Palatability: feline food preferences

Author : Tim Watson

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Tim Watson discusses how getting cats to eat can be influenced by factors such as the animal's own dietary requirements – and that of its mother

Summary

Palatability describes how readily a food is accepted and measured in terms of its attractiveness and consumption. It has long been believed that palatability of cat foods is determined by sensory characteristics – notably smell, taste and mouth-feel – and previous experiences. Cats are highly specialised carnivores, with high protein requirements, and this is reflected in their sense of taste. They are attracted to some amino acids, allowing them to identify foods rich in protein, but avoid bitter stimuli and do not select foods on the basis of their sugar or salt content. Preferences are also strongly shaped by experiences as kittens, with early exposure influencing food choices in later life. Cats become averse to long-term feeding of a single food, which may be a mechanism to avoid potential nutritional imbalances associated with monotonous consumption and reflects an inherent drive to seek variety. Recent research has shown that cats demonstrate "nutritional wisdom" and select foods in order to meet specific intake targets of protein, fat and carbohydrate. This new science may reframe our understanding of palatability and indicates that underlying nutrition plays a far greater role than previously understood. In fact, tastants or palatability cues may simply be sensory mechanisms by which cats identify foods with a good nutritional composition, mediating an initial attraction that is only sustained if the diet proves to be of appropriate nutritional quality.

Key words

cat, palatability, food preference, macronutrient target

PALATABILITY, along with nutritional quality and digestibility, is a key attribute of pet foods and is as important to manufacturers as it is to cats and their owners.

But what does the term palatability actually refer to? In addition, what determines whether a cat will eat a food and, if so, how much?

Nutrition scientists have worked hard to understand what makes a food attractive to cats. This knowledge is explored in this article, in terms of the dietary evolution of cats, what we know about their sensory physiology and how – together with dietary experiences – it shapes domestic cats' feeding behaviour.

Research has, however, challenged the view that cats simply select foods based on sensory properties and previous experiences.

It provides compelling evidence that cats, when given freedom to choose their own diet, adapt the intake of key nutrients to meet specific targets.

This suggests that nutritional content is a key driver of palatability, with tastants acting as a "navigational aid" to help identify nutritional composition and quality.

What does palatability actually mean?

The purpose of food is to provide energy and essential nutrients, but this can only be achieved if the animal is willing to eat it. This willingness is not necessarily a measurable property of the food because it depends on a number of individual factors that influence whether a meal is consumed.

These include the animal's sensory perception of that food, as well as the shaping of acceptance by previous experiences and genetic variation.

It is thus an animal's response to a food that is defined by the term palatability. With regards to pet foods, this is usually measured by how much is eaten on a meal or daily basis, or whether diet A is preferred to X, Y or Z when different products are offered simultaneously. A palatable diet could, therefore, be sufficiently acceptable to cats so that they consume amounts adequate to meet requirements for energy and essential nutrients – or it might simply be preferred by more cats.

What determines the palatability of a food?

The key determinants of a food's attraction are its sensory characteristics – notably smell, taste and mouth-feel. These features, together with learning from previous experiences with the same or similar foods and possible genetic factors, have traditionally been believed to shape food choices made by cats and have been linked to their nutritional evolution.

Cats are highly developed carnivores – technically termed hypercarnivores – that have evolved to consume almost exclusively vertebrate prey[1]. This is reflected in their nutritional needs, dental anatomy and digestive physiology, as well as their taste systems.

Unlike dogs, which hunt in packs, cats are solitary hunters and so usually take live prey, such as mice, voles, small rabbits and birds, with a body mass less than their own. The habit of consuming live prey has led to a preference for foods at body temperature and for multiple, small meals throughout the course of the day.

The feline taste system is similar to other carnivores, but, as they have evolved as obligate meat eaters ([Figure 1]), it is further specialised to provide for their high requirements of protein and specific amino acids, such as methionine and cysteine, and need for taurine and arginine that can only be met by the consumption of animal tissues[2].

Cats have highly sensitive taste receptors to acidic and bitter stimuli, which allow them to identify foods rich in selected amino acids and avoid bitter or sour stimuli associated with potentially toxic ingredients[3],[4]. It is, therefore, not surprising that in palatability tests, cats prefer foods that contain substances associated with meat and fishbased diets[5].

Cats lack sweet taste receptors and do not select foods on the basis of their sugar content[6]. This insensitivity to sugars is unlikely to be a problem for cats, as they derive little nutritional benefit from sugar-containing foods, such as fruits. Their preybased diet contains less than five per cent carbohydrate on a calorie basis[7]. It has been suggested that the inability to taste sugars enables better appreciation of essential amino acid balance within foods by removing any masking effect from sugars[8].

Although the precise contribution of odour to palatability is less clear, cats are believed to have an acute sense of smell that works in tandem with taste to inform about a food's suitability and safety. Form and texture are important, with the particle size of dry foods and viscosity or stickiness of wet foods being prominent factors ([Figure 2])[9].

Effects of experience and genetics

It is clear that cats do modify their food preferences based on experience. In the wild, this ensures they avoid repeating disadvantageous feeding experiences associated with nutritionally incomplete or potentially toxic prey. Domesticated cats also express this behaviour, although it is most commonly manifested as a growing aversion towards foods that form a large part of their diet[10].

This so-called "monotony effect" reduces the perceived palatability of habitual foods in favour of a novel food with contrasting sensory characteristics. This could represent a mechanism by which cats avoid long-term consequences associated with consuming foods that are unbalanced in one or more nutrients. Alternatively, it may reflect a hard-wired drive to seek variety – a survival strategy that avoids dependence on a single food source or, indeed, minimises the risk of depleting a single source of prey.

