Why cats are fussy eaters but dogs will consume almost anything

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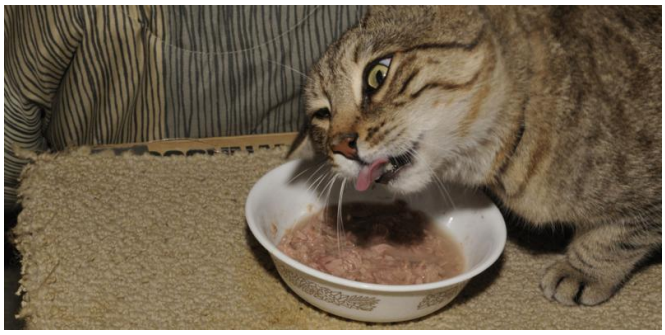

Credit: Robert H Howington/Flickr, CC BY-SA

Anyone who's watched a cat throwing up after munching on grass knows that our feline friends aren't natural plant eaters. So you might be surprised to discover that these carnivorous animals share some important genes that are more typically associated with herbivores. And this might help explain why cats aren't always easy to please when it comes to food.

New research suggests that cats possess the genes that protect vegetarian animals from ingesting poisonous plants by giving them the ability to taste bitter. Animals use their sense of taste to detect whether a potential food is nutritious or harmful. A sweet taste signals the presence of sugars, an important source of energy. A bitter taste, on the other hand, evolved as a defence mechanism against harmful toxins commonly found in plants and unripe fruits.

Evolution has repeatedly tweaked animals' taste buds to suit various dietary needs. Changes in an animal's diet can eliminate the need to sense certain chemicals in food, and so receptor genes mutate, destroying their ability to make a working protein.

One example of this comes from strictly meat-eating cats, who can no longer taste sweetness. But if bitter detection evolved to warn of plant toxins, then it stands to reason that cats, which (usually) eschew plants, shouldn't be able to taste bitter either. Humans and other vegetable-munching animals can taste bitter because we possess bitter taste receptor genes. If cats have lost the ability to taste bitterness, we should find that their receptor genes are riddled with mutations.

Geneticists at the Monell Chemical Senses Center in Philadelphia scoured the genome of cats and other carnivorous mammals like dogs, ferrets, and polar bears to see if our carnivorous cousins have bitter genes. They were surprised to find that cats have 12 different genes for bitter taste. Dogs, ferrets, and polar bears are equally well endowed. So, if meat eating animals are unlikely to encounter any bitter morsels, why do they boast genes for tasting bitterness?

Taste test

I can haz chlorophyll. Credit: Lisa Sympson/Wikimedia Commons, CC BY-SA

To find out, Peihua Jiang, a molecular biologist at Monell, put cat taste buds to the test. He inserted the cat taste receptor gene into human tissue cells

in the lab. When combined, the cell and the gene act as a taste receptor that responds to chemicals dropped onto it.

Jiang discovered that the cat's taste receptors responded to bitter chemicals found in toxic plants and to compounds that also activate human bitter receptors. The cat bitter taste receptor, known as Tas2r2, responded to the chemical denatonium benzoate, a bitter substance commonly smeared on the fingernails of nail-biting children.

So why have cats retained the ability to detect bitter tastes? Domestic cats owners know how unpredictable cats' dietary choices can be. Some of the "presents" cats bring to their owners include frogs, toads, and other animals that can contain bitter and toxic compounds in their skin and bodies. Jiang's results show that bitter receptors empower cats to detect these potential toxins, giving them the ability to reject noxious foods and avoid poisoning.

But how often do meat-loving cats actually get exposed to bitter and toxic compounds in their diet, compared with the plethora of plant toxins that their vegetarian counterparts have to contend with? Jiang suggests this is not enough to explain why cats have retained such an arsenal of receptors.

Instead, cat taste receptors may have evolved for reasons other than taste. In humans, bitter taste receptors are found not only in the mouth, but also in the heart and in the lungs, where they are thought to detect infections. It remains to be seen if feline bitter receptor genes also double-up as disease detectors.

Hair of the dog. Credit: Michal Hrabovec/Flickr, CC BY-NC-SA

The discovery of feline bitter receptors might explain why cats have got a reputation as picky eaters. But their unfussy canine counterparts have a similar number of bitter taste receptors – so why are cats so finicky? One answer might lie in how the cat receptors detect bitter-tasting compounds. Research published earlier this year by another team of researchers showed that some of the cat taste receptors are especially sensitive to bitter compounds, and even more sensitive to denatonium than the same receptor in humans.

Perhaps cats are also more sensitive to bitter chemicals than dogs, or they may detect a greater number of bitter compounds in their everyday diet. Food that tastes bland to us or to a dog could be an unpleasant gastronomic experience for cats. So rather than branding cats as picky, perhaps we should think of them as discerning feline foodies.

More information: Michelle M Sandau et al. A functional comparison of the domestic cat bitter receptors Tas2r38 and Tas2r43 with their human orthologs, *BMC Neuroscience* (2015). DOI: 10.1186/s12868-015-0170-6

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