FACULTY OF
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INSECTS ON THE MENU: EXPLORING PALATABILITY PREFERENCES FOR CATS

PART 1: RATIONALE

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1 Context

1.1 Insects as feed for pets

1.1.1 Nutritional value of insects

The most common insects found in academic research are the yellow mealworm (YMW) and the black soldier fly (BSF). Meanwhile, yellow mealworm larvae (YMWL), black soldier fly larvae (BSFL) and crickets are currently the only insect species used in pet food (Zou et al., 2024). Even though not many species are commonly used, there are currently eight species legally allowed to be incorporated in pet nutrition (EFSA, 2015). These insects are considered high-quality protein sources with high-fat concentrations and a good amino acid profile, making them suitable for inclusion in pet food formulations (Kępińska-Pacelik and Biel, 2022). Weru et al. (2021) reviewed 26 articles regarding the nutritional composition of insects and concluded that edible insects are a good source of nutrients, and certain species can help prevent undernutrition. Moreover, the chemical composition of insects varies depending on different factors such as the species, the diet they were fed, gender, the developmental stage and the processing techniques that were used (Van Huis et al., 2021). This facilitates the possibility of manipulating the nutritional composition by adjusting the diet of the insects. For instance, adding omega-3 fatty acids to the food of various insect species increases their fatty acid content (Oonincx and Finke, 2021).

Using insects as the main protein source in animal diets has been the subject of various studies, mainly in aquaculture and poultry (Józefiak et al., 2016; Allegretti et al., 2018; Abd El-Hack et al., 2020; Alfiko et al., 2022; Hameed et al., 2022; Tran et al., 2022). As Zou et al. (2024) stated, YMW is known as a “treasure trove of protein feed” because 64.8% of its dry weight can be protein. Meanwhile, for BSFL only 40% of its dry weight is protein. Housefly larvae consist of 37.5-63.1% protein. Furthermore, the high digestibility of insect-based pet foods has been studied and confirmed a considerable number of times (El-Wahab et al., 2021; Freel et al., 2021; Kröger et al., 2020; Penazzi et al., 2021). For instance, the in vitro nitrogen digestibility of BSFL, housefly and mealworm are respectively 87.7%, 93.3% and 92.5% (Bosch et al., 2016). According to Bosch et al. (2014), insect species vary in digestibility with house fly and BSF pupae being less digestible than other insects. The amino acid and fatty acid profiles differ between insect species Reilly et al. (2022). However, it must be noted that all essential amino acids can be found in insects (Zhou et al., 2022). The primary amino acids found in BSF, mealworms and crickets are glutamic and aspartic acids (Makkar et al., 2014). The limiting amino acids for cats are methionine in BSF and in YMW and leucine in housefly. The same applies to dogs, adding threonine to the list as a limiting amino acid in BSF (Bosch and Swanson, 2021).

Additionally, insects are rich in fat, with crude fat levels between 14.41% and 37.1% (Kępińska-Pacelik and Biel, 2022). The observed fatty acid profiles most likely come from the fatty acid composition of the feed that was used and the environment in which they were grown. The saturated fatty acid levels of insects are approximately 28.20-49.60% of fatty acids and are similar to those of conventional animal sources. Likewise, the fatty acid composition of insects resembles those of the common protein sources (Kępińska-Pacelik and Biel, 2022). The main fatty acids in mealworm larvae and crickets are oleic, linoleic, and palmitic acid, while the main fatty acids for BSF are lauric, oleic and palmitic acid (Makkar et al., 2014). The highest amount of crude fat (36.2% on dry matter (DM) basis) is provided by the BSF, while the YMW sits around 26.7% DM and crickets at 29.2% DM (Huang et al., 2019). To meet the daily protein and lipid needs of adult cats and dogs a smaller amount of insect meal can be given compared to chicken meat (Valdés et al., 2022).

