Applied Animal Behaviour Science 159 (2014) 55–61

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Behaviour in order to evaluate the palatability of pet food in domestic cats

Aurélie Becques[a,*], Claire Larose[a], Céline Baron[a], Cécile Niceron[a], Christophe Féron[b], Patrick Gouat[b]

[a] SPF Diana, ZA du Gohélis, 56250 Elven, France
[b] Laboratoire d'Éthologie Expérimentale et Comparée EA 4443, Université Paris 13, Sorbonne Paris Cité, Avenue JB Clément, 93430 Villetaneuse, France

ARTICLE INFO

Article history:
Accepted 22 July 2014
Available online 1 August 2014

Keywords:
Cats
Pet food
Feeding behaviour
Palatability

ABSTRACT

Palatability of pet food has been mainly assessed by intake ratios. In the present study we have searched for behavioural clues of food palatability in domestic cats *Felis catus*. Two diets differing in palatability (Very Palatable Kibbles and Low Palatable Kibbles) were evaluated by a panel of 17 cats using an automated feeding station and video recordings. The cats tested each diet in two different sessions, with only one diet during a given session. A session lasted for two consecutive days with food continuously available during 20 h per 24 h period. At each of their visit to the feeding station, the quantity of food eaten by a cat, the speed of consumption and the latency to eat were recorded. The behaviour of the cat was also analysed for each visit. All the cats made at least four visits to the feeding station during a 24 h period. We compared the different quantitative variables between the two diets for the first three visits and for the last visit of each of the two days of a session. Our results showed that, as expected, cats ate more VPK than LPK. Addressing behavioural patterns, the length of sniffing was significantly reduced with VPK on the two first visits of the first day, suggesting less hesitation in this situation. Neither the latency nor the speed of consumption was affected by the palatability of the kibbles.

1. Introduction

Food is a basic biological commodity and taste is a powerful stimulus which can elicit either positive or negative reaction. Studies have shown that specific behaviours (i.e. facial and body reaction) can be expressed in relation to the taste of the food. In rats (Grill and Norgren, 1978) and in primates (Steiner et al., 2001) a sucrose solution elicited tongue protrusion and mouth movements whereas quinine solution elicited gapes, chin rubs, headshakes and forelimb flailing. In humans, sweet foods elicited positive or hedonic patterns of lip smacking and tongue protrusion, accompanied by relaxation of muscles of the middle face, and an occasional smile. On the other hand bitter quinine elicited negative or aversive gapes, and complex grimaces involving retraction of the lips, frowning of the brows and muscles around the eyes, and wrinkling of the nose (Schaal et al., 2000; Steiner et al., 2001).

The domestic cat is, with the dog, the most representative pet in households (Murray et al., 2010). Their feeding

* Corresponding author. Tel.:+33 0 2 97 93 20 20; fax: +33 297938041.
E-mail addresses: abecques@diana-petfood.com, aurelie.becques@gmail.com (A. Becques).

http://dx.doi.org/10.1016/j.applanim.2014.07.003
0168-1591/

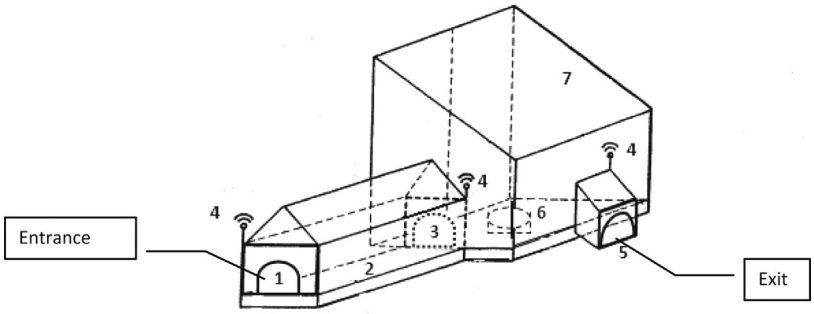

Fig. 1. Automated feeding system (patent Larose 2007). Description of feeding system used:1—first flap; 2—corridor; 3—second flap; 4—RFID system; 5—third and last flap; 6—bowls; 7—feeding area.

