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DO INSECTS SMELL ATTRACTIVE TO DOGS? A COMPARISON OF DOG REACTIONS TO INSECTS AND COMMERCIAL FEED AROMAS – A PRELIMINARY STUDY*

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Abstract

The goal of the present study was to investigate the olfactory attractiveness of air-dried insects used as aromas to dogs. The trial consisted of 35 adult dogs (20 males, 15 females) aged between 12 months and 7 years (mean = 3.6), varied in terms of breed, kept as companion animals. The dogs had free olfactory access to selected unprocessed dried insects, i.e., mealworm (*Tenebrio molitor*), Turkestan cockroach (*Shelfordella lateralis*), black soldier fly (*Hermetia illucens*), and tropical house cricket (*Gryllodes sigillatus*), as well as commercial dried and pelleted dog feed, which was used as a control treatment. Samples (100 g) were located separately in non transparent closed boxes with 5 perforations in the cover (7 mm each) to improve the intensity of the aromas without direct contact with the tested samples. The box was recorded as chosen when the dog showed interest in it for more than 15 seconds continuously per each attempt (3 attempts per dog). The presented study shows that the selected insect species were chosen as frequently as the control group (P=0.03). However, in terms of preferences by dog gender, *Tenebrio molitor* was favored more often by males than by females, which preferred *Shelfordella lateralis*. The current preliminary data suggest that the olfactory features of the selected insect species may be attractive to dogs.

Key words: dogs, feed additives, insects, aroma, nutrition

Edible insects are considered novel, environmentally friendly, and nutritious compounds used in animal nutrition (Józefiak et al., 2016). Moreover, even in the case of Europeans, who do not traditionally eat insects, the acceptance for insect use in animal nutrition is increasing. This acceptance is mainly caused by the need for alternative protein sources to soybean and fish meal (Verbeke et al., 2015). The Eu-

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ropean Union has defined insect meal as a processed animal protein and has imposed legislative barriers (Regulation (EC) No. 1069/2009) to its inclusion into livestock diets. However, insect meal may be used in companion animal nutrition, such as in hypoallergenic diets. Currently, live insects are frequently used as nutrition for exotic animals such as amphibians, reptiles, birds and rodents, and in some cases, insects in dried or lyophilized form are included in commercial diets to increase the attractiveness of the meals. The application of insects as an innovative feedstuff component is becoming one of the most interesting issues in the case of companion animal nutrition and is used in the case of hypoallergenic feeds in which soybean or chicken are eliminated. Moreover, insects are considered a functional feed due to their chitin and antimicrobial peptide contents (Józefiak et al., 2016; Józefiak and Engberg, 2017). In addition, it is well known that in animal, nutritional aromas and flavors are supplemented in feeds as attractants (Chen et al., 2017). These substances stimulate feed intake as well as the consumption of poorly palatable feedstuffs. However, the use of supplemental aromas and flavors in pet foods generates additional costs without direct feed quality improvement. Insect use may be an alternative that improves both palatability and quality of the feed. It is particularly important in the case of pet food production, which reached 19 billion US dollars in the United States in 2012 alone (Koppel, 2014). In the available literature, there are no data about the effect of various insect species as an aroma source on dogs' preferences. Due to the abovementioned facts, the goal of the present study was to investigate the attractiveness of selected insect aromas to dogs.

Material and methods

The present study was carried out using 35 dogs kept as companion animals. The dogs' age varied between 12 months and 7 years (mean = 3.6), 20 males and 15 females differing in terms of breed (Yorkshire Terrier, Beagle, Labrador Retriever, and mongrels) participated in the study. The dogs which were used in the present study met the following criteria: no human-directed aggression history; no illness or injury; no oestrus or lactating period. The dogs were not fed with insect-containing feeds earlier, and each dog was subjected to the test separately. Due to neophobia limitations, only adult animals were used in the study (Bradshaw, 1986). Furthermore, before the experiment, each dog was fed diversely (commercial and home prepared feeds) to eliminate the "monotony effect". Moreover, the dogs were not fasted before trial. The design of the current trial was performed in accordance with commonly used palatability measurements, i.e., the bowl test (Koppel, 2014). In the experiment, the dogs had free olfactory access to 4 selected dried (50°C for 48 h) insect species, i.e., *Tenebrio molitor*, *Shelfordella lateralis*, *Hermetia illucens*, and *Gryllodes sigillatus*, as well as a commercial dry pelleted feed for dogs (based on maize, wheat, chicken and turkey meal, animal fat, as well as soybean meal, digest), which was used as a control. The nutritive value of each component was shown in Table 1. The experiment was conducted in each dog's household environment conditions by the owner (without experimenter presence) to eliminate stress factor, impact