Further, insects are considered a good source of micronutrients. They can provide a variety of vitamins, including vitamin A, vitamin D2, vitamin D3, vitamin C, vitamin E, vitamin K thiamin, riboflavin, pantothenic acid, niacin, pyridoxine, folic acid, D-biotin, and vitamin B12. Likewise, they are high in minerals, especially zinc and iron (Zhou et al., 2022). For the species-dependent vitamin and mineral composition one can be referred to the review of Zhou et al. (2022). It can be concluded that insects carry great potential to fulfil the nutritional requirements of cats and dogs as an alternative protein source (Ahmed et al., 2022).

1.1.2 Potential health benefits

Apart from their nutritional value, research has shown that certain insect species contain bioactive components with potential health-promoting properties. For instance, the lauric acid in BSFL can contribute to the immune response by functionning as an antimicrobial factor against fungi, viruses and Gram-positive bacteria like *E. coli, Salmonella* sp., and *Clostridium perfringens* (Skrivanová et al., 2006; Valdés et al., 2022). It is known that edible insects also contain antimicrobial peptides (AMPs), mainly in their adipocytes and hemolymph (Arrese and Soulages, 2010; Tanga and Ekesi, 2023). These AMPs work against bacteria, fungi and viruses and facilitate the therapeutical and prophylactical use of insects (Van Huis, 2022). Moreover, insects have antioxidative properties due to the presence of chitin, cuticle proteins, catalase, antibacterial peptides and superoxide dismutase. These substances can play a role in protecting tissues against oxidative damage (Valdés et al., 2022).

Further, edible insects contain variable amounts of chitin in their exoskeleton, depending on species and life stage (Smets et al., 2020). Chitin is seen as an antinutritional factor because of the lack of chitinase in the human and animal body, but it is potentially beneficial as a source of dietary fiber to the gut microbiota. It can act as a prebiotic for beneficial bacteria, while also being antimicrobial against harmful bacteria. Additionally, chitin can bind to cholesterol in the digestive tract leading to lower cholesterol levels (Kipkoech, 2023).

Insect-based pet foods are claimed to be hypoallergenic diets due to the proteins being novel and unfamiliar to the immune system of pets (Siddiqui et al., 2023). In a study conducted by Böhm et al. (2018) 20 dogs with atopic dermatitis, as a result of adverse food reactions, were given an insect-based diet as the sole protein source for two weeks. The results showed that this diet can significantly improve the lesion score and coat quality of these patients. This was also confirmed in a study by Lee et al. (2021) where the same type of patient was given a diet based on YMW for 12 weeks. Nonetheless, researchers warned that every protein greater than 20 kDa can cause an allergic reaction. Thus, with the increasing frequency of insect protein ingested, there remains a possibility for allergies to appear in the future. Broekman et al. (2017) concluded in their study that patients with a shrimp allergy can most likely experience food reactions towards mealworm and other insect species as well. However, adverse food reactions towards mealworm does not indicate allergies towards all insect species. Another study found a potential cross-reactivity between storage mites and mealworm proteins, meaning dogs with allergies to mites can also have an allergy to mealworms (Premrov Bajuk et al., 2021). It is necessary to do further research on the possible health-promoting properties and the long-term use of insect-based diets (Bosch and Swanson, 2021; Tanga and Ekesi, 2023).

1.1.3 Sustainability of insect-based pet food

In recent years, there has been a growing interest in the use of insects as a sustainable alternative protein source for pet food. One of the greatest challenges of the twenty-first century is to produce food in sufficient quantities to maintain the human population while also minimizing environmental impacts and preserving the health of ecosystems (Guiné et al., 2021). Conventional protein sources for human consumption like poultry, beef and fish are associated with a significant environmental impact, which includes deforestation, greenhouse gas emissions and overexploitation of natural resources (Vega Mejía et al., 2018; Grossi et al., 2019). The pet food industry generally uses by-products of human consumption and can therefore be considered more sustainable than the human food production sector (Swanson et al., 2013).