behaviour is unique in regard to circadian rhythm, cats being intermittent feeders. They have several short feeding periods, referred thereafter as meals, throughout the 24-h period and there is no direct relationship between the size of a meal and its timing (Mugford, 1977; Thorne, 1982). Cats may have 11 to 16 meals per day with 5 to 7 g eaten per meal (Kane et al., 1981, 1987). Cats are strictly carnivore with specific needs in nutrients; they are selective in food and prefer to consume freshly killed carcasses like mice, rats, rabbits, birds, lizards, insects and other animals rather than carrion (Bontempo, 2005; Bradshaw et al., 1996; Bradshaw, 2006; Watson, 2011). It is, therefore, a challenge for industrials to find the equilibrium between palatability and the nutritional quality of a diet for cats. It does not matter how well-formulated a diet if cats will not eat it.

To investigate the role of palatability, Petfood industries usually use expert panels of cats trained to discriminate food with different sensory properties. In the usual testing procedure, cats have the choice between two different diets presented simultaneously and available for several hours. The quantity of each food eaten and the dynamic of the consumption of each food during the test are used as indices of food palatability. The aim of our study was to enrich the classical palatability criteria by looking for differences in the behaviour of cats which could be attributed to palatability perception. To our knowledge only one study has examined the behaviour of cats during a food test (Van den Bos et al., 2000). In their study, cats were presented successively two canned diets differing in their level of palatability. The complete duration of each test session did not exceed 30 min and the cats were under their usual diet the rest of the time. The authors then described a "hedonic" taste reactivity pattern where cats licked and sniffed the feeding bowl, licked their lips and groomed their face, and an "aversive" taste reactivity pattern where cats licked and sniffed the food and licked their nose. Based on these results we decided to study the behaviour of cats at feeding occasions using two different dry food diets between which a known difference of palatability has been established using the classical expert panel evaluation. Dry food is strategic for petfooders because it is the most popular form of diet given and bought by pet owners (Crane et al., 2000). In order to respect the natural feeding rhythm of cats, each test lasted 20 h with the diet continuously available.

2. Methods

2.1. Animals

The experiments were conducted at Panelis, Diana Pet Food Division expert panels in palatability measurement. This center specialized in the evaluation of food palatability for dogs and cats is modelled on the real-life home environment and is committed to the well-being of pets and to the expertise in palatability measurement and to the observation of the feeding behaviour of dogs and cats. Cats were recruited between two months and three months of age from breeders and private owners. Kittens were always adopted by two, a male and a female from the same litter. The selected kittens were in good health and tolerant towards both conspecifics and human contact. From recruitment until approximately eight months of age, cats get accustomed to their new environment with other kittens in our catteries and to be in contact with different persons. They were trained with our experimental procedures (see below) and tasted different types of food from economical to super premium brands. The population of cats kept in the expert panel is representative of cat population in France (approximately 80% of European cats and 20% of purebred cats; FACCO/TNS SOFRES survey, 2012) and balanced in terms of age (from 8 months to 10 years) and sex. Because pet owners frequently sterilize males (81%) and females (75%) (FACCO/TNS SOFRES survey, 2012), the males of the expert panel were castrated at puberty and most of the females were sterilized. In the present study seventeen adult cats (5 ± 1.5 years old) have been used and six of them were purebred cats (one British Shortair, one Somali, one Chartreux and three Armenian Van). The cats were distributed into two groups, housed in two separate rooms several months before the beginning of the experiment. The rooms were equivalent in surface (13 m^2 indoor and outside) and equipment; three litters per room, toys and cat trees. Cats had a free access to an enriched outdoor courtyard. In our study, Room 1 contained three males and six females (all sterilized); Room 2 contained three sterilized males and five females with only one intact female.

