A Review of the Current Methods Assessing Food Preferences in Dogs and Cats

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Abstract
Food is a major aspect of pet care; therefore, ensuring that pet foods are not only healthful but also attractive to companion animals and their owners is essential. The petfood market remains active and requires ongoing evaluation of the palatability – foods' characteristics enticing animals and leading them to consumption - of new products. Based on the type of information needed, different pet populations (expert or naïve) can be tested to access their preference and acceptance for different food products. Classical techniques are the one-bowl and two-bowl tests, but complementary (i.e. operant conditioning) and novel (i.e. exploratory behavior) approaches are available to gather more information on the evaluation of petfood palatability. The methods can be combined to have the best view of the different dimension of products palatability.

Keywords: pet food; palatability; acceptance; preference; dogs; cats; emotional palatability

1. Introduction

The hedonic aspect of food is often defined by the organoleptic properties of the product but also through the nutritional and physiological post-ingestion effects. Palatability is related to how readily a food is accepted and measured in terms of its attractiveness and consumption. Because understanding animals' preference is not obvious, indirect objective methods have to be developed in order to rank different products based on animal feeding behaviors and reactions. Assessment of palatability in companion animals is strategic for developing foods, treats and (oral) medications that they will consume. Feeding pets or giving them treats is a key moment which strengthens the bond between the owners and their animals. Referring to emotions and perceived palatability, recent protocol developments also took into consideration owners' perception of their pets' feeding enjoyment and consequently their perception of a diet's palatability.

2. Panels and Methods Classically Used to Assess Food Preference and Acceptability

2.1 In-Home and expert panels

Palatability assessment tests can be run on two types of animal panels: either in pet centers with expert panels or in an in-home environment with owner's pets. Both approaches have advantages and constraints [1]. During the product development stage, the scientific and technical questions will lead towards one or the other option. Expert panels perform palatability tests on a daily basis. They can be

specialized on one type of food (dry only or wet only) or test different types of diets. The expert pets are more reliable and accurate than in-home pets, but need intensive training (to be exposed to a diversity of foods), qualification tests (when one product is known to be highly palatable compared to the other or when products are known to be equal to check that animals select as expected) and a permanent quality follow up (to check their accuracy in discrimination, reproducibility of answers, and potential side bias) [2]. The repeatability of testing conditions and the control of environmental perturbations are also among the key-characteristics of expert panels. To build such supervised "samples" of expert animals and to analyze this type of data (bimodal distribution), a minimum number of 30 individuals is necessary to secure statistical robustness. [2].

In-home panels are constituted of naïve family-owned pets that are selected according to different criteria- (age, sex, dietary history, etc.). These tasters have a lower testing frequency than expert panels and testing conditions are less controlled. In-home pets feeding history can be vague and can lack diversity (at least in comparison with expert panels). It is very difficult to make sure that the testing protocol has been respected and that the owners' perceptions have not biased objective measurements. For all these reasons, palatability tests performed in such panels should include a lot more animals: ideally ≈100. The automation of the data collection can also provide additional reliability for the quantitative data gathered [3]. On the other hand, the main advantage of an in–home panel is in providing data representative of the final market: to get "real-life" feedback. Furthermore it is a good way to evaluate owners' reactions to the products' cosmetics and about their perception of palatability through pet-centric criteria.

Griffin et al. [1] found more consistency between the different panels when testing wet products. It was also noted that in-home panels may be more stable in their preferences [1] but that expert panels may be better discriminating small differences.

2.2 Preference and acceptance tests

Two protocols are most commonly used: 1) Preference test based on a simultaneous presentation of two diets, were the preference is assesses through quantities eaten of each product; 2)Acceptance test consisting in the presentation of one diet only and in the assessment of the quantity eaten, as the expression of the product's intrinsic palatability. The food can be available for a limited period (for dogs for example) or for a longer period (or even *ad libitum*) to reproduce the 'natural' conditions encountered in the home environment or, to respect a more natural feeding rhythm, for cats particularly.

The two-bowl test compares two products (mainly in expert panels) and establishes a preference based on the difference of quantities consumed. Waterhouse & Fritsch [4] and Gershoff et al. [5] described the general method and the possible factors that could influence the results. In such tests, two identical bowls are delivered simultaneously to the tested animal, each bowl containing one of the two products to be tested (A or B). The animal has free access to the bowls for a preset period of time. The quantity available in each bowl is more than sufficient to cover the energetic requirements. At the end of the feeding time or when one bowl is finished, bowls are taken back and weighted again to measure the quantity consumed. For each pair of products tested a second test maybe necessary, this time switching their relative position, in order to control any position bias. This second measure enables an evaluation of repeatability.

Important parameters in this two-pan test include the first choice (first food product tasted, reflecting the olfactory perception and attractivity), the amount of food consumed, the ratio (A/B) of food consumed, the percentage of food intake (A/(A+B)) [6] and the preference ratio (quantity of food A consumed over the total of food distributed). Usually the percentage of consumption is used [7]. The two-pan test enables a ranking between different products but is not transitive as the 'preference' is based on a forced choice. The palatability of the diet is not considered *per se* but in comparison to the other diet, which means that all the paired comparisons should be tested.

Some versus trials are conducted with pets in-home [3], but it is generally less precise in this condition due to the lack of environment control [2,4,8].

One inconvenience of two-pan testing is that the method does not offer control of how different foods (smell and taste) may affect the palatability of each other or of the long-term effects of caloric and nutritional value. This technique may also lead to animals consuming excessive quantities of food, if necessary human resources are not available to remove bowls when one is finished, or enough food from both bowls is consumed.

