NUTRITIONAL BENEFITS OF INCLUDING EDIBLE INSECT CO-PRODUCTS IN PET FOOD

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ABSTRACT: Continued advancement in the pet food industry reflects a growing concern for the nutrition and well-being of pets, which are now considered integrated members of families. This progress drives innovations tailored to the specific needs of each breed and age, incorporating sustainable ingredients such as alternative and natural protein sources. Increasing attention to food customization and quality highlights adaptation to the particular demands of these animals. The focus on nutritional and environmental developments in the industry reflects a growing awareness of the importance of health and comprehensive care for pets in the family context. Despite growing demand for sustainable food options, insect co-products have emerged as promising alternatives, not only providing a high-quality protein source but also addressing crucial issues of sustainability and efficiency in food production. This study explored the feasibility and nutritional benefits of including these co-products in the diets of dogs and cats.
KEYWORDS: Alternative foods, food industry, Nutrition, Pets.

BENEFÍCIOS NUTRICIONAIS DA INCLUSÃO DE CO-PRODUTOS DE INSETOS COMESTÍVEIS NA ALIMENTAÇÃO DE CÃES E GATOS

RESUMO: O avanço contínuo na indústria de alimentos para pets reflete uma crescente preocupação com a nutrição e o bem-estar dos animais de estimação, agora considerados membros integrados das famílias. Esse progresso impulsiona inovações adaptadas às necessidades específicas para cada raça e idade, incorporando ingredientes sustentáveis, como fontes de proteína alternativas e naturais. A atenção crescente à personalização e qualidade dos alimentos destaca a adaptação às demandas particulares desses animais.

O enfoque na evolução nutricional e ambiental na indústria reflete uma conscientização crescente sobre a importância da saúde e do cuidado integral dos animais de estimação no contexto familiar. Diante da demanda crescente por opções alimentares sustentáveis, os co-produtos de insetos surgem como uma alternativa promissora, não apenas proporcionando uma fonte de proteína de alta qualidade, mas também abordando questões cruciais de sustentabilidade e eficiência na produção alimentar. O estudo em questão visa explorar a viabilidade e os benefícios nutricionais da inclusão desses co-produtos nas dietas de cães e gatos.
PALAVRAS-CHAVE: Alimentos alternativos, indústria alimentícia, Nutrição, Pets.

INTRODUCTION

With the significant increase in pet ownership and growing concern about the health and well-being of these companions, the pet food industry is constantly evolving (White, 2022; Watson et al., 2023). As pets become increasingly integrated members of families, their owners are increasingly attentive to their specific nutritional and care needs.

This increase in awareness about the importance of adequate and healthy nutrition for pets has driven the industry to develop foods that are more adapted to the specific needs of each animal, influencing a series of significant innovations. From formulations that aim to meet the specific nutritional needs of different races and ages to the introduction of alternative and more sustainable ingredients, such as alternative and natural protein sources (FEDIAF, 2019).

In this scenario, a rising topic that deserves attention is the nutritional benefits associated with the inclusion of edible insect co-products in the diets of dogs and cats (Bosch & Swanson, 2021; Gałęcki et al., 2024). The growing demand for sustainable food options has directed attention to alternative protein sources, especially considering the environmental challenges linked to conventional animal food production. In this context, insect co-products have emerged as a promising alternative, offering not only a high-quality protein source (Gałęcki et al., 2024) but also addressing crucial issues related to sustainability and efficiency in food production.

The main objective of this study was to explore the feasibility and potential nutritional benefits of including edible insect co-products in the diets of dogs and cats. We highlight the crucial role that this approach can play in promoting healthy, ecologically accountable eating for our beloved furry friends, aligning with growing demands for sustainable eating practices.

INSECT CO-PRODUCTS IN PET FOOD

Pet ownership has been increasing globally, and estimates indicate that more than 50% of all families own a pet (Valdes et al., 2022). This current trend is due to several factors such as increased income, household autonomy, increased life expectancy, urbanization, and humanization of animals (Alexander et al., 2020). Consequently, pet food is now one of the fastest-growing economic products in the world, with global pet food sales increasing considerably, reaching $125 billion in 2020 (Valdes et al., 2022).