Nevertheless, insect farming requires considerably fewer resources and is characterized by lower greenhouse gas emissions compared to conventional livestock farming (Halloran et al., 2016; Van Huis and Oonincx, 2017; Hancz et al., 2024). The environmental impact of insect rearing is quantified through the entire chain by performing a life cycle assessment (LCA). A LCA for mealworm production conducted by Oonincx and de Boer in 2012 showed that 1 g of edible mealworm protein requires two to three times less land and 50% less water compared to the same amount of chicken protein. Moreover, when compared to beef, the same amount of edible mealworm protein requires 8-14 times less land and around 5 times less water. These findings were also confirmed in a study by Miglietta et al. (2015). Life cycle assessments performed on other insect species showed similar results. When comparing housefly meal to a mixture consisting of 50% fish meal and 50% soybean meal, a reduction of 98% in land use, 61% in global warming potential and 38% in energy use can be seen (Van Zanten et al., 2015). In 2019, a life cycle analysis of the BSF conducted by Smetana et al. showed that the production of fresh insect biomass is almost twice more sustainable than fresh chicken meat.

The energy requirements for the rearing of insect biomass are higher than those of chicken, and pork and lower compared to beef. Insects are poikilothermic, meaning their internal temperature varies significantly and they mostly rely on the environment heating (Guiné et al., 2021; van Huis, 2022). Therefore, the use of renewable energy is important to compete with the production of fishmeal and crops (Smetana et al., 2019). However, feed given to insects can be efficiently used for their growth because they do not need energy to maintain their body temperature. As a result, the feed conversion efficiency is remarkably high (Halloran et al., 2016; Guiné et al., 2021; Van Huis, 2022). Additionally, insects can efficiently utilize organic waste streams to convert low-value by-products into nutritious biomass, contributing to waste reduction and applying the circular economy principle (Surendra et al., 2020; Gasco et al., 2021). The by-products that can be used depend on the insect species. The BSF is the best-known species for rearing on organic side streams, including rice straw, coffee pulp, fish offal, dried distillers' grains with soluble and catering waste (Van Huis and Oonincx, 2017). Yet, in the European Union, there are currently restrictions on feeding certain materials to insects intended for human or animal consumption because these insect species are defined as livestock (Gasco et al., 2020). Even though it is currently not allowed, BSF could even be grown on chicken, swine and cattle manure, while sultaneously killling present pathogenic bacteria e.g. *Salmonella enterica* or *Escherichia coli* (Van Huis and Oonincx, 2017). In addition, conducting evaluations of the nutritional value of feed materials is essential to ensure that their specific nutrient requirements are being met (Kierończyk et al., 2022).

1.1.4 Challenges

Regardless of the many benefits insects can offer, there are still several challenges and concerns associated with their utilization. One of the main considerations regarding the use of insects in pet food is the potential for allergenicity. As previously stated, insects are generally considered hypoallergenic. However, certain pets can still develop a food allergy to insects (Broekman et al., 2017). This may be provoked by a cross-reaction with a different allergen or by a primary sensitization (de Gier and Verhoeckx, 2018). For instance, in a study conducted by Broekman et al. (2017), it was concluded that patients with a food allergy to shrimp are most likely at risk of also being allergic to mealworms and other insects. It is therefore crucial to identify specific allergens in insect-based pet food and to conduct allergen testing so that consumer safety is ensured. Luckily, edible insects can be processed in a certain way that reduces allergenicity (Zhou et al., 2022).

Contamination by pathogenic microorganisms is also a concern associated with insect-based pet food. Like any food source, insects can be occupied by harmful bacteria, fungi, or parasites that pose risks to pet health. The risk of transmission of zoonotic pathogens to humans and pets is considered to be insignificant because most insects are fed on plants (Doi et al., 2021). However, viral and bacterial infections originating from insect-based foods can not be entirely neglected. Bertola and Mutinelli (2021) found in the literature that more than 70 virus species were already detected in edible insects. They concluded that biosecurity is essential for the mass rearing of insects. Another study found potentially pathogenic bacteria including *Vibrio, Streptococcus, Staphylococcus,* and *Clostridium* in edible insects that are being sold in the EU (Osimani et al., 2017). It was determined by Vandeweyer et al. (2021) that the highest risk for food safety is posed by the bacteria *Staphylococcus aureus*, *Clostridium* spp., and *Bacillus cereus* species. Yet, they also stated that these biological contaminants can sufficiently be reduced by different processing methods for extruded and canned pet food. Further, certain parasites can also be present in edible insects and may be transmitted through consumption (Zhou et al., 2022).

