Annals of Warsaw University of Life Sciences – SGGW
Animal Science No 57 (1), 2018: 47–53
(Ann. Warsaw Univ. of Life Sci. – SGGW, Anim. Sci. 57 (1), 2018)
DOI 10.22630/AAS.2018.57.1.4

Impact of food type on long term consumption kinetics in group-housed domestic cats (*Felis catus*)

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Abstract: *Impact of food type on long term consumption kinetics in group-housed domestic cats (*Felis catus*)*. The aim of the current research was to assess the impact of the type of dry food on the long term acceptance in cats, expressed as consumption curves. A group of 14 adult neutered domestic cats were subsequently offered three types of products: economy, medium and premium. The consumption of food has been carefully monitored each day of the experiment, which enabled the drawing of the precise consumption curve. The average daily consumption showed differences between feeding periods (98.33, 61.17 and 55.04% for premium, medium and economy diet type, respectively). In all groups the monotony effect has been observed, but the relative stability of the consumption has been observed only in cats fed with the premium type of food. The attractiveness of the economy type of food was distinctively low, resulting in a regularly waved consumption curve. It can be concluded, that the prolonged offering of a particular type of complete dry pet food within the limits of metabolizable energy requirements may potentially lead to adverse consequences for cats. The food consumption level that supplies the minimal daily energy amount can likely result in imbalanced macronutrient intake.

Key words: cat, consumption, pet food, acceptability, colony

INTRODUCTION

Feeding a group of domestic cats (*Felis catus*) housed together in a shelter, cattery or in an experimental facility is of a particular importance, because the type of the food has to be carefully selected to cover the requirements of all group members. Generally, high quality commercial foods providing balanced macronutrients and of high-digestibility are recommended (Bradshaw and Cook 2006). Cats are strict carnivores, relying on nutrients present in animal tissues to fulfill their specific and unique nutritional requirements. Although they have adjusted to commercial diets, limitations of substituting animal-origin nutrients with plant-origin in foods formulated for cats are being generally realized (Zoran 2002).

Currently a tremendous interest in identifying the ideal macronutrient profile to maximize health and longevity in cats is being observed (Hewson-Hughes et al. 2011). However, nutritional recommendations are based on minimal intake

data rather than optimal, as the optimal intake is harder to measure due to substantial difficulties in measuring health and longevity outcomes (Villaverde and Fascetti 2014).

According to Bradshaw (2006), cats are equipped with flexible behavioral strategies, based on experience, aiming at achieving a balanced diet regardless of available types of food. Hewson-Hughes et al. (2011) described mechanisms of strong dietary macronutrient regulation in cats, towards a target profile high in protein and fat. It has to be noted, that domestication led to a modification of cats' way of life and feeding. Currently available commercial cat foods contain various amounts of carbohydrates for technical and economic reasons (Salaun et al. 2017).

Metabolic adaptation was previously demonstrated in cats chronically exposed to high-fat or high-carbohydrate diets, but it was suggested that studies exceeding 14 days may be required to show effects of restricted macronutrient intake (Gooding et al. 2014).

The current study, therefore, aimed at assessing the effects of prolonged offering of three different types of commercial dry foods on the consumption kinetics in group-housed cats.

MATERIAL AND METHODS

Animals and housing

The research was conducted on 14 neutered adult domestic cats of mixed gender, between 3 to 8 years of age, in good health and physical condition (average body weight 4 kg). The cats were housed as a colony in a stable room temperature with controlled humidity and light cycle (Serisier et al. 2013). All animals had access only to single food source, i.e. supplied by caretakers.

Diets

Before and during the experiment all animals were fed dry expanded diets in amounts covering the daily metabolizable energy requirements of spayed cat, i.e. 313.6 × (body weight)$^{0.67}$ kJ (Gross et al. 2010, Mitsuhashi et al. 2011), complying to 100% consumption of the daily ration.

According to descriptions given by Crane et al. (2010), the types of pet foods used in the study can be defined as: generic with low price set as their primary selling point (economy), private label with varying ingredient selection and quality (medium) and specialty products with emphasized superior ingredients and nutritional adequacy (premium). Basic analytical constituents and the percentage of metabolizable energy (% ME) supplied by the particular type of cat food are presented in Tables 1 and 2.