2.2. Automated feeding system

Each room is equipped with two automated feeding stations (Fig. 1, Larose et al., 2007). At each visit and

Table 1
List and description of the variables taken into account in each session.

Variable (unit of measurement)	Description
Consumption (g)	Total amount of food eaten
Speed of consumption (g min^{-1})	Weight of kibbles eaten divided by the time the cat spent eating (i.e. ingesting and chewing)
Latency to eat (s)	Defined as the latency between the opening of the feeding area flap by the cat and the first eating of kibbles
Number of visits per session	The number of visits per day and the time of each visit were recorded
Eating in a sitting position (%)	Time spent to eat in a sitting position divided by the time spent eating. In a sitting position the cat was resting on its two hind legs with the tail down and the two front legs were straight. During the remainder of the time the cat was eating standing up with its four legs straight
Sniffing food (%)	Time spent sniffing the food divided by the time spent around the bowl. When the cat was near the bowl (i.e. head at less than 6 cm from the edge of the bowl) it was considered to be sniffing when its head was tilted with the nose at less than 3 cm from the bowl
Licking (nb min^{-1})	The number of licks per min spent inside the feeding station. Because the difference between the licking of the lips and the licking of the nose could not always be verified, particularly during the night period, the global number of licks on the face was quantified whatever the target

before entering into the feeding station, a RFID (radio frequency identification) system automatically identifies cats by their own microchip (Metal Process, Montrévrain, France) inserted in their collar. Only one cat at a time can be inside the feeding station. The area becomes free as soon as the cat is detected leaving the feeding station. According to the feeding habits of cats, the device gives a free access to the food every day from 11:15 h am to 07:15 h am (i.e. 20 h per 24 h). The food is placed into two stainless steel bowls at the centre of the feeding area. A scale is placed under each bowl to measure the consumption of a cat at each visit. Two feeding stations per room are sufficient to allow an easy access to food to all cats of the group. All feeding stations are connected to a computer system (Dell Inc., Round Rock, Texas, United States) recording varied data about cats' visits: time, duration and food consumption.

2.3. Diets

The two diets used in our experiments were made of the same kind of kibbles and differed only in the coating and other additions (see below). To avoid a kibble and a batch effect, only Royal Canin™ kibbles, as a kibble basis, were used and all the kibbles were coated at the same time with an identical quantity and nature of fat (6% of poultry fat). One half of the kibbles was coated with one palatability enhancer and the other half with a second one, during two minutes by using a mixer (FORBERG International AS) dedicated to the coating of kibbles. The food was then put into plastic bags hermetically sealed by a specific machine and kept at 20 °C for two weeks before consumption. Two different palatability enhancers applied on the kibbles were chosen: one very palatable (VPK) was a super-premium hydrolyzate with a poultry basis; the other one was less palatable (LPK) and was a standard hydrolyzate with a viscera basis. According to previous preference tests cats tended to eat significantly more VPK than LPK (Diana Pet Food division, unpublished results). The cats included in the present study have experienced the two types of palatability enhancers prior to the experiment. The difference between VPK and LPK is based only on the palatability produced by the coating, the kibble base being the same and no nutritional differences existing in terms of caloric value and nutritional components (3567 kcal kg^{-1}). To further increase the palatability of the VPK food, 180 g commercially canned tuna (Entire natural tuna Petit Navire™) were mixed to the kibbles just before the beginning of test (in the following proportions by weight: 83% of kibbles and 17% of tuna in the bowl). Mixing the tuna only slightly decreased the caloric value of the diet (3203 kcal kg^{-1}). It was the first time cats tested tuna mixed with their kibbles and this diet will be referred to as VPK thereafter.

2.4. Recording procedure

In order to link specific behaviour to a specific diet, we chose to present only one diet per session. A session lasted two consecutive days. A first session with VPK and a second with LPK were planned in each group. On each day the food was available to cats during a 20 h period. These two sessions were included within a testing time table where cats were made to test different diets according to the requirements of customers. A group had two days of testing between the first and the second session whereas the other group had a ten day period of testing between the two sessions. The cats experienced different diets on a day-by-day basis which limited the interactions between the two successive diets. Before each test, the area and the two stainless steel bowls were washed and dried.