Chemical contaminants including heavy metals, pesticides, drug residues and organohalogen compounds can also be present in edible insects (Van der Fels-Klerx et al., 2018). Pesticides pose a problem for insects harvested in the wild, that can feed on sprayed material. Farming insects will eliminate this issue. The same can be said about the bio-accumulation of heavy metals, considering this originates from human pollution and the habitat of the insects (Zhou et al., 2022). Cadmium and arsenic can be accumulated in BSFL and YMWL, respectively (Van der Fels-Klerx et al., 2018). It is still important to monitor the amount of toxic heavy metals present in the insects (Kępińska-Pacelik and Biel, 2022). In conclusion, similar to other food-processing chains, insect-based diets can be considered safe, as long as the conditions for their production and rearing are optimal (Valdés et al., 2022).

Other challenges for insect-based pet food include the regulatory framework and consumer acceptance issues. The legal framework in Europe, the USA, and North Korea restrict the possible opportunities for edible insects. Additionally, the regulations around insect feed differ substantially around the world (Zou et al., 2024). Harmonization of regulations is necessary to ensure consistency in the regulatory framework for insect-based pet food products and to ensure consumer confidence (Lähteenmäki-Uutela et al., 2018). The acceptance of consumers and pet owners is still a considerable difficulty (Bae et al., 2020). As Siddiqui et al. (2023) stated, the growth of the insect-based pet food industry will largely depend on the perceptions of pet owners of health benefits and sustainability claims. Pinney and Costa-Font (2024) conducted an online survey among 280 dog owners in the UK, showing the concern of people about the healthiness of insect-based pet food. The results showed that almost half of the respondants answered that they neither agreed nor disagreed with the statement 'Insect-based dog food is safe for dogs to eat'. Additionally, 62% responded the same thing for the statement 'insect-based dog food is healthy'. A survey by Naranjo-Guevara et al. (2021) showed that 94% of the participating Dutch students and 75% of the German students are willing to accept the use of insects as animal feed. They also concluded that the acceptance of insect-based pet food is based upon the education of consumers about the health and environmental advantages.

1.2 Palatability in cats

1.2.1 Domestication and feeding habits

Even though insect-based pet food can provide a fully balanced diet, palatability plays a deciding role in whether cats will readily accept and consume this type of food. In 1985, Cook et al. published a paper in which they demonstrated that cats prefer a diet low in protein with high palatability content over one that was high in protein but less tasty. A diet simply being complete and balanced is not enough if the food is not tasty and the cat is not willing to eat it. Therefore, to ensure customer satisfaction, success on the market and repurchases, it is important to study and understand the sensory aspects and preferences that influence a cat's willingness to eat a certain diet (Zaghini and Biagi, 2005; Dodd et al., 2019; Knight and Satchell, 2021).

Cats have retained many of the feeding behaviors and preferences of their wild ancestors, despite being domesticated since roughly 9000 years ago (Driscoll et al., 2007). Cats are, just like dogs, members of the order Carnivora (Bradshaw et al., 1996). However, dogs are facultative carnivores, while cats are true obligate carnivores, meaning they require certain nutrients found only in animal-based proteins to survive and thrive (Li and Wu, 2024). Their ancestor, the African wildcat (*Felis silvestris lybica*), is a small wild cat native to the Middle East and is a further specialized predator than the ancestor of dogs, the gray wolf (*Canis lupus*) (Bradshaw, 2006; Driscoll et al., 2009). Their carnivorous nature is clear in their teeth which are adapted to ripping meat (Van Valkenburgh, 1989). Since cats are exclusively solitary hunters, they target prey with significantly lower body mass than themselves. As a result, they typically need multiple kills every day. This may be an important factor in their feeding patterns, as domestic cats tend to consume several small meals throughout the day, following an *ad libitum* feeding schedule (Bradshaw, 2006). Further, cats show a higher level of selectivity in the foods they choose to consume compared to dogs and they can notice even small variations in food composition (Watson et al., 2023).