TABLE 1. Analytical constituents of cat food types as declared on the labels

Chemical analysis	Premium	Medium	Economy
Protein (% DM)	32	35	32
Fat (% DM)	15	11	8
Fibre (% DM)	4.4	7	2
Ash (% DM)	6.9	7	6
ME (MJ/100 g DM)	1.49	1.34	1.37

Major fee materials, as listed on the labels of the products, were the following:

- economy – cereals, meat and meat derived products, plant proteinaceous

TABLE 2. Calculated* percentage of metabolizable energy in 100 g of DM derived from macronutrients in foods

% ME	Premium	Medium	Economy
Protein (P)	31	38	34
Fat (F)	36	30	21
Carbohydrates (C)	33	32	45
P : F : C	1 : 1.2 : 1.1	1.3 : 1 : 1.1	1.6 : 1 : 1.3

*On the basis of information labeled by producers.

extracts, vegetables, oils and fats, minerals;
- medium – meat and meat derived products, plant proteinaceous extracts, cereals, oils and fats, yeast;
- premium – dried chicken meat, rice, animal fat, maize, maize gluten meal, lignocellulose, hydrolyzed animal protein, LIP, wheat, beet pulp, yeast, minerals.

Experimental procedures

In three consecutive 31-day periods different type of food was served to all the cats in the colony according to the following sequence: (1) medium, (2) economy and (3) premium. To avoid the possible competition and hierarchy effects, individually calculated amount of food was always served in a sufficient number of bowls for the group (Ramos et al. 2013). Drinking water was constantly available. During the experiment, daily food consumption was continuously recorded and pooled to express the overall average for the colony, which was considered an experimental unit throughout the study. On the basis of the calculated data the daily food consumption kinetics curves were constructed for all subsequent periods of controlled feeding.

RESULTS AND DISCUSSION

Evaluation of consumption curves for premium, medium, and economy cat food revealed relative stability of the former. For medium and economy type the acceptance showed temporary fluctuations (the figure). In the case of the medium type, the consumption fluctuation was regular, and occurred every 3–4 days. On the other hand, feeding cats with the economy product led to

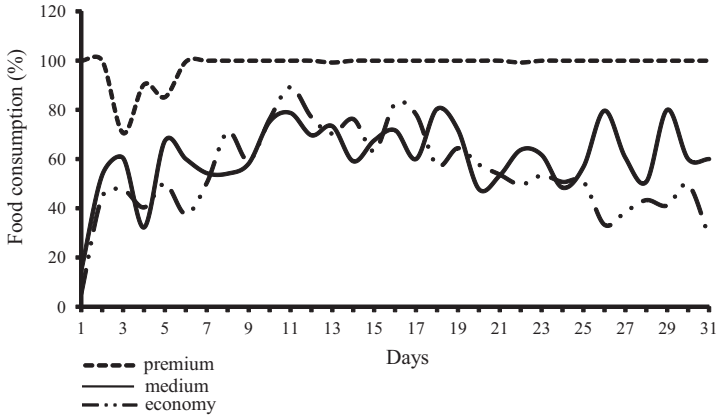

FIGURE. Consumption kinetics of three different types of cat food during 31-day observation periods

more frequent variations in food intake (approximately every other day).

On the first day of offering the medium type diet, the cats almost completely refused it, showing clearly a neophobic reaction to the food. On the second day the acceptance increased to approximately 55% of the offered amount. On day 4 the consumed amount was only ±30%, followed by the increase to 65 on day 5. Onwards, from 7th to 31st days of observation, the observed range of consumption of the medium type food was between 55 and 80%.

Similarly, on the first day of serving the economy diet, the acceptance dropped to 10%. Then, from day 2 to day 6 it increased and ranged between 40 and 50%. The peaks of consumption of this diet (80%) were observed on days 11 and 16. Afterwards, it started to decline until 30% on day 31.

From the beginning of feeding the colony with the premium type of food, the acceptance was substantially higher than that for two other products. The most notable fluctuation was found on day 3 with acceptance of 70% followed by an increase to about 90% on day 4 and than another slight decrease on day 5 (the figure). From day 6 of the observation period, the premium type of food was consumed in 100% until the end of the experiment.

We speculate, that the initial low acceptance of medium and economy types of foods, can be attributed to the neophobic behavior, affected most likely by the flavour (Bradshaw 1986, Bradshaw et al. 1996). It was previously reported, that in a switchback design study, the animals presented with no choice refuse new food (Aldrich and Koppel 2015). Hewson-Hughes et al. (2016) demonstrated that in the short term, organoleptic properties may override the dietary selection in cats, but with experience the macronutrient regulation prevails. This effect can be the plausible explanation of the consumption fluctuations observed for medium and economy type of foods in the current study. Similar results of prolonged commercial dry food consumption kinetics were described for young cats by Bermingham et al. (2013). Towards the end of a 28-day long observation period, the daily intake tended gradually to decrease. Moreover, significant differences in the average food intake were reported in cats fed moderate or high-protein diets for 8 weeks, but the tendency of time-dependent decreasing consumption was observable irrespective of the protein content (Wei et al. 2011).