Before the beginning of the test, a video camera (Panasonic Inc., Osaka, Japan) with dual mode colour and monochrome CCD high quality was positioned on the outside and in front of each device in order to record the behaviour of cats during their meal. Each camera had a zoom lens with manual iris 3.5–8 mm. To be able to record day and night, two infrared spotlights (Ansmann, Assamstadt, Germany) were positioned near the camera. Each camera was connected to a computer (Dell Inc, Round Rock, Texas, United States) storing digital images using the MPEG Recorder Software (©Noldus Information Technology, version 10.1, Wageningen, Netherlands).

Table 2
Comparison of each behavioural criteria (Mean ± standard error of mean [SEM]) analysed by visit and day for each diet. A paired *t*-test was used to compare the two diets. The significant values are in bold.

Variables	Day	Visits	VPK	LPK	*N*	*P*-value
			Mean ± SEM	Mean ± SEM		
Consumption (g)	D1	V1	**21.1 ± 2.0**	**3.4 ± 0.9**	17	**<0.001**
		V2	**9.4 ± 1.3**	**4.3 ± 1.1**	17	**0.006**
		V3	**7.6 ± 1.3**	**2.6 ± 0.6**	17	**0.005**
		F	4.8 ± 1.2	7.1 ± 0.8	17	0.100
	D2	V1	**15.4 ± 1.8**	**4.7 ± 0.8**	17	**<0.001**
		V2	**12.2 ± 1.4**	**4.8 ± 0.8**	17	**0.001**
		V3	**11.1 ± 1.8**	**5.7 ± 0.7**	17	**0.013**
		F	**9.7 ± 1.3**	**5.8 ± 0.9**	17	**0.021**
Speed of consumption ($g\,min^{-1}$)	D1	V1	4.8 ± 0.5	3.8 ± 0.7	17	0.228
		V2	4.1 ± 0.5	4.6 ± 0.8	13	0.730
		V3	4.2 ± 0.6	4.5 ± 0.6	12	0.928
		F	3.4 ± 0.5	4.3 ± 0.4	12	0.061
	D2	V1	5.2 ± 0.7	4.2 ± 0.4	15	0.210
		V2	5.0 ± 0.6	4.2 ± 0.4	15	0.243
		V3	5.3 ± 0.5	4.9 ± 0.9	16	0.730
		F	4.9 ± 0.6	3.8 ± 0.4	15	0.156
Latency to eat (s)	D1	V1	14.9 ± 1.6	14.5 ± 2.7	17	0.904
		V2	17.0 ± 2.3	18.0 ± 4.2	13	0.902
		V3	17.7 ± 2.5	18.6 ± 2.9	12	0.696
		F	**22.8 ± 3.4**	**11.2 ± 0.9**	**12**	**0.001**
	D2	V1	13.3 ± 1.8	12.4 ± 1.3	15	0.602
		V2	15.4 ± 2.0	13.2 ± 1.1	15	0.391
		V3	13.1 ± 1.8	21.7 ± 9.5	16	0.573
		F	19.3 ± 3.7	12.1 ± 1.3	15	0.103
Eat in a sitting position (%)	D1	V1	63.2 ± 9.7	42.6 ± 9.1	17	0.145
		V2	69.8 ± 0.7	63.7 ± 10.4	13	0.523
		V3	61.9 ± 9.5	49.2 ± 11.7	12	0.446
		F	65.6 ± 10.4	79.0 ± 6.6	12	0.223
	D2	V1	76.8 ± 8.6	60.5 ± 9.8	15	0.121
		V2	80.5 ± 6.9	74.3 ± 8.4	15	0.524
		V3	73.2 ± 8.6	70.5 ± 8.8	16	0.808
		F	77.0 ± 8.5	81.6 ± 6.1	15	0.635
Sniffing food (%)	D1	V1	**6.6 ± 1.1**	**24.4 ± 4.8**	17	**<0.001**
		V2	**9.9 ± 2.1**	**20.2 ± 4.0**	17	**0.011**
		V3	14.2 ± 4.8	30.1 ± 7.4	17	0.108
		F	16.5 ± 5.5	10.9 ± 2.7	17	0.413
	D2	V1	9.6 ± 3.0	12.5 ± 2.9	17	0.509
		V2	8.9 ± 2.6	9.7 ± 2.9	17	0.823
		V3	9.9 ± 2.5	10.8 ± 3.0	17	0.830
		F	**9.6 ± 1.6**	**6.1 ± 1.0**	17	**0.027**
Licking ($nb\,min^{-1}$)	D1	V1	5.9 ± 0.8	5.7 ± 0.6	17	0.894
		V2	4.6 ± 0.5	4.5 ± 0.7	17	0.854
		V3	4.7 ± 0.6	4.6 ± 0.7	17	0.905
		F	**2.5 ± 0.6**	**4.2 ± 0.4**	**17**	**0.018**
	D2	V1	4.8 ± 0.5	5.1 ± 0.6	17	0.622
		V2	4.9 ± 0.7	5.0 ± 0.6	17	0.816
		V3	4.9 ± 0.6	5.0 ± 0.6	17	0.901
		F	3.7 ± 0.5	3.6 ± 0.5	17	0.789