1.2.2 Sensory perception

Several factors contribute to the dietary choices of cats. Cats use their sense of taste and smell to select their food (Hullár et al., 2001; Pickering, 2009; Alegría-Morán et al., 2019). Since cats have twice as many receptors in their olfactory epithelium, their sense of smell exceeds that of humans. Their olfactory system is estimated to be around fourteen times more sensitive (Padodara, 2014). This allows them to detect subtle differences in food palatability. In 2001, Hullár et al. conducted four preference tests in cats. They concluded not only that cats unquestionably use their sense of smell when selecting their food but that they will not even taste the less attractive food when the odor of another diet is significantly more attractive. In addition, when no certain food smelled especially appealing to the cats, they would taste the different options and choose depending on both taste and aroma. According to Aldrich and Koppel (2015), cats rely on their olfactory sense to assess their food for new or untrusted scents. They often thoroughly investigate the safety and freshness by sniffing the food intensely before eating.

While both taste and smell play significant roles in selecting food, taste is still the main sense in food preference (Watson et al., 2023). Cats can perceive only four different basic tastes using their taste buds – salty, sour, bitter and umami. They have limited ability to detect sweetness compared to humans since their sweet taste receptor gene is pseudogenized, meaning the gene has been mutated into an inactive form during evolution (Li et al., 2005, 2006; Adler, 2014). As a result, they are indifferent to glucose, fructose and sucrose (Pekel et al., 2020). The greatest number of taste receptors in cats are those that detect amino acids (Bradshaw et al., 1996; Zaghini and Biagi, 2005), allowing them to assess the quality of meat (Bradshaw, 1991). Cats are typically attracted to a diet with a strong umami flavor, associated with a high amount of amino acids and nucleotides (Salaun et al., 2017; Alegría-Morán et al., 2019). This is connected to their preference for protein-rich meat-based diets. Conversely, bitter foods are often refused by domesticated cats (Sandau et al., 2015). In comparison to humans, cats are reported to have fewer bitter taste receptors (Lei et al., 2015; Sandau et al., 2015). Cats' aversion to these bitter foods can be attributed to their infrequent exposure to such items, which often contain bitter and potentially toxic compounds (Glendinning, 1994). Cats are also indifferent to low concentrations of salt (≤0.05 M), possibly because of the high amount of sodium in meat (Mcgrane et al., 2023). As Mcgrane et al. (2023) stated, considering cats are obligate carnivores, their taste perception seems to have evolved to mainly detect substances present in meat.

Further, according to Pekel et al. (2020), cats utilize a combination of their nose, mouth and vomeronasal organ to assess the taste of a certain food. The vomeronasal organ or Jacobson's organ lies on the bottom of the nasal cavity. Its duct connects both the nasal and oral cavity and has the anterior opening into the incisive duct (Salazar and Sánchez-Quinteiro, 2011). The vomeronasal organ must compensate for the relatively weak taste sensitivity since cats have quite a small amount of taste buds on their tongue. They only have around 470 of these taste buds, while dogs, cattle and humans have 1700, 20,000 and 10,000, respectively (Davies et al., 1979; Ganchrow and Ganchrow, 1987; Robinson and Winkles, 1990).

1.2.3 Taste preference

Research into the development of food preferences indicated that dietary choices may be determined innately, by social influences and/or by early experiences with food (Bradshaw et al., 1996). The maternal influence on taste perception starts already very early through the transmission of flavors via amniotic fluid in the utero and postnatal milk (Houpt and Zicker, 2003; Zaghini and Biagi, 2005; Bradshaw, 2006; Aldrich and Koppel, 2015). Becques et al. (2009) conducted a study in which they fed cats a diet with cheese flavor during their gestation. When their kittens were two days old, they gravitated first towards the cheese smell they were previously exposed to whilst they were in utero. Similarly, when the cats were 45 days old, they consumed a larger quantity of a diet with cheese flavor than a common pet food diet. During weaning, kittens do not prefer the most palatable diet based on innate preferences but they rather go for their mother's food, even when this is an uncommon food for cats (Bourgeois et al., 2006). Wyrwicka (1993) trained mothers to exclusively eat bananas and observed that 15 out of 18 kittens followed their mother in eating this unpalatable food. Even when separated from their mothers, they still chose bananas above pet food. Moreover, the kittens mimicked their mother's eating habits with remarkable precision. This favoritism for their mother's diet is called the primacy effect and is probably caused by neophobia to other foods, which is the initial rejection of an unfamiliar food (Bradshaw, 2006; Watson, 2011). Supposedly, cats may stay away from harmful or poisonous foods by this sort of diet rejection (Pekel et al., 2020). This behavior is usually associated with physiologic, emotional, or environmental stress e.g. when the cat is sick, in pain or when the cat is visiting the veterinarian (Bradshaw, 1991; Bradshaw et al., 1996). Therefore, presenting a new food should occur in a positive and familiar situation to evade neophobia (Bourgeois et al., 2006).