Powerful monotony effects are observed in kittens as well as adult cats, and appear to be stronger in free-ranging cats than those living in households and exclusively fed nutritionally complete diets[11].

This supports the belief that the monotony strategy works on the assumption that two foods, with markedly different flavours, are not both likely to be nutritionally incomplete.

It is during early life that food selection is most plastic and easily modified, with kittens strongly influenced by the preferences of their mothers ([Figure 3])[12]. This effect stems from the mother bringing food to the kitten, as well as her simply being present when a new food is introduced[13].

It is also possible that maternal influence starts before weaning, with the transfer of flavours via amniotic fluid and milk. This is supported by the observation that kittens born to mothers trained to eat unusual foods, such as potato and banana, will select their mother's diet in preference to meat[14]. A more recent study confirmed this, showing that kittens exposed to cheese flavours during uterine and early postnatal life via their mother's diet were more likely to select cheese-flavoured foods[15].

The bias that cats show towards their mother's diet may be a manifestation of neophobia, the magnitude of which is related to the contrast between the new foods' sensory attributes and those of the foods they, or their mother, were accustomed to. This effect can be reduced by weaning kittens to varied diets, which results in them having broad food preferences throughout life[8]. The triggering of neophobia appears to be reduced in these instances, because any new food is likely to have some similarity to those already experienced. Genetics appear to play only a small role in determining food preferences, with differences between cat populations more readily explained by their feeding experiences, rather than genetic diversity[16].

Importance of nutrition in determining food palatability

Compared with other species, relatively little information is available about the role of specific nutrients in food selections made by cats.

It is known that they do not select foods on the basis of their sweetness[3] or salt content[17], and some evidence suggests cats can develop learned aversions or preferences when foods are lacking in certain nutrients.

Because of the cat’s high protein requirement and nutritional peculiarities related to amino acid requirements, it is the response to dietary amino acids that has been most frequently studied. Cats exhibit a severe depression in food intake, together with a learned taste aversion, when fed a diet deficient in arginine[18].

They also show initial preference for diets containing adequate methionine over methionine-free diets, although this preference is not maintained beyond two days of feeding19 and cats will tend to avoid diets lacking isoleucine[20].

By contrast, kittens willingly consume diets with excess leucine[21] and adult cats continue to consume diets deficient in essential taurine, despite their taste system having the ability to detect this amino acid[22].

These studies indicate that the metabolic feedback from specific amino acids is complicated and raises the question of whether they select proteins, rather than essential amino acids. A prev ous attempt to answer this led researchers to conclude that cats do not select for or against protein, even if this results in the consumption of protein-deficient diets, with the consequent detriment to growth[23].

Evidence has emerged that minks, which are also hypercarnivores, are able to modify feeding behaviour to balance protein and fat intake[24].

This prompted re-evaluation of the effects of protein, as well as fat and carbohydrate, on cats’ food selection[25].

This showed that cats modify choices and consumption of foods to regulate their intake of protein, fat and carbohydrate and achieve a target balance. Cats consistently choose to eat diets with specific macronutrient profiles equivalent to a daily intake of around 420kJ protein, 280kJ fat and 100kJ carbohydrate ([Figure 4]). These values equate to a diet containing 52 per cent of energy as protein, 36 per cent as fat and 12 per cent as carbohydrate.

The research also revealed how cats prioritise nutrient intakes when fed diets that do not enable them to meet targets. When given foods high in carbohydrate and lower in protein, they did not eat more to achieve the protein intake target because of a ceiling on carbohydrate intake of 300kJ/d (20.5g/d). There was more flexibility in consumption of fat and protein, with cats overshooting their target intakes to meet protein or energy requirements.

What does research tell us about nutrition and palatability?

These latest findings indicate that the palatability of cat foods is intimately linked to their nutritional profile, with cats choosing foods to meet an “intake target” of protein, fat and carbohydrate. The benefit to the cat of achieving the intake target is not clear, although in other species it has been suggested as a target to support optimal performance[26].

Given how cats have evolved, it comes as no surprise that the targets expressed are similar to the composition of their natural vertebrate prey, particularly in relation to protein and fat, and queens' milk ([Table 1]). They do, however, differ with regard to carbohydrate.

While domestic cats selected diets with 12 per cent energy from carbohydrates (8g/day to 10g/day), a prey-based diet of six to 12 small rodents would contain – at most – 3g of carbohydrate that is equivalent to just four per cent of energy. The reasons for this discrepancy remain unclear.

When the macronutrient targets are compared with the composition of commercially available cat foods, meat-based wet foods have protein content similar to the target, but they contain slightly more fat ([Figure 5]). Dry diets have less protein, but a similar fat content. The most obvious difference is in relation to carbohydrate – wet foods contain minimal amounts of carbohydrate (less than 15 per cent energy) compared with up to 40 per cent in dry foods.

This raises the question of whether wet cat foods are inherently palatable because their nutritional profile is more closely aligned to intake targets.

If this is the case, palatability may reflect a response to nutritional adequacy, rather than just sensory properties. Indeed, the inherent nutritional wisdom shown by cats suggests that no amount of tastants or attractants will overcome the food's basic nutritional quality.

While the majority of cats readily consume foods in either wet or dry formats, it is interesting to speculate whether macronutrient targets are linked to the monotony effect seen with long-term feeding of a single food. Could this be a mechanism by which owners are forced to offer alternative foods, thereby satisfying the cat's need for variety while allowing them to select foods that enable them to meet nutritional targets?

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