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Black soldier fly as a sustainable and nutritious pet food ingredient

By Geert van der Velden, Innovation Manager at IQI Trusted Petfood Ingredients

In the coming years, the pet food industry will be confronted with an increasing animal and marine protein deficiency. At the same time, ways need to be found to meet consumer interest in the field of sustainability. Alternative proteins, such as insect protein, can offers solutions for both issues. Black soldier fly, the only insect species currently commercially viable for pet food applications, is a great example of an innovative, sustainable, and functional pet food ingredient with high levels of protein, fats, and other important nutrients.

Due to rapid global population growth and the increasing numbers of pets, animal protein demand is expected to increase significantly in the coming decades. This demand cannot be met by traditional animal protein sources alone because of the reduction in arable land and declining freshwater supplies. Furthermore, traditional meat production is recognized as one of the leading causes of climate change. This creates an increasing need to switch from traditional animal-based sources of protein to more novel and sustainable sources with similar functionality and palatability.

A SUSTAINABLE SOURCE OF PROTEIN

Insects offer great potential as an alternative to traditional meat-based ingredients for food, pet food, and animal feed. Insect production requires far less food, water, and space compared to beef or other livestock, such as pork or chicken, and has a much smaller- carbon footprint. Black soldier fly larvae produced on less than half a hectare of land contain more protein than cattle grazing on around 1200 hectares, or 52 hectares of soybeans. Furthermore, insects suitable for use in pet food do not produce methane, which is one of the strongest greenhouse gasses. Besides being far more sustainable, insect protein is also a more healthy and nutritious alternative to mainstream sources of animal protein, such as beef, pork, chicken, or even fish.

HIGH-QUALITY SOURCE OF NUTRIENTS

Many insects are a high-quality source of protein containing good fats as well as high levels of calcium, iron, and zinc. Because they are cold-blooded, insects are very efficient at converting feed into protein. According to the UN's Food and Agriculture Organization, crickets, for example, need 12 times less feed than cattle, four times less than sheep, and half that of pigs and broiler chickens to produce the same amount of protein. When comparing 100 grams of ground beef and grasshopper, the insect yields 20.6 grams of protein containing 6.1 grams of fat, 35.2 milligrams of calcium, and 5 milligrams of iron compared to 26 grams of beef protein containing 18 grams of fat, 13 milligrams of calcium, and 3.5 milligrams of iron.

BLACK SOLDIER FLY AS A PET FOOD INGREDIENT

The only insect species currently commercially viable for pet food applications is hermetia illucens, also known as black soldier fly (BSF), which can be used in pet food applications as frozen larvae,

meal, and oil. BSF larvae are a source of high-quality protein and other nutrients, including essential amino acids, unsaturated fatty acids, minerals, and vitamins. After processing, BSF meal typically consists of minimum 55% crude protein and maximum 15% crude fat, 8% crude fiber, 9% ash, and 7% moisture. While more research into the nutritional value of BSF needs to be done, these figures indicate that BSF is not only a more sustainable but also a healthier alternative to both meat and plant proteins (see table 1).

Table 1. Proximate composition (percentage of DM), indispensable amino acid composition (percentage of CP) and amino acid (AA) score of insect and reference substrates