Concerning feed for dogs and cats, one of the most expensive nutrients for diet formulations is protein, due to the high amino acid requirements of these animals, varying between 18% and 22% for canines and 26% to 30% for cats. % for felines, based on dry matter (AAFCO, 2021). It is also worth noting that foods with better quality have a higher protein content, as well as a higher proportion of proteins of animal origin, which are more expensive than protein sources of vegetable origin (Acuff et al., 2021). Given this, the growth of the human population has influenced an increase in the search for foods of animal origin, combined with the tendency of canine and feline owners to use foods with a higher proportion of animal protein, putting pressure on natural resources (Gómez et., 2019).

Ingredients of animal origin have several advantages for the nutrition of dogs and cats, such as a high crude protein content, amino acid profile, and greater digestibility than those from vegetable sources (Pimentel and Pimentel, 2003), providing vitamins and minerals, such as B vitamins, especially cobalamin, phosphorus, and calcium, which are found in more bioavailable forms than in plant sources (Meeker and Meisinger, 2014). Sustainability and negative environmental impact are disadvantages of current foods based on animal protein (Henchion et al., 2017). A study conducted by Alexander et al. (2020) reported that global dry pet food production is associated with 56 to 151 Mt of CO^2 equivalent emissions annually (which represents between 1.1% and 2.9% of global agricultural emissions).

Entomoculture on an industrial scale to obtain protein ingredients of animal origin has been proposed worldwide as a viable alternative. Edible insect species (Figure 1) have been used as food ingredients for farm animals and humans because of their nutritional quality, specifically protein (25% to 70%) and lipid (10% to 50%) content based on dry matter (Dobermann et al., 2017). There are several advantages of total insect production to conventional animal husbandry systems: (1) less water use, (2) less land use, (3) they can be fed with residues or by-products (agro-industrial, domestic, forestry, slaughterhouses and others), (4) they emit low levels of greenhouse gases and ammonia and (5) they have the most efficient food conversion rates (Van Huis, 2013).

House crickets
(*Acheta domesticus*)

Yellow mealworms
(*Tenebrio molitor*)

Black soldier fly (BSF)
(*Hermetia illucens*)

Figure 1. Common types of insects used in the production of feed

Source: Adapted from UK Pet Food, (2021).

Worldwide, there is already a wide variety of insect-based foods and treats for dogs and cats, which are produced and sold mainly in Europe and North America. However, research on the effect of insect co-products on the health and nutrition of dogs and cats is still scarce. Furthermore, there are some issues regarding the technologies used to produce and incorporate insect-based ingredients into pet foods and the regulations in each country that allow their use in animal feed (Valdes et al., 2022).

Insects provide high nutritional and energy value as dietary ingredients for dogs and cats (Table 1). As a general rule, the nutrient content in insects, in descending order, is protein > lipids > ash > fibre (Makkar et al., 2014). Proteins from insect co-products have high digestibility (76% to 98%), as they are similar to animal proteins and are rich in essential amino acids (Bosch et al., 2014), with a high content of glutamic acid and aspartic acid. Glutamic acid is related to the perception of *umami* flavour, which has been described as a gratifying and appetizing taste for dogs, cats, and other animals (Luna et al., 2020). According to Bosch and Swanson (2021), the limiting amino acids in insects are methionine and threonine in black soldier fly larvae meal (*Hermetia illucens*) and mealworm larvae meal (*Tenebrio molitor*) for dogs and cats.

Properties	Cricket	Mealworm	Black Soldier Fly	References
				
Crude protein (%)	58–69	48–57	41–43	[1]
Main amino acids	1. Glutamic acid 2. Leucine 3. Alanine	1. Glutamic acid 2. Leucine 3. Aspartic acid	1. Aspartic acid 2. Glutamic acid 3.Valine	[1]
Lipids (%)	11–23	32–40	17–34	[1]
Main fatty acids	1. Linoleic acid 2. Oleic Acid 3. Palmitic acid	1. Oleic acid 2. Linoleic Acid 3. Palmitic acid	1. Lauric acid 2. Oleic acid 3. Palmitic acid	[1]
Crude fiber (%)	6–8	2–5	4–10	[1,2,3,4,5,6]
Ash (%)	3–8	2–4	15–27	[18]
Gross energy (MJ/kg)	20–22	26–27	20–24	[1,4,7,8]
Calcium (g/kg)	5–15	1–5	58–93	[1]
Phosphorus (g/kg)	7–8	4–11	5–13	[1]

Table 1. Nutritional properties of insects used in pet food

Source: Adapted from Valdés et al. (2022). References: [1] - Makkar et al. (2014); [2] - Cutrignelli et al. (2018); [3] - Ribeiro et al. (2019); [4] - Caimi et al. (2020); [5] -Kröger et al. (2020); [6] - Hawkey et al. (2021); [7] - Marco et al. (2015); [8] - Montowska et al. (2019).

