted distribution might have provided less evolutionary pressure for animal ancestors to evolve the means to deal with them (of course other factors will also be involved).

Why dogs poison themselves on chocolate and grapes

It is well known that chocolate can poison dogs. This is due to its theobromine content, an alkaloid found in the cocoa plant that dogs cannot metabolize very well, but humans can. Chocolate also contains other ingredients, most notably sugar and flavourings such as vanilla. It may be that the additional ingredients in chocolate mask the smell and taste of the theobromine, thus preventing the dog from perceiving it as distasteful (just as adding sugar to other medicines makes them more palatable). Evolutionary separation may be another explanation in this case, as cocoa plants are native to the Amazon where dogs have had no evolutionary ancestor.

The Veterinary Medicine Association suggests that grapes and raisins can be toxic, and fatal to dogs in some instances, however, the first reported case of grape poisoning in dogs was as recent as 1998, which should pose some questions. Initially I found grape poisoning with dogs very confusing, since dogs have evolved with grapes.

Observational research has perhaps shone some light onto the subject. Captive meerkats roll some of their grapes in powdered green clay before eating them and not others. Green clay is a well-known detoxifier. Also parrots have been seen pealing the skin off some grapes but not others. It has been proposed that the culprit might be a mycotoxin (a fungal toxin). There are around 400 different mycotoxins produced by fungi, could it be a strain that certain dogs cannot recognise? There are also plausable links to fluoride due in the pesticide cryolite. in the 2014 annual use summary report issued by the California Department of Pesticide Regulations, it states that cryolite is allowed on organic crops. Wild dogs such as coyotes and wolves have been known to forage on grapes and in some parts of the world they eat them regularly and don't seem to develop acute renal failure. This is a subject that needs further investigation.