of new places and habituation on the experimental room, which could affect the results. Insects were offered as whole dried, unprocessed larvae (*Tenebrio molitor*, *Hermetia illucens*) or imagoes (*Shelfordella lateralis*, *Gryllodes sigillatus*). The selection of life stages of the insects was determined by their practical use in animal nutrition. The components were presented in separate tightly closed boxes with perforations (5 holes in the cover, each hole in each corner and one in the center; 7 mm in diameter), to improve the intensity of the smell without the possibility of direct contact with the components. The dogs were not able to see the experimental components in boxes and choose visually preferred component due to the usage of white covers, as well as the identical non transparent boxes. A total of 5 experimental feeds including control were offered repeatedly (3 times) to dogs using a randomized block design. The olfactory test was conducted at the opposite site of the room to where the sampling had taken placed. The dog was held on a leash at a starting point, which was located 2.0 m in front of the experimental boxes. The distance from the starting point to each box was equal. The boxes were located on the floor, 50 cm apart. When the owner led the dogs to the experimental area, they were walked around the experimental boxes and allowed to choose the most preferred component. The box was recorded as chosen when the dog showed interest in it for more than 15 seconds continuously per each attempt. After the first choice, the owner came back to the starting point and was waiting two minutes for the next attempt, as well as provided the dog with no form of attention at this time. After that, the experimenter was changing the order of the boxes for the next attempt. There were 105 replications, with 3 attempts per dog.

Table 1. Nutritive value of selected insect species and control feed used in the study

Item	Control diet	*Gryllodes sigillatus*	*Hermetia illucens*	*Tenebrio molitor*	*Shelfordella lateralis*
		Imago	Larva	Larva	Nymph
Per kg of DM[1]					
crude protein (g)	236.1	564	404	588	734
crude fat (g)	161	177	335	273	192
crude fiber (g)	21	60	97	85	86
crude ash (g)	ND[2]	66	71	45	46

[1]DM – dry matter; [2]ND – data not available.

All obtained data were tested for a normal distribution using the Kolmogorov-Smirnov test. Analysis of variance was conducted using Bartlett's test. The significance of differences among groups was determined by Duncan's multiple range test at a significance level of $P \leq 0.05$. The following general model was used:

$$Y_i = \mu + \alpha_i + \delta_{ij}$$

where:

Y_i is the observed dependent variable,
μ is the overall mean,
α_i is the effect of offered aroma,
δ_{ij} is the random error.

Ethics statement

According to the Polish law and the EU directive (No. 2010/63/EU), the experiments conducted within the study did not require approval of the Local Ethical Committee for Experiments on Animals in Poznań.

Results

No acceptability disturbances were recorded during the experiment. The presented study showed no significant differences between the control treatment and the experimental treatments. However, the aromas of *Tenebrio molitor*, as well as *Shelfordella lateralis*, were chosen as frequently as the control treatment. Despite those results, different choices were noticed between males and females. Males showed strict preferences towards *Tenebrio molitor* (Figure 1) in comparison to females, which preferred *Shelfordella lateralis* (Figure 2) more than the other components (P=0.03).

