

Insect protein - a novel and sustainable source of protein for pet food?



One of the most important ingredients in a dog and cat's diet is protein.

The protein requirements of dogs are a minimum of 18% to 22% (AAFCO guidelines), depending on life stage, and 26% to 30% on a dry matter basis for cats. The digestibility of the protein source plays a big role in determining how much protein a dog or cat will require. Animal-based ingredients have several advantages for animal nutrition, such as higher crude protein content (20% to 23% on a fresh basis for meat and fish), more digestible amino acids than those from vegetable sources, and significant amounts of some vitamins and minerals, such as complex B vitamins, especially B12, phosphorus and calcium, which are found in organic form in animal-derived foods and are more bioavailable than in plant sources.[1]

However, an increased growth of the human global population coupled with demands of pet owners for high quality pet food containing animal protein is exerting strong pressure on the natural environment.

A 2020 study by researchers in the UK and Germany concluded that the impacts of pet food "are equivalent to an environmental footprint of around twice the U.K. land area and would make greenhouse gas emission from pet food around the 60th highest emitting country, or equivalent to total emissions from countries such as Mozambique or the Philippines".[2]

In order to meet the demand for highly nutritious animal food, many argue that the future will drive animal production systems to find new sources of high-quality and sustainable protein feed raw materials.[3]

Insect protein is now an approved ingredient by AAFCO for feeding adult dogs.

Do animals eat insects?

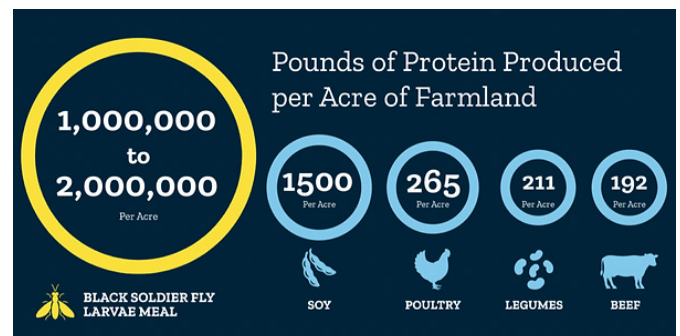
According to a recent review, there is evidence that insects have been part of the diets of wild canids and are commonly consumed by feral and domestic cats, contributing up to 6% of their diet.[1]

The use of insect-based ingredients in pet food is growing in interest in European countries, such as Germany, France, the Netherlands, England and Denmark. Increasingly, there are companies producing these foods in Canada and the United States including Mars and Nestle pet food companies. There are some producers in Asia and South America too.[1]

Should we be using insect protein in pet food for environmental reason?

Insect farming is considered environmentally friendly and sustainable compared to livestock farming. Insect protein has several advantages over land animal farming systems, as:

- (1) it has a lower water and carbon footprint,
- (2) less land is used to raise insects,
- (3) insects can be fed with waste (agro-industrial, household, forestry, slaughter plant and others)
- (4) insects emit low levels of greenhouse gases and ammonia and
- (5) insects' feed conversion rates are more efficient
- (6) it is relatively simple and inexpensive.[1]



Are insects safe to eat?

- Of relevant concern by the EFSA Scientific Committee.
- Insects could be vectors of bacteria (Escherichia, Staphylococcus, Bacillus, Vibrio, Streptococcus, Campylobacter, Pseudomonas, Clostridium), viruses (Poxviridae, Parvoviridae, Picornaviridae, Orthomyxoviridae, Reoviridae), fungi (Fusarium, Aspergillus, Penicillium) and parasites (Dicrocoelium dendriticum, Entamoeba histolytica, Giardia lamblia, Toxoplasma spp.)[1]
- Chemical contaminants - heavy metals are of greatest concern due to their potential for accumulation in insects, including cadmium in BSFL, however data on the accumulation is very limited.[1]
- Insect consumption can be considered safe, provided that the rearing and production conditions are optimal. To reduce food safety problems, special attention must be paid to the substrates used to raise and feed the insects, the most risky being those of animal origin and faeces.[1]
- The EFSA Scientific Committee concluded that microbiological risks are expected to be comparable with other food raw materials, provided that insects are fed with allowed feedstuff.[5][6]

Nutritional benefits of BSFL

Fat:

BSF fat contain up to 50 % medium chain (saturated) fatty acids in the form of lauric acid.

The highest content of monounsaturated fatty acids is oleic acid (c9C18:1), palmitoleic acid (C16:1), and which ranges from 10.3 to 192.0 g/kg, linoleic acid (C18:2n6) and linolenic acid.[3]

Lauric acid:

- Has antimicrobial activity against Gram-positive bacteria, fungi and viruses.[1]
- Helps regulate total cholesterol levels.[1]
- Has strong antimicrobial activity in monogastric animals.[7]
- Improves cognitive health.[7]
- There is abundance of literature reporting the beneficial role of dietary medium chain fatty acids in improving intestinal immunity of monogastric animals. These fatty acids can positively modulate intestinal morphology and barrier function.