2.5. Data observed

All the video-recordings were analysed by the same observer, using The Observer XT Software (© Noldus Information Technology, version 10.1, Wageningen, Netherlands). The variables measured during each visit of a cat to the feeding station are listed in Table 1.

2.6. Statistical analysis

As cats made at least four visits per day, the first three visits (V1, V2, V3) and the last one (FV) were selected in order to describe the complete feeding period.

The comparisons between the two diets were made independently for each visit on each day. A cat entering in the feeding station usually ate some food. In some occasions, a cat that has entered in the station did not eat any food. In this event all the variables linked with consumption (i.e. speed of consumption, latency to eat, eat in a sitting position) cannot be calculated. As a consequence these data and their paired data (i.e. same cat, same day and same visit but other diet) were discarded from the statistical analysis. The mean and SEM were calculated accordingly and the sample size was added for each comparison in Table 2.

We used non-parametric statistics because the sample size was small ($N \leq 17$). Data were compared between the two diets using permutation tests for paired

samples (StatXact, Cytel Software Corporation, Cambridge, MA, U.S.A.). All effects were evaluated at the $\alpha = 0.05$ level.

3. Results

3.1. Consumption

As expected from Diana Pet Food division (unpublished results), the cats ate significantly more food per day (80.66 g ± 4.92 g) during the VPK session than during the LPK session (52.91 g ± 2.66, $P = 0.0008$). On day 1, the cats ate significantly more VPK than LPK during the first three visits (Table 2). This difference was not observed during the last visit. On day 2, the differences of consumption between the two diets were always significant whenever the visit. No significant differences were observed between the two diets for the other two variables related to food consumption (i.e. speed of consumption and latency to eat, Table 2).

Cats did significantly fewer visits per day (8.74 ± 0.44) during the VPK session than during the LPK session (11.44 ± 0.92; $P = 0.0002$). The time of the different visits did not differ significantly between the two sessions in the majority of cases (Fig. 2). The only significant differences occurred on day 2. The third visit was earlier for the LPK than for the VPK diet ($P = 0.0089$) whereas the inverse was true for the last visit, earlier for the VPK than for the LPK session ($P = 0.0281$). The duration between two visits was 2.5 ± 0.05 h and varied from six minutes to more than eleven hours.

3.2. Behaviour

3.2.1. Eating in a sitting position

The proportion of eating time spent in a sitting position did not differ significantly between the two diets (Table 2).