The monadic test [9], in which the animal has free access to a single food for a determined amount of time, is used to assess the acceptability of a food product. A control diet for comparison is not necessary. This method is quite similar to the situation that can be found at home where a pet-owner introduces a new food product [10] and, thus, is well adapted to in-home panels. The indicators of this kind of testing will be mostly the quantity consumed and sometimes the speed of consumption. Furthermore, when tested in-home, it is possible to use questionnaires in order to enrich the information gathered. For example, additional data such as human perceptions of the food [11] or the animals' enthusiasm to eat it [11,12] can be collected.

Several factors can influence the results of the one-bowl test such as the seasonal effect (i.e. in cats: eating less during winter [13]) or a daily variation (i.e. dog eating more during their afternoon meal compared to the morning meal; personal communication) requiring a calculation of a reference consumption level and adapted distributed ration that would take into account those factors.

3. Complementary Methods and New Approaches

3.1 Liking test

The Liking test consists of a one-bowl test with adjusted food quantity (which enables the animal to finish the bowl, but not frequently) [14] available for a preset period of time. The monitored indicators reflect meaningful criteria for owners in the understanding of their pets' feeding enjoyment: the percentage of finished bowls and refusals, the consumption speed or the gap with the reference consumption rate of each individual between groups' means on fixed variables. A random variable is used to take into account the individual variability and to extrapolate the results to a larger population.

3.2 Kinetics of consumption

Cumulative intake on a moment-by-moment basis over a long period can provide quantitative information about individual feeding styles (rapid eaters vs slow eaters), the way animals distribute their feeding between two foods in a choice test and, in some cases, the initial disruptive effects of a new diet [10]. Using a monadic method on a preset period (over 20h for instance) with a follow up of the quantity consumed helps to compare the profile of acceptance of the different products [15] which did not distinguish one from the other during the preference test (versus test). Kinetics can be used to measure new indicators of performance and enjoyment, including criteria reflecting attractivity: average time before the first visit (passage or feeding events), average consumption per feeding events, number of passage without consumption, etc. or post ingestive effects such as number and regularity of the visits and meals size.

3.3 Operant conditioning

Operant conditioning is a procedure used to assess the strength of an animal's motivation to eat [24]. This method used to compare quantitative and qualitative differences requires a specific motor action directed to specifically designed device such as a lever-pressing apparatus [16,17] or through human-animal interaction (e.g. nose-touching on experimenter's hand; [18]). This kind of approach (concurrent schedule paradigm) assesses animal's reactivity to food with minimum post-ingestion

complications (relatively small food quantity) and enables comparison of very different food products as it is the 'currency' (motivation to work) that is compared.

Araujo & Milgram [19] developed a method based on associative learning (object discrimination learning task) where the animal can express a preference without any food intake. The dog can interact with three different objects, two of them paired with different types of food. Once the animal develops a preference for a specific object (and its associated outcome) the pairs are switched and the dog has to learn the new association if he wants to keep receiving its 'preferred' food product. The no reward object provides a control for individuals without any preference between the two compared foods. The results suggest that the CPAP is less sensitive to the effects of prior feeding and satiation than the two-pan test [20].

Technically demanding and time consuming, operant conditioning methods requires highly trained individuals, tested over a relatively long period but can be performed on a small sample size even with in-home panelists. Concurrent schedule paradigm and CPAP methods may not be biologically relevant as they are very different from the real living conditions and feeding habits of the pets.

3.4 Exploratory behavior

Recent studies assess differences in the perceived palatability of products using a spontaneous behavior such as the olfactory exploration. In the Becques et al. [21] study for instance, the cats were video recorded during their feedings over several days. Behaviors and postures were coded according to different categories and correlated with food intake measures. In the dog study [22] individuals first had the opportunity to taste the different food products before experiencing the situation where a wire mesh was impeding the access to the different bowls. The authors looked at the time spent exploring both food locations. The results revealed that cats [21] spent significantly longer sniffing at the product less preferred. Dogs were the opposite [22] exploring longer the preferred food product. The difference between the two species could be explained by their natural history and dietary behavior or by the difference in the protocol used, as cats could access the food product at the end, while dogs could not

4. Conclusion

Each of the methods counts advantages and disadvantages but are complementary, can be combined and finally deliver an in-depth evaluation of pet foods' comprehensive palatability and performance. New assessments integrate the triangular relationship in petfooding: considering not only the behavioral expressions of pets but also the interactions with their owners and finally the owners' perception of their pet enjoyment.

	What for?	Limits?	What else?
Two-bowl tests	- New products in development - Measurement of fine differences (ingredient effects on same kibble base, screening of new formulas…) - Rather on expert panels	- Forced comparison in expert panel ≠ in-home - Not adapted to compare different nutritional values	-CPAP to remove the influence of food intake - Kinetics to differentiate palatability levels with new criteria and visualize how preference has been built
One-pan tests	**On expert panels:** - Product development validation - Measurement of product acceptability in natural conditions, of specific criteria related to enjoyment observation or to nutritional specificities such as weight management… -Comparison of expected bigger differences **On in-home panels:** - Access to owners perception	- Lack of accuracy due to uncontrolled parameters - Possible Subjective interpretation of owners	- Kinetics to differentiate iso palatable products with new criteria or analyze consumption of different nutritional values or physiological effects - Liking Tests for new enjoyment and behavioral criteria

Table 1: Summary of the pros and cons of the different methods

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