

Kinetics of consumption, an innovative tool to measure cat food palatability and satiety

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Abstract

Classical methods to measure how animals appreciate food consist in measuring the food intake. The amount of food eaten by the animal during the meal is indeed one of the first criteria that will be perceived by the owner as a sign of palatability. However, the cat feeding and the amount of food eaten is composed of multiple small meals during the whole day. Therefore the way the animal consumes its food over time is another indicator of pet food palatability performance that can be perceived by owners. The analysis of relevant criteria obtained from kinetics of consumption allows characterizing precisely the food consumption profile over a period of time and studying how food characteristics can modify it. 38 different sessions on 40 cats each and more than 100 diets were used to understand the cat behavior during its consumption throughout the day. A dozen criteria were studied as well as their relation to the two-pan tests consumption ratio results and to the food characteristics. Data from individual kinetics were statistically analyzed using a mixed model (SAS®), with the individual animal effect as a random variable and the product and day effect as fixed variables. The results led to the identification of seven relevant criteria from the kinetics, such as the average time before the first approach to the diet, the number of cats with at least one approach with low consumption or the evolution of the consumption through the time. These new criteria were selected according their power to discriminate different diets but also according their interest to discriminate a satiety effect from a low palatability effect. For instance, the average consumption during the first feeding event of the cat should for a satiating product should be equivalent to a standard product since the satiating effect is not activated at this first event. So the consumption level at the first feeding event is also a very useful criterion included in the final list of the seven selected criteria. To conclude, this new method allows a more in-depth evaluation of the petfoods' performance and give additional information such as food attractivity, which is meaningful for the owner in his perception of pets' enjoyment.

Key words: cat, kinetic of consumption, attractivity, weight management

1. Introduction

According to the Association for Pet Obesity Prevention (APOP, 2014), 58% cats and 53% dogs are overweight or obese in the US (<http://www.petobesityprevention.org>). Overweight and obesity are the result of various factors including breed, age, sex, neutering (hormonal influences), exercise, owner style effects. Ultimately, it is the consequence of an energetic imbalance between expenses and requirements (Zoran, 2010). Reduction of energy intake is therefore essential in weight loss programs and obesity prevention. The main nutritional strategies to decrease energy intake consist in reducing diet caloric density or using satiating foods that decrease and delay pet hunger. However, in both cases it is mandatory to develop foods with a high attractivity (no food refusals) in order to encourage owners to support their pets' weight management program. If these conditions are not met, pets will develop begging and scavenging behaviors and owners will be tempted to provide food amount exceeding animal's requirements (Weber, 2007). Pet food experts thus need to develop diets showing the right balance between palatability and satiety. Therefore, a strong need of new measurement methods occurs to assess these new petfood characteristics.

2. Palatability and satiety measurement

2.1 Classical method

Palatability can be defined by the capacity of a food or an ingredient:

- to attract pets and stimulate their appetite
- to motivate them to eat the food
- to satisfy the pet during the consumption and procure the enjoyment

The more palatable is the food, the better it is eaten. It's measured by the intake of a food expressing food acceptance or preference. In order to assess the palatability of a petfood product, 2 types of trials are commonly conducted: the monadic test and the two-bowl versus test. The versus test is the forced-choice test usually used to know which product is preferred by the pet. This information represents a great interest for the petfood industry aiming at developing markedly improved new products over the existing ones.

In both tests the amount of food eaten by the animal during the meal is indeed one of the first criteria that will be perceived by the owner as a sign of palatability. However, the cat feeding is composed of several small meals taken during the whole day. Therefore the way the animal consumes its food over time is another indicator of pet food performance that can be perceived by owners. Thus studying the kinetics of cat's consumption aims the acquisition of better knowledge of cat's food consumption profile in order to measure the impact of food on this one. This is particularly an important issue for weights management products, and more precisely satiated ones, as their effect is dynamic and the product must be both: palatable and consumed differently.

Such petfoods will have a commercial interest only if they are also palatable, otherwise they won't be even eaten by the animals. By using the classical measurement method a satiating product will not have a chance to reach the same palatability level as a standard product even with a good palatability enhancer coated. In fact, the main goal of a satiating product is to decrease the quantity of food eaten which is also the main criterion to assess a petfood palatability nowadays. Taking a satiating petfood as an example, the main difficulty is to be able to ensure that a lack of a reduction of consumption of the food is not due to a lack of palatability but to a satiating effect. In addition, if a petfood is both palatable and satiating, this obviously leads to a misinterpretation of the consumption data using versus tests.