3.2.2. Sniffing the food

On day 1 the cats spent more time sniffing the LPK food than the VPK food when they were around the bowl. The difference was significant only for the two first visits. On the second day there were no more differences during the first three visits whereas during the last visit the cats spent less time sniffing the LPK food than the VPK food when they were around the bowl (Table 2).

3.2.3. Licking behaviour

There was no significant difference in the number of licks in proportion to the time spent in the feeding station with the exception of the last visit of day 1 (Table 2), where more licks occurred during the LPK test.

4. Discussion

In our experiment the two diets were proposed individually to the cats during two different sessions. Compared to the study by Van den Bos et al. (2000) where cats had a food access during 30 min, in our study they had free access to the food during 20 h. This situation corresponded to the usual situation of a domestic cat at home. Under these conditions the cats could display a stronger affinity for one food rather than for another even if this attractiveness could vary between visits at the feeding station. Two main findings resulted from the present study.

As expected, the consumption of kibbles was higher during the VPK session than during the LPK one. The difference in consumption was also significant for the first three visits on each of the two days of a session. On the last visit of day 1, nevertheless, the difference was not significant anymore. As the food was available during a 20 h period, one may think that a decrease in the freshness of the VPK diet could be involved. During the last visit of day 2, however, the difference of consumption between the two diets was still observed. If the attraction of the diet decreased with time the effect should have been higher for LPK since the last visits occurred later than during the VPK session on day 2. A regulation process of food intake might also have caused this result. Cats are able to regulate their consumption but this regulation is a complex phenomenon and is still poorly understood. Kane et al. (1981) have demonstrated that cats offered commercial cat food with different caloric content, quickly adjusted the amount of food ingested to maintain stable their calorie intake. Thorne (1982) also used commercial cat food with different water contents and found evidence for an energy intake regulation. In our study cats ate more VPK than LPK during a session and the difference of consumption clearly over-compensated the difference in caloric value of the VPK diet (average calorie intake/session: VPK = 258.3 kcal and LPK = 188.73 kcal). If a regulation of energy intake might have caused the lack of a significant difference of consumption during the last visit of day 1, the higher palatability of VPK was clearly demonstrated by the higher consumption of this diet during the two days of the session. We could not exclude, nevertheless, that a regulation process of food intake might have taken place over a longer period.

Among the behavioural variables, only the time spent sniffing the food while the cat was near the bowl, revealed clear significant results. The sense of smell is powerful and important in cats and plays a major role in food selection. Perinatal experiences have been shown to influence preference for a specific diet. Two-day-old kittens tend to prefer an odour previously encountered in utero, through the mother's diet, rather than an unknown odour. Later they prefer to eat the food odorized with a flavour experimented perinatally than a food odorized with an unknown flavour (Becques et al., 2009). When an adult cat is eating, blowing a succession of attractive food odours increased the duration of the meal and the quantity of food ingested (Mugford, 1977; Bradshaw, 1986). In our study, the behaviour of cats differed between the two diets in the proportion of time spent sniffing during the two first visits on day 1. This difference disappeared for the other visits on day 1 suggesting that the novelty of the situation was involved. The first day of a session corresponded to a change in the diet of the cats. One may have expected that the novelty of the diet should have caused more sniffing. On the contrary the cats tended to sniff more LPK, a diet that they have already experienced, than VPK that they have previously experienced but without the addition of tuna. The tuna was very odorant and it seemed that this odour was attractive enough to elicit eating in a short lapse of time. On the other hand the longer