Parameter	Insect substrates										Reference substrates		
	HFp	BSFI	BSFp	HC	YMW	LMW	MW	SSR	DHCR	ACR*	PMM	FM	SBM
CP	62.5	56.1	52.1	70.6	52.0	64.8	47.0	66.3	65.0	64.4	69.1	71.0	51.6
Fat	19.2	12.8	19.7	17.7	33.9	22.2	39.6	25.1	22.0	24.5	12.8	9.2	2.5
Ash	5.6	12.6	13.9	5.3	3.9	4.1	3.0	3.6	3.9	4.4	15.4	19.9	6.8
AA													
Arg	4.2	3.7	4.2	5.7	4.6	4.8	4.6	3.6	3.9	3.5	5.8	4.5	6.3
His	4.8	4.4	4.7	3.4	5.1	4.9	4.8	4.3	4.6	4.5	3.7	3.4	3.1
Ile	4.0	4.0	4.2	4.0	4.6	4.6	5.0	3.4	3.7	3.2	3.8	4.8	5.0
Leu	6.1	6.1	6.5	6.6	7.3	6.7	7.2	5.4	5.9	5.3	6.4	7.1	7.8
Lys	6.2	5.4	5.4	5.8	5.5	6.5	5.3	4.3	4.7	4.0	5.6	7.4	6.2
Met	2.6	1.4	1.7	1.6	1.4	1.3	1.6	1.3	1.2	1.3	1.0	1.9	2.0
Phe	5.2	3.1	3.3	3.2	3.4	3.9	3.7	2.6	2.7	2.7	3.3	3.5	5.2
Thr	3.8	3.6	3.6	3.6	4.0	4.0	4.1	3.1	3.3	3.1	3.6	4.0	3.9
Val	5.0	5.5	5.7	5.7	6.3	5.9	6.5	5.6	6.1	5.4	4.6	5.0	5.0
tIAA	41.8	37.1	39.3	39.6	42.3	42.7	42.7	33.5	36.2	33.1	37.8	41.5	44.4
AA scores†													
Dog	94.0	63.4	74.4	69.3	68.4	60.4	73.8	53.0	55.5	59.7	44.6	73.1	89.1
Cat	106.1	79.2	93.0	86.6	85.5	75.5	92.2	66.2	69.4	74.6	55.8	91.6	107.5

CP, crude protein; HFp, housefly pupae; BSFI and BSFp, black soldier fly larvae and pupae; HC, house cricket; YMW, yellow mealworm; LMW, lesser mealworm; MW, Morio worm; SSR, six spot roach; DHC, death's head cockroach; ACR, Argentinean cockroach; PMM, poultry meat meal; FM, fish meal; SBM, soyabean meal; tIAA, total indispensable amino acids.

*Females.

†Calculated as described in Kerr *et al.*⁽¹⁹⁾ using minimal requirements for growth of kittens and puppies⁽¹⁻¹⁾ as reference values.

Table 1: Proximate composition (percentage of DM), indispensable amino acid composition (percentage of CP), and amino acid (AA) score of insect and reference substrates.

HEALTH BENEFITS OF BLACK SOLDIER FLY

The high-quality protein and other nutrients in BSF larvae and BSF meal are expected to offer specific benefits to the health and wellbeing of pets, such as cats and dogs. Preliminary research



indicates that BSF larvae and BSF meal have excellent anti-inflammatory and anti-oxidative capacity, even with inclusion rates as low as 1% and 2%. This is because BSF larvae-derived ingredients contain bioactive peptides, which have anti-inflammatory, antimicrobial, and hypoallergenic properties, and bioactive lipids, which have antimicrobial properties. Because it is a new ingredient, BSF is a great alternative protein in hypoallergenic pet food.

Unlike the meat of slaughtered animals, BSF larvae-derived ingredients also contain the polysaccharide chitin. As the primary component of the developing exoskeletons, chitin is the indigestible fraction of the larvae. Preliminary research indicates that it acts as dietary fiber that is fermented in the large intestine to become a substrate for the 'good' microflora in the gut. These beneficial microflora ferment the fibers into volatile short-chain fatty acids, resulting in an increase in their population in the gastrointestinal tract. This process is described as a prebiotic effect. Chitin therefore has specific benefits for the health and wellbeing of cats and dogs, including anti-inflammatory properties and an effective reinforcement against digestive disorders, such as diarrhea and inflammatory bowel disease.

PALATABILITY

Palatability studies with dogs have produced very favorable results for BSF-based dog food, including BSF meal and BSF oil, compared to plant-based protein. In a 10-day palatability trial conducted by Enterra, dogs were given two bowls of dog food each day at the same time, each with the same plant-based dog food, but one containing 20% BSF meal and 6.8% BSF oil. Both diets were treated with the same yeast-based palatant. On average over a 10-day period, the dogs consumed twice the amount of food containing the BSF meal and BSF oil (see figure 2).