2.2 Kinetics of consumption

After years of study and comprehension on the cat feeding behavior and more than 100 different diets, 7 relevant criteria were selected among many others. The following figure shows a schematic feeding behavior of a cat during a 20 hour period with different criteria recorded throughout the time of the trial. Indeed the cats are obligate carnivores and their natural diets consist of eating many rodents per day, which corresponds to the small meal performed all the day (Fitzgerald and Turner, 2000).

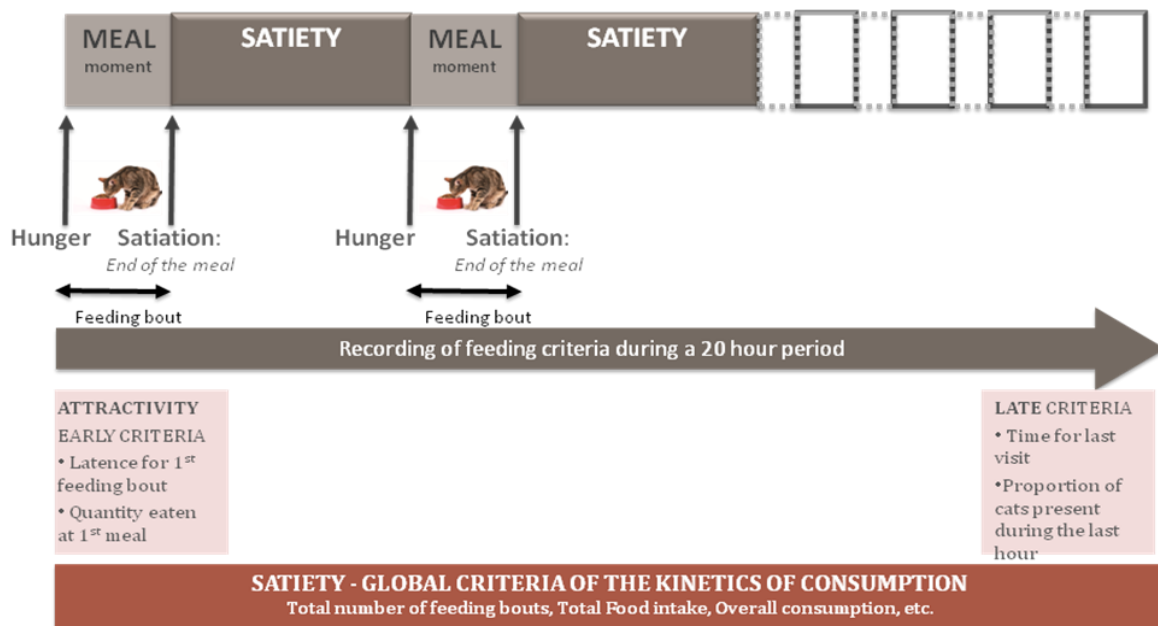


Figure 1: Schematic representation of cat feeding behavior and criteria measured

These criteria are listed below and were chosen according to their reliability and their capacity to highlight differences between different types of petfood products. The distinction between palatability and satiating effect will be performed thanks to 4 criteria measured with the kinetics of consumption and highlighted in red in the following figure.

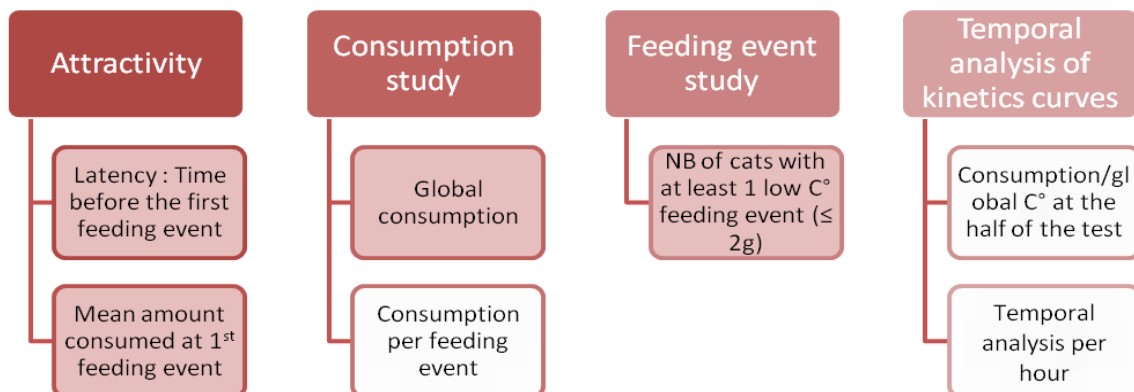


Figure 2: List of the 7 selected criteria and the 4 criteria studied to distinguish palatability and satiety