Table 2 shows the values for dry matter composition, crude protein, crude energy, ether extract, mineral matter, and apparent metabolizable energy, and the digestibility coefficients for dry matter, crude protein, ether extract, mineral matter, and crude energy of *Gryllus assimilis* nymphs and *Tenebrio molitor* larvae based on dry matter.

	DM	**MM**	**CP**	**EE**	**GE**	**AMEn**
	Chemical composition of the NM/DM (%)				**(Kcal/Kg of NM/DM)**	
GAN	90.15	3.69/4.10	52.66/58.41	26.61/29.52	5975/6628	-
TML	94.56	3.16/3.34	49.34/52.18*	30.44/32.19	6074/6423	-
	Digestibility/retention coefficient ± standard error (%)				**(Kcal/Kg of NM)**	
GAN	52.5±5.0	49.4±7.3	31.3±2.8	64.0±8.6	58.7±2.6	4412±307
TML	64.9±8.3	56.6±12.0	49.3±7.7	76.2±20.9	76.9±3.6	4847±450

Table 2. Chemical composition and digestibility/retention coefficients for dry matter (DM), crude protein (CP), ether extract (EE), mineral matter (MM) and gross energy (GE), and apparent metabolisable energy (AMEn) of the insect meals, *Gryllus assimilis* nymphs (GAN) and *Tenebrio molitor* larvae (TML).

Source: Adapted from Dourado et al. (2020). DM: dry matter; NM: natural matter. *37.5/39.7% according to the nitrogen conversion factor established by Janssen et al. (2017).

Insects generally provide a good energy density for diets due to the high content of fatty acids, especially in species that have larval (holometabolous) stages, as the larvae accumulate energy reserves that will be used during metamorphosis up to the pupal stage and in the adult stage, where a large amount of energy is destined for reproduction. Tenebrio and cricket larvae meal contain unsaturated fatty acids, which can be beneficial for the health of canines and felines; however, the predominant fatty acid is palmitic acid (16:0) (Aguilar, 2021). The main fatty acid present in black soldier fly larvae is lauric acid (12:0), a saturated fatty acid that has antimicrobial activity against Gram-positive bacteria, fungi, and viruses and has been reported to regulate total cholesterol levels (Aguilar, 2021).

The third most important component of insect meals is ash or mineral matter. The ash content of black soldier fly larvae is high (2 to 25% of DM), as it contains high concentrations of calcium and phosphorus. Insects are rich in several microminerals such as copper, iron, magnesium, manganese, selenium, and zinc (Ordoñez-Araque et al., 2023). Insect co-products contain significant amounts of fibre derived from chitin, a polysaccharide that constitutes the insect exoskeleton. Fibre also originates from sclerotized proteins and other substances bound to chitin. Black soldier fly larvae, mealworms, and house crickets are good sources of riboflavin, pantothenic acid, biotin, and folate (Ordoñez-Araque et al., 2023).

The use of insects in the feeding of dogs and cats is a reality that has been spreading across various countries. Currently, several industries are producing dry pet food and treats based on insects for pets, which can be purchased at specialized stores, retail outlets, or on the internet, although still in relatively low numbers in Brazil. The commercialization of these co-products is on the rise, and pet owners seem to approve of the use of insect flours as ingredients for dog food in live, dehydrated, or ground forms. Future studies should investigate the acceptability of insects for dogs and cats, their nutritional safety, as well as their functional properties such as antioxidant, antimicrobial, and prebiotic capacities. Other relevant issues include potential risks to food safety resulting from animals consuming insects and the economic sustainability of insect farming on an industrial scale.

CONCLUSION

The incorporation of insect co-products into dog and cat food proves to be not only interesting but also a sustainable and innovative solution. The nutritional benefits associated with these ingredients, with their rich composition of proteins, vitamins, and minerals, stand out as a promising alternative to meet the specific demands of these pets. Furthermore, the sustainability inherent in the production of insect co-products offers an accountable approach in line with growing environmental concerns.

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