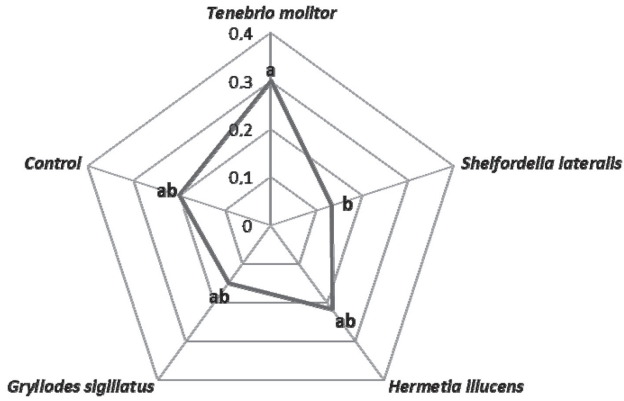

Figure 1. The frequency of aroma first choice in male dogs

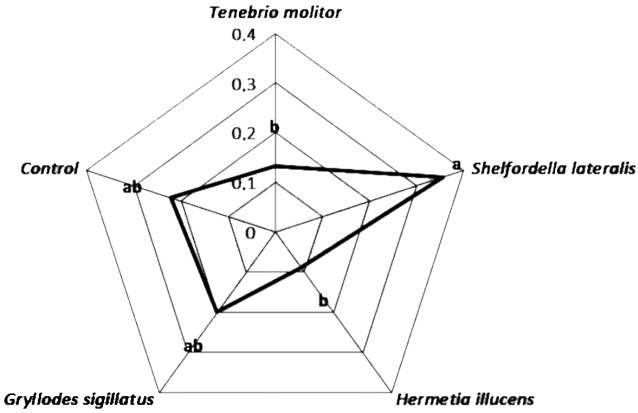

Figure 2. The frequency of aroma first choice in female dogs

Discussion

Olfaction in canines is one of the most important senses. It determines sexual behavior and ingestion, as well as assessment and localization of feed. Moreover, it was proven that smell also plays a crucial role in indicating nutritional preferences (Houpt et al., 1978). The olfactory attractiveness analysis of pet foods or their compounds have been limited in the current literature. Simultaneously, this kind of examination is crucial to understand canine behavior and expand knowledge about diet formulation for dogs. However, Di Donfrancesco et al. (2012) described a few attributes (aromas) in dog food samples, i.e., fish, meaty, liver, oil, burned, dusty, and soy, as well as spice complexes. It is well known that various dog breeds are characterized by the different preferences of feed, e.g., Basset hounds and German Shepherds prefer fish meal in comparison to Salukis, which mainly choose corn flakes (McCay et al., 1949). However, from a practical point of view, the design of the present trial examined the preferences of a wide population of various dog breeds with the aim of verifying the usefulness of insect attractants, in general. Moreover, in the available literature, there is no information about the inclusion of insect species in companion animal diets as an aroma additive. However, there is abundant evidence that insects are part of wild Canidae diets, such as those of *Atelocynus microtis*, *Otocyon megalotis*, *Vulpes rueppellii*, *Vulpes zerda*, *Canis lupus*, and *Lycaon pictus* (Sawosz-Chwalibóg and Kosieradzka, 2012). The current study demonstrated a positive effect of *Tenebrio molitor* as well as *Shelfordella lateralis* on improving attractiveness. In the literature, there are very few studies that consider the effect of aroma on palatability in dog genders separately. Houpt et al. (1978) observed more inclinations to take in sugar by females compared to males. In contrast to this, Guerra (2015) noticed that dog gender did not influence preference for diet type. From this point of view, it is difficult to explain why males and females preferred the abovementioned insect species. In addition, there is a lack of information about what characterizes the volatile substance profiles in insects. These data could be very helpful to understanding the attractiveness of the selected insects in comparison to the commercial diets. The increased interest of dogs may be caused not only by odorant substances but also by additional nutrient sources. Józefiak et al. (2016) presented the nutritional value of insect species predominantly used in animal nutrition. In comparison to other components used in the study, *Tenebrio molitor* and *Shelfordella lateralis* contained the highest crude protein levels, up to 59% and 73%, respectively. Moreover, the fat content of selected insects was higher than that of the control feed. The possibility of insect application to dog diets provides the double benefit of an encouraging aroma as well as an additional, high-quality nutrient source. It is important from a practical point of view, where producers of companion animal feed use expensive aroma and flavor supplements that do not provide any nutrients. As shown in the present study, insects may effectively affect dogs to the same extent as the commercial feed containing aroma, simultaneously provide an additional source of high-quality crude protein and fat.

Conclusions

The obtained preliminary data suggest that insects may play important roles as alternatives for commercial aroma additives in dog nutrition. However, more data are needed to explore insect attractants of other insect species, especially in terms of their volatile substances.

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