By combining the 4 criteria, the differentiation is possible between a poor palatability and a satiating effect. In fact these two effects conducts to the same result; a decrease of the final consumption, therefore it's interesting to separate them according other criteria linked to the cat food consumption.. The first step is to compare the global consumption of 2 diets assuming that the satiating diet will conduct to a significant decrease of consumption compared to maintenance diet at the end of the day. But this decrease of consumption should appear during the consumption but not directly at the first feeding event performed by the cat. Indeed, as long as the cat hasn't begun to eat the product, the satiating effect can't be measurable. So the quantity eaten at the first feeding event between the maintenance and the satiating diet should be at a same level with no significant differences. The two last criteria are present to check the attractivity and the palatability of the satiating product compared to the other one. In order to assess differently the palatability, a strong correlation between the consumption ratio of a versus test and the number of cats with at least one feeding event with a low consumption (≤ 2 g). Higher is the number, lower is the palatability of the product. The other criterion, also checked by the pet owner at home, is the attractivity of the product, assessing by measuring the time before the first feeding event and the beginning of the test. This variable is strongly linked to the odor of the product and should be equivalent between a satiating product and a maintenance product. With the combination of these 4 variables, it possible to separate the satiating effect from a low palatability effect.

3. Petfood selection for a satiating effect: a case study

Three different dry pet food products were selected for the study: one maintenance product, one product with a cellulose fiber and the last product with a sugarcane fiber. The satiating performance was tested at Panelis during a 20 hour consumption kinetics test on 72 cats (split in 2 catteries with a 50/50 ratio of males/females and sterilised/not sterilised). The kinetics data are obtained according a trial performed at Panelis with a free access of the feeding station for each cat and a recording of each feeding event associated with consumption. The cat has free movements inside the feeding station in order to get closer to in home feeding condition. The trial lasts 20 hours for one product and the kinetics data processing and analyzses are performed every hour. In order to reduce environnemental variations, the products were presented to the cats according a latin square design. The results obtained were analyzed using the SAS software by computing an analysis of variance with the animal as a random effect and the diet effect as a fixed effect.

product	total consumption (kcal)	latency for the 1st meal occurrence (minutes)	Consumption at the 1 st feeding event (kcal)	Percent of cats with a feeding event with low consumption (< 2 gr)
Cellulose fiber	165 A	111 A	24,67 A	41,7% A
Sugarcane fiber	145 B	99 A	24,83 A	44,4% A
Maintenance product	177 A	97 A	25,02 A	43,1% A

Table 1: Main results of the kinetics of consumption analysis. The letters stand for the significant differences (if the letters are the same there is not a significant difference and if they are different there is a significant difference between the products on the considered variable)

Table 1 contains the results for the 3 products and the 4 main criteria to conclude whether the satiating effect happens for the 2 types of tested fibers. The first criterion to focus is the number of cats with at least one low consumption feeding event (≤ 2 gr) which is strongly linked to the palatability level of

the product. The 3 products have obtained similar results on this variable so the palatability level is equivalent. Cellulose inclusion had no impact on feeding early criteria - latency for the 1st meal occurrence and quantity eaten at the first eating occasion - indicating no impairment in food attractivity (cf. table 1). There were no differences between the cellulose benchmark and the control food, neither on the final quantity of food eaten nor on the eating profile. Cellulose might thus be only used to decrease food energy density but not for satiating purpose.

With the sugarcane fiber, food attractivity was maintained (same latency time and consumption at the first feeding event) and food intake reduction occurred later in the test, indicating a satiating effect without palatability impairment (cf. figure 3). This kinetics is typical of what is expected from satiating products. Indeed the analysis of consumption kinetics highlighted a persistent decrease of food intake for this diet in comparison to the control food at the middle of the test but not at the beginning ($p > 0.05$ at the first 5 hours ; $p < 0.05$ 11 hours after the start of the kinetics and $P < 0.0001$ after 14 hours).