On the other hand, in wild and farm cats a bigger consumption of unknown and more scarce foods has been observed. This behavior is believed to take care of fulfilling all their nutritional requirements by improving their range of food choices (Alegría-Morán et al., 2019). Thus, neophobia can certainly not always be noticed in practice (Watson et al., 2023). This opposite effect of neophilia is called the novelty effect and is mostly present in cats that have exclusively been eating a single diet over an extended period. It is reported that these animals preferred a novel diet above their usual known food and that the amount of time of this preference is dependent upon its palatability (Bourgeois et al., 2006; Pekel et al., 2020; Watson et al., 2023). Bourgeois et al. (2006) warned that this novelty effect could influence the results of short-term palatability tests typically during several days, after which dietary preferences become stable. Further, when cats must choose between two familiar and readily available diets, they tend to consume a combination of both to gain a diversity of nutrients and a better nutritional balance (Watson et al., 2023). If one of these two diets is less readily available, cats prefer the diet that is rarer, which is defined as anti-apostatic selection. This behavior has been noticed in cats that hunt prey, but also in cats that eat commercial pet food. It tends to be more pronounced in cats with varied feeding experiences (Bourgeois et al., 2006).

Exposure to a wide variability of foods leads cats to neophilia instead of neophobia as adults (Bourgeois et al., 2006). Introducing these diverse diets during weaning leads to kittens developing broad food preferences. These preferences developed during weaning in the presence of their mother continue to be present in kittens until they are four to five months old and can undergo significant changes throughout the initial year of life. (Bourgeois et al., 2006; Bradshaw, 2006). The degree of neophobia towards a novel food revolves around the number of differences in its sensory characteristics compared to the familiar food. Cats that have been fed a single type of commercial pet food usually appear to have a strong preference for alternative commercial foods when initially presented to them. The resemblance between commercial pet foods results in minimal or absent neophobia, giving the upper hand to the monotony effect (Bradshaw, 2006). This effect involves the decrease in the perceived palatability of familiar foods in favor of a new unknown food with different sensory features. This might serve as a method to avoid potential long-term effects of nutritional imbalance from consuming a single diet (Pekel et al., 2020). The monotony effect is seen more clearly in free-ranging cats, for instance, strays or cats found on farms, but has already been observed under all living conditions and in all ages (Bradshaw, 2006). Thus, cats can adjust their food preferences based on their experiences.

The taste system of cats is linked to their nutritional needs. They can accept or reject diets to regulate their food intake and fulfil their nutritional requirements (Peachey and Harper, 2002; Zoran and Buffington, 2011; Hewson-Hughes et al., 2013; Salaun et al., 2017). Cats prefer a diet high in protein when presented with complete and balanced diets with different proportions of protein, fat, and carbohydrate (without influencing palatability) (Li and Wu, 2024). The effect of certain nutrient components such as dry matter, crude protein, crude fiber, total lipids, ash and metabolizable energy has been evaluated by Alegría-Morán et al. (2019). It was found that dietary fiber, calcium, phosphorus, and ash have a negative impact on palatability. Cats can also pick their target intake of protein, fat, and carbohydrates to achieve nutritional balance when choosing between diets with different macronutrient compositions (Watson et al., 2023). Balancing these nutrients is even proposed to be an essential driver for longstanding diet selection in cats (Hewson-Hughes et al., 2016).