The differences between average daily consumption of particular types of foods calculated for the whole observation period were distinct, namely 98.33 ±5.96%, 61.17 ±13.91% and 55.04 ±17.83% for premium, medium and economy diet type, respectively. Further, after the re-calculation of ingested food amount (in grams) into caloric intake it turned out that an average daily energy intake was 350, 196 and 180 kcal ME, for premium, medium and economy type, respectively. This indicates, that the consumption of the premium food delivered approximately double energetic load to animals as compared to medium and economy products. The plausible explanation for the limited acceptance of high-carbohydrate economy diet in the current study is the ceiling for carbohydrate consumption in cats that constrains them to deficits in protein and fat intake

(Hewson-Hughes et al. 2011). There are reports, however, that over time, the carbohydrate ceiling is higher if cats are more adapted to the diet (Farrow et al. 2013), but the present results do not support the adaptive tendency for the economy diet. We observed noticeably low attractiveness of the economy type food, which resulted in a regularly waved consumption curve, with the intake increase occurring most likely due to inefficient supply of metabolizable energy. Consequently, distinct differences in macronutrients content between products assessed in the study (Table 2) may lead to potential unbalanced dietary intake in cats, during longitudinal offering.

One explanation for the fluctuations, both at the beginning of premium food feeding period and from day 6 to the end of periods of medium and economy type foods offering can be a monotony effect, affecting the palatability of repeatedly served food. Cats may show growing aversion toward products that have formed a significant part of their diet in the past (Bradshaw 2006).

The apparent stability of the food consumption has been observed for the premium type, and the instinct of looking for new food was either not activated, or weak due to apparently low risk of malnutrition (Thorne 1982).

Additionally, the premium type product supplied almost twofold more metabolizable energy, compared to medium and economy types. Considering that the taste of the commercial dry cats food relies mostly on the fat and protein contents, in line with the sparing manufacturing practice, it seems likely that products containing the breakpoint amount of fat (medium and economy type) presented generally low attractiveness for cats, and resulted consumption barely covering their minimal energy requirements.

CONCLUSIONS

The prolonged observation of food acceptance in colony cats fed quantities of restricted energy content may help reveal substantial information on the macronutrient intake regulation of commercially available products.

Particular types of complete dry pet food offered within the limits of metabolizable energy requirements may render ineffective or lead to imbalanced macronutrient intake in adult neutered cats.

Acknowledgements

There is no conflict of interest to disclose in this work.

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Streszczenie: *Wpływ typu karmy na długookresową kinetykę konsumpcji u kotów domowych (*Felis catus*) utrzymywanych w kolonii*. Celem doświadczenia było określenie wpływu typu podawanej suchej karmy pełnoporcjowej na długookresowe wskaźniki akceptacji określane dla utrzymywanych grupowo kotów domowych. Grupa 14 dorosłych, kastrowanych kotów otrzymywała kolejno karmę typu medium, economy i premium w okresach trwających 31 dni. Spożycie było ściśle kontrolowane każdego dnia trwania eksperymentu, co pozwoliło na wykreślenie dokładnych krzywych. Zaobserwowano istotne różnice wartości średniego współczynnika konsumpcji między poszczególnymi okresami żywienia (98,33; 61,17 i 55,04% odpowiednio dla karmy typu premium, medium i economy). We wszystkich okresach zaobserwowano efekt monotonii, relatywnie stabilny poziom akceptacji zanotowano jedynie w okresie podawania karmy typu premium. Atrakcyjność karmy typu economy była wyraźnie mniejsza w porównaniu do pozostałych. Zaobserwowano znaczące

fluktuacje przebiegu krzywej konsumpcji tego produktu. Można stwierdzić, że długotrwałe podawanie kotom jednego typu karmy w ilości zapewniającej pokrycie dziennego zapotrzebowania na energię metaboliczną potencjalnie może mieć niepożądane konsekwencje. Regularne pobieranie taniej karmy pełnoporcjowej w ilości zapewniającej pokrycie jedynie minimalnego zapotrzebowania energetycznego może spowodować zaburzenie właściwego bilansu podaży podstawowych składników odżywczych.

Słowa kluczowe: kot, spożycie, karma dla zwierząt, akceptacja, kolonia

MS received 03.01.18

MS accepted 22.02.18

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