10-Day Palatability Trial

BSF-based (inclusion of 20% protein meal, 6.8% oil)
dog food vs. plant protein-based dog food (both with yeast-based palatant)

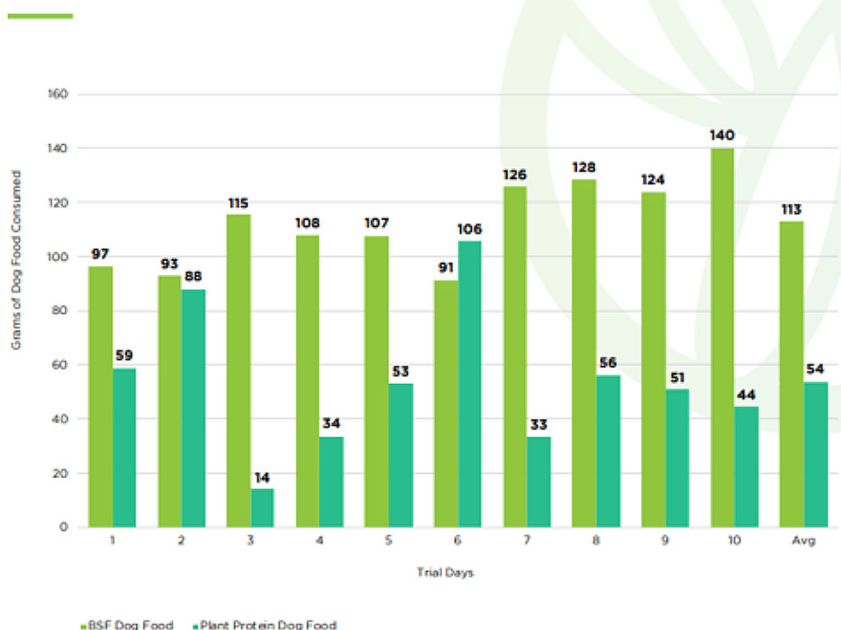


Figure 2: Results of the 10-day palatability trial conducted by Enterra.

GREEN LIGHT FOR APPROVAL

Black soldier fly is a safe species for use in human food, pet food, and animal feed. It has never been associated with any kind of disease transmission. BSF larvae, meal, and oil have been approved for use in pet food in Europe for a number of years. In 2021, AAFCO (Association of American Feed Control Officials) voted to include adult dogs among the animals for which the ingredients whole dried BSF larvae, BSF meal, and BSF oil are suitable. This means that pet food manufacturers in the United States can now also start using these ingredients in dog food and treats. AAFCO approval of BSF ingredients for use in cat food is expected in 2022.

POTENTIAL OF BSF LARVAE AND MEAL

In 2021, the Dutch Rabobank issued a report on trends in the pet food industry and in particular those relating to the increasing future demand for insect protein. According to Rabobank, because of the sustainability aspects and functional benefits, there is great potential to develop specialized ingredients and products from insect protein for a variety of applications. The report's main conclusion is that demand for insect protein, mainly as an animal feed and pet food ingredient, could reach half a million metric tons by 2030, compared to today's market of approximately 10,000 metric tons. Pet food is predicted to become the second largest consumer of insect protein production by 2030, surpassed only by aquaculture.

PRODUCTION OF BLACK SOLDIER FLY INGREDIENTS

Black soldier fly (*hermetia illucens*) is a naturally occurring species in Vietnam. The country has favorable environmental conditions, including a steady temperature of 30 degrees Celsius year round, and an abundant supply of feedstock. The insects are reared in controlled vertical farming systems mimicking their natural habitats, making it an ethical farming alternative.

Black soldier fly larvae are grown on low-value organic substrate, consisting of plant-based raw materials, enabling them to recover nutrients in an efficient and sustainable way. By stocking the eggs very densely, more larvae can be grown per square centimeter, allowing for an early harvest and a higher yield of protein. Insect larvae are harvested on a daily basis. The larvae are then dried at a temperature between 85 and 95 degrees Celsius before being further processed into different products. BSF oil is first extracted from the dried larvae before they are further processed into BSF meal, as well as fertilizer. Antioxidants are added to the BSF meal after production.

Due to the perfect climate conditions, local production in Vietnam allows for the highest production volumes. This offsets the carbon footprint of transporting the BSF meal to Europe or North America. South East Asia is also expected to become the largest market for BSF meal for use in pet food and aqua feed.

BLACK SOLDIER FLY SOLUTIONS FROM IQI TRUSTED PETFOOD INGREDIENTS

Together with its supplier Entobel, IQI Trusted Petfood