However, the research on the influence of intrinsic and extrinsic factors on cats' nutritional habits is limited (Bradshaw, 2006; Aldrich and Koppel, 2015). It is known that certain food characteristics like texture and temperature influence palatability (Bradshaw et al., 1996). Cats prefer food at a comparable hotness to the body temperature of prey (37°C) and refuse foods at a temperature below 15°C or above 50°C (Zaghini and Biagi, 2005; Eyre et al., 2022). Further, they usually favor wet diets over dry or semi-moist foods as the moist level of wet food is similar to that of meat (Zaghini and Biagi, 2005). Alegría-Morán et al. (2019) studied the effect of intrinsic variables such as age, body weight, sex, and seasonal variations on the diet choices of a cat. Body weight and sex influenced food intake, with females and relatively heavier cats having a lower food intake. This is not the case for the age of cats. Differences in food preferences were only seen in varying body weights, particularly the heaviest animals just showed a bigger preference in general. Further, it was observed that female cats eat more during the colder months, while male cats had a higher preference for a more palatable diet during warmer months.

2 Research question

Even though insect-based pet food is becoming increasingly more popular, there are only few reliable studies conducted on the palatability of those diets (Kępińska-Pacelik and Biel, 2022). Moreover, most of the research on such diets have focused on dogs, while only a limited number have involved cats (Valdés et al., 2022). There are most likely some companies that have done more palatability testing internally, but hardly any data has been published (Bosch and Swanson, 2021). Paßlack and Zentek (2018) fed two diets containing either 22% or 35% BSFL to ten healthy cats for six weeks each. Regarding the first diet, one cat vomited and afterwards refused the diet and two cats showed a low food intake (83% and 88%). As for the second diet, three cats refused the food and three cats had a low food intake (78%-87%). However, they still concluded that most cats generally accepted the food sufficiently. This statement was also supported by Do et al. (2022) who compared the palatability and digestibility of three canned diets containing BSFL to a control chicken diet. The results showed that BSFL-containing diets had higher consumption ratios and were for most cats first approached and first consumed. Another study randomly assigned 28 adult cats to either a diet containing speckled cockroach, Madagascar hissing cockroach, superworm, or a control chicken-based diet (Reilly et al., 2022). They observed no difference in daily food intake between the four diets, but saw an intermittent inappetence for all diets. According to the authors, this variable food intake may be attributed to neophobic behavior of some cats. Since cats do not readily accept just any food that is nutritionally complete and balanced, palatability testing plays an important role in the success of composing insect-based diets (Zaghini and Biagi, 2005; Bosch and Swanson, 2021).

3 Study Aim

Because of the importance of palatability in cats and the lack of research on this topic regarding insect-based diets, the aim of this study is to verify whether cats would accept these foods. Specifically, their preference of diets containing different percentages of BSF as a protein source will be studied. A multiple day 2-pan test will be carried out by using SureFeeders and the kinetics of the cats' consumption will be reviewed. During the 2-pan or two-bowl test the cats are presented with two diets at the same time and different characteristics will be monitored (Tobie et al., 2015). These characteristics include total consumption, consumption ratio, intake ratio, first-approach and first-choice (Aldrich and Koppel, 2015). A one-bowl test is also possible where the cat is just presented with one diet but this is used to measure only the acceptability of a food (Tobie et al., 2015). The kinetics of consumption is useful to define the food consumption profile over time (Roguès et al., 2016). The behavior of the cats while the food is presented can also be analyzed. According to Van den Bos et al. (2000), cats lick and sniff the feeding bowl, lick their lips, and groom their faces more often when they like the food. These signals must be differentiated from licking and sniffing the food and licking their nose, which are signs of food aversions. Becques et al. (2014) found only the time spent sniffing food gave significant results with cats spending more time sniffing low palatable food. There is no general agreement among researchers about the best protocol for evaluating food preferences, leading to highly variable results (Pires et al., 2020). The participating cats should be healthy and well trained at the beginning of the study to understand that they have two food choices. Further, the cats should already be well adapted to the experimental conditions and their environment to avoid neophobia or neophilia (Pires et al., 2020).

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