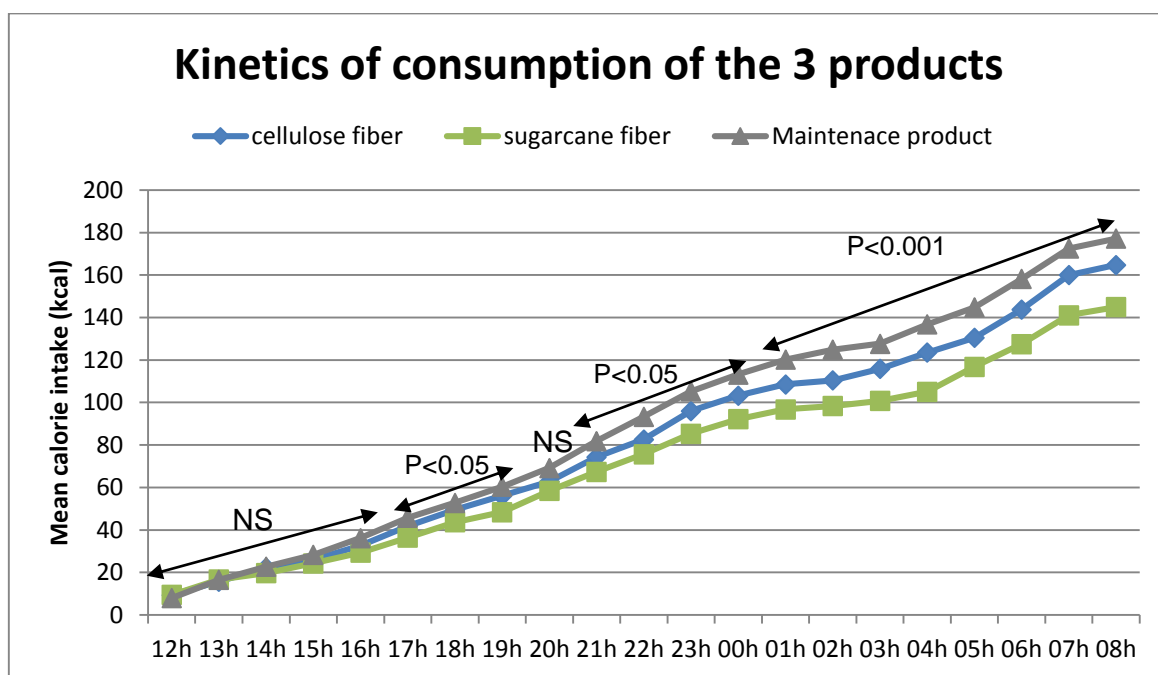


Figure 3: Cumulative mean calorie intake per hour of the test for the 3 product

The use of the kinetics methodology allowed demonstrating sugarcane fiber satiating effect. This insoluble fiber may exert its satiating property by two possible actions:

- Stretching of the stomach (satiating effect);
- And possibly, due to its high water binding capacity, via a physicochemical action on the stomach content delaying the separation of solids from liquids, and therefore delaying gastric emptying (satiety effect) (Zoran, 2009)

In order to obtain a good weight management program for the pets 3 key points about the product are mandatory and indivisible: the food attractivity, the global palatability and the satiating effect.

4. Conclusion

Developing weight management products covers different nutritional strategies such as caloric dilution using fiber (light products) or inclusion of satiating ingredients to decrease food intake. Different and complementary feeding test methodologies are required to assess the performance of such diets. The success of weight management products being a challenge for the cat-owner couple, it is indeed crucial to characterize the effect of these foods on cat feeding behavior, and also the owner perception.

Therefore the development of a new tool to assess these specific effects of the product was necessary to better select raw materials to produce this new generation of petfood satiating product. By combining these criteria, we were able to clearly identify the satiating effect of a petfood product, which is the essential part of a weight management program. Also, weight management diets need to have a high level of attractivity in order to avoid refusals, provide cues of cat enjoyment to the owner during the meal thus supporting product buying intentions. Moreover, they should have a true satiating effect in order to reduce cat food intake without drastic restrictions. Combining these conditions is critical for the success of the cat weight loss program not only from the pet standpoint, but also from the owner's.

In order to improve the knowledge of the cat consumption, the kinetics of consumption analysis could be done in a versus test, which allow to better explain the diet choice of the cat by analyzing more in detail the feeding events according to the 2 specific products and the interaction between them. It could also be advantageous to include the time effect directly in the statistical model to see the global evolution of the consumption throughout the time or to create other criteria's associating simultaneously the time and the consumption, for instance by calculating the area under the curve or the slope at specific time points.

References

- Fitzgerald, M., Turner, D.C., 2000. Hunting behavior of domestic cats and their impact on prey populations. In: Turner, D.C., Bateson, P. (Eds.), *The Domestic Cat*, 2nd ed. Cambridge University Press, Cambridge, UK, pp. 151-176.
- Rogues J, Nicéron C., 2015. Method for selecting petfoods having a palatability effect and a calorie intake reducing effect for pets. WO/2015/155177
- Weber M, Bissot T, Servet E, 2007. A high protein, high fiber diet designed for weight loss improves satiety in dogs. *J Vet Int Med* 21, 1203-1208.
- Zoran, D.L., 2009. Feline obesity: recognition and management. *Compend. Contin. Educ. Vet.* 31,284-293
- Zoran DL; 2010. Obesity in dogs and cats: a metabolic and endocrine disorder. *Vet Clin Small Anim* 40 (2010) 221-239.