Additionally, these molecules can potentially regulate host intestinal immune response, and thus suppressing the intestinal inflammation. [7]

Protein:

- BSFL has a rich amino acid profile. The most abundant essential amino acids are leucine, lysine and valine.[3]
- The limiting amino acids in insects are methionine for dogs and cats and threonine for dogs.[4]
- In a study which analysed the protein quality of a selection of insect species including BSFL, it was found that the crude protein content of insect substrates was in general higher than that in soyabean meal and close to that in poultry meat meal and fish meal.[4]
- Insect amino acids have high digestibility (76% to 98%) as they are similar to animal proteins.[1]

Minerals:

- The ash content is high, as it contains high concentrations of calcium and phosphorus.[1]
- BSFL are rich in minerals: calcium (Ca) (most abundant), Copper (Cu), Iron (Fe), Magnesium (Mg), Manganese (Mn), Phosphorus (P), Potassium (K), Sodium (Na) and Zinc (Zn).[3]
- Some toxic and harmful elements (such as Ba, Hg and Mo) can also bioaccumulate in BSFL which will pose a challenge to the safety of feed and food production.[3]

Fibre:

- Insects contain significant amounts of fibre, which comes from chitin, a polysaccharide that constitutes the exoskeleton of insects. Fibre also originates from sclerotized proteins and other substances that are bound to chitin.[1]
- BSFL is a good source of riboflavin, pantothenic acid and biotin.[1]

Antioxidants:

- Insect meal is high in antioxidant activity, with capacity similar to foods recognised for their high antioxidant levels such as cucumbers, apples and kiwifruit.[1]
- The high antioxidant capacity is associated with the presence of chitin, cuticle proteins, catalase, antibacterial peptides and superoxide dismutase.[1]

Digestibility food trial

Study: Penazzi L, Schiavone A, Russo N, Nery J, Valle E, Madrid J, Martinez S, Hernandez F, Pagani E, Ala U & Prola L 2021, "In vivo and in vitro Digestibility of an Extruded Complete Dog Food Containing Black Soldier Fly (*Hermetia illucens*) Larvae Meal as Protein Source", *Frontiers in Veterinary Science*, vol. 8, 653411

Design: Latin square design

Sample: 6 WHWT research dogs

Intervention: Two isonitrogenous and isoenergetic dry diets containing either venison meal (CONTROL diet) or black soldier fly larvae meal (BSF diet) were fed.

Outcomes measured: collected faeces and samples of food. Measured the digestibility of nutrients using both in vivo and in vitro methods.

Results:

- Both diets showed similar nutrient digestibility values for dry matter, organic matter, ether extract, ash, and phosphorus.
- A statistical trend ($p = 0.066$) was observed indicating greater protein digestibility in the BSF diet compared with the venison diet.
- Calcium digestibility was higher in the BSF diet compared with the venison diet ($p = 0.018$).
- Fibre digestibility was lower in the insect-based diet compared with the venison diet ($p < 0.001$).

Insects as a novel protein source for dogs with cutaneous adverse food reactions??

Study: Böhm TMSA, Klinger CJ, Gedon N, Udraitė L, Hiltenkamp K, Mueller RS 2018, "Effekt eines Insektenprotein-basierten futters auf die symptomatik von futtermittel allergischen hunden", *Tierärztliche Praxis Ausgabe K Kleintiere Heimtiere*, vol. 46, pp. 297–302. doi: 10.15654/TPK-170833

(German study)

Sample: 15 dogs with atopic dermatitis.

(inclusion: Canine Atopic Dermatitis Lesion Index (CADLI), Pruritus Visual Analogue Scale (PVAS) and coat quality score).

Intervention: fed commercial mealworm (*Tenebrio molitor*) meal based dog food only for 2 weeks

Results:

- dermal lesions improved in 12 dogs
- pruritus was reduced in 8 dogs but there was no significant change in pruritus scores ($p = 0.53$).
- 6 dogs showed an improvement in coat quality.
- 2 dogs showed mild deterioration of their lesions (on average by 1.5 CADLI points).
- One dog's skin lesions were unchanged.
- The improvement of the lesion scores (Wilcoxon test, $p = 0.007$) and coat quality (Wilcoxon test, $p = 0.01$) was significant



References:

- [1] Valdés F, Villanueva V, Durán E, Campos F, Avendaño C, Sánchez M, Dominguez-Araujo C & Valenzuela C 2022, "Insects as Feed for Companion and Exotic Pets: A Current Trend", *Animals (Basel)*, vol.12, no. 11, pp. 1450. doi: 10.3390/ani12111450. PMID: 35681914; PMCID: PMC9179905.
- [2] Alexander P, Berri A, Moran D, Reay D, & Rounsevell MDA 2020, "The global environmental paw print of pet food", *Global Environmental Change*, vol. 65, 102153.
- [3] Lu S, Taethaisong N, Meethip,W et al. 2022, "Nutritional Composition of Black Soldier Fly Larvae (*Hermetia illucens* L.) and Its Potential Uses as Alternative Protein Sources in Animal Diets: A Review, *Insects*, vol. 13, pp. 831.
- [4] Bosch G, Zhang S, Oonincx DGAB & Hendriks WH 2014, "Protein quality of insects as potential ingredients for dog and cat foods", *Journal of Nutritional Science*, vol. 3, pp. 1–4, doi: 10.1017/jns.2014.23.
- [5] Penazzi L, Schiavone A, Russo N, Nery J, Valle E, Madrid J, Martinez S, Hernandez F, Pagani E, Ala U & Prola L 2021, "In vivo and in vitro Digestibility of an Extruded Complete Dog Food Containing Black Soldier Fly (*Hermetia illucens*) Larvae Meal as Protein Source", *Frontiers in Veterinary Science*, vol. 8, 653411
- [6] EFSA Scientific Committee 2015, "Risk profile related to production and consumption of insects as food and feed", *EFSA Journal*, vol. 13, pp 4257. doi: 10.2903/j.efsa.2015.4257
- [7] Kotob G et al. 2022, "Potential application of black soldier fly fats in canine and feline diet formulations: A review of literature", *Journal of Asia-Pacific Entomology*, vol. 25, no. 4, 101994