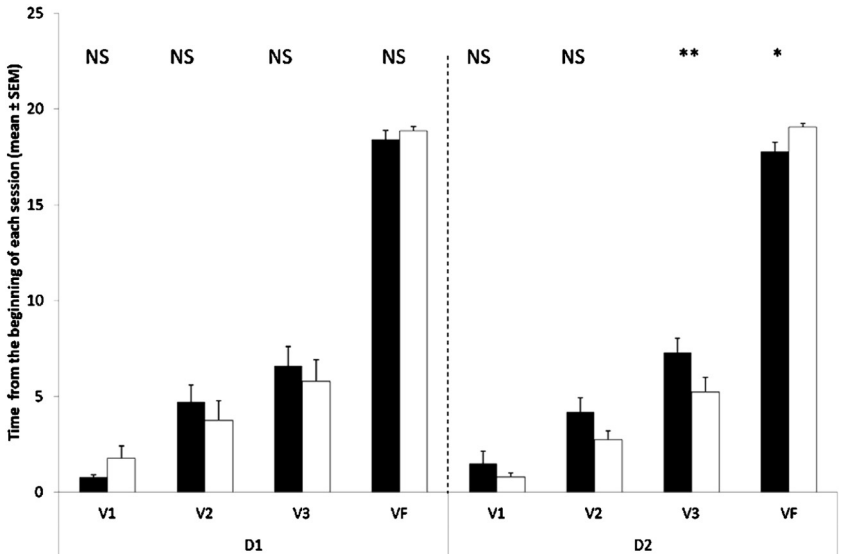

Fig. 2. Comparison of the time of the different visits (V1 to VF) between the two sessions. The time of a visit is expressed in hours and corresponded to the elapsed time between the beginning of the test and the given visit. Cats ($n = 17$) had a free access to the food by using a feeding station. Black bars: VPK session; empty bars: LPK session. A session lasted for two days (D1 and D2). A paired t-test was used to compare the two sessions. NS: no significant result, *: $P < 0.05$, **: $P < 0.01$.

duration of sniffing the LPK diet may correspond to a hesitation to consume a less palatable diet. On the last visit of day 2, nevertheless, the cats spent less time sniffing the LPK than the VPK diet. In fact, there was no major change in the sniffing duration of the VPK diet whereas the sniffing duration of the LPK diet reached its lowest level suggesting a kind of resignation by the cats. In conclusion, a low amount of time spent sniffing the food seems therefore to be a reliable behavioural indicator of the palatability of food when newly proposed to cats.

Other behavioural variables had been measured but they did not differ clearly between the two diets. The speed of consumption in cats in a given state of hunger has been shown to be greater for a high palatability diet at least at the beginning of a meal (Foucault, 1992). In our experiment, neither the speed of consumption nor the latency to eat, differed significantly between the two diets. The cats have access to food during 20 h every day with a constant time schedule. As a consequence the cats have experienced that food was always available during a test session. At the beginning of a test, after four hours without any food, cats were not very hungry. Our data revealed that during a session the time between two successive meals could exceed ten hours even though food was available, and some cats had their first meal two hours or more after the bowls were refilled. Moreover, being alone inside the feeding station prevented any direct social pressure, and a cat could take its time to eat. These reasons might explain the lack of any differences in the speed of consumption and the latency to eat. Licking behaviour did not reveal any clear differences between the two diets. In their study, Van den Bos et al. (2000) have related licking behaviour to food palatability. A difference was made between licking the nose, related as an aversive taste reactivity pattern, and licking of lips which appeared more after a more palatable wet food. We were unable to clearly distinguish these two types of licking behaviour on videos. This might have caused the lack of a behavioural difference between the two diets. A video recording system, focussed on the head of the cat, would surely have allowed a more precise analysis of the facial mimics displayed by the cat when eating and after. More details of the eating behaviour could also have been recorded using a transparent feeding bowl or a plate without any edge.

Bradshaw and Cook (1996) have demonstrated in their study that cats display a variety of signals (visual, vocal, tactile and olfactory) just before and after the meal. In our protocol a meal corresponded to the time spent inside the feeding station. In the future, it would be interesting to complete this study with observations performed just before and just after the period spent inside the feeding station. Moreover, our subject cats live in a social group, and the social transmission of information about the diet may also have an important influence on food attractiveness as shown in the rat (Galef, 1993). Finally our study suggested that behavioural criteria, such as the time spent sniffing the food, can be used to assess the palatability of food. Such criteria can be easily implemented by professionals and by pet owners. We think that behavioural criteria might reveal to be more relevant than the simple measurement of food consumption to collect the cat's assessment of a diet.

Acknowledgement

We thank Lavinia Bruneau for the revision of the English version of the manuscript.

References

Becques, A., Larose, C., Gouat, P., Serra, J., 2009. Effect of pre- and postnatal olfactogustatory experience on early preferences at birth and dietary selection at weaning in kittens. Chem. Senses 35, 41–45.

Bradshaw, J.W.S., 1986. Mere exposure reduces cat's neophobia to unfamiliar food. Anim. Behav. 34, 613–614.
Bradshaw, J.W.S., Goodwin, D., Legrand-Defrétin, V., Nott, H.M.R., 1996. Food selection by the domestic cat, an obligate carnivore. Comp. Biochem. Physiol., A 114 (3), 205–209.
Bradshaw, J.W.S., Cook, S.E., 1996. Patterns of pet cat behaviour at feeding occasions. Appl. Anim. Behav. Sci. 47, 61–74.
Bradshaw, J.W.S., 2006. The evolutionary basis for the feeing behavior of domestic dogs (*Canis familiaris*) and cats (*Felis catus*). J. Nutr. 136, 1927S–1931S.
Bontempo, V., 2005. Nutrition and health of dogs and cats: evolution of petfood. Vet. Res. Commun. 29, 45–50.
Crane, S.W., Griffin, R.W., Peter, R.M., 2000. In: Hand, M.S., Thatcher, C.D., Remillard, R.L., Roudebush, P. (Eds.), Introduction to Commercial Pet Foods. Chapter 3 in Small Animal Clinical Nutrition. , fourth ed. Mark Morris Institute, Topeka, KS.
Foucault, V., 1992. Contribution à l'étude du comportement alimentaire du chat. Veterinary PhD thesis at ENVL n° 73, 140 p.
Galef Jr., B.G., 1993. Functions of social learning about food: a causal analysis of effects of diet novelty on preference transmission. Anim. Behav. 46, 257–265.
Grill, H.J., Norgren, R., 1978. The taste reactivity test I. Mimetic responses to gustatory stimuli in neurologically normal rats. Brain Res. 143, 263–279.
Kane, E., Rogers, Q.R., Morris, J.G., Leung, P.M.B., 1981. Feeding behaviour of cat fed laboratory and commercial diets. Nutr. Res. 1, 499–507.
Kane, E., Leung, P.M.B., Rogers, Q.R., Morris, J.G., 1987. Diurnal feeding and drinking patterns of adult cats as affected by changes in the level of fat in the diet. Appetite 9, 89–98.
Larose, C., Letoux, M., Guiller, I., 2007. Improved appetence measurementsystem. Patent WO 107508 A1, 27-09-2007.
Mugford, R.A., 1977. External influences on the feeding of carnivores. In: Kare, M., Maller, O. (Eds.), The Chemical Senses and Nutrition. Academic Press, New York, NY, pp. 25–50.
Murray, J.K., Browne, W.J., Roberts, M.A., Whitmarsh, A., Gruffydd-Jones, T.J., 2010. Number and ownership profiles of cats and dogs in the UK. Vet. Rec. 166 (6), 163–168.
Schaal, B., Marlier, L., Soussignan, R., 2000. Human fetuses learn odours from their pregnant mother's diet. Chem. Senses 25, 729–737.
Steiner, J.E., Glaser, D., Hawilo, M.E., Berridge, K.C., 2001. Comparative expression of hedonic impact: affective reactions to taste by human infants and others primates. Neurosci. Behav. Rev. 25, 53–74.
Thorne, C.J., 1982. Feeding behavior in the cat-recent advances. J. Small Anim. Pract. 23, 555–562.
Van den Bos, R., Meijer, M.K., Spruijt, B.M., 2000. Taste reactivity patterns in domestic cats (*Felis silvestris catus*). Appl. Anim. Behav. Sci. 69, 149–168.
Watson, T., 2011. L'appétence chez le chat. L'Essentiel 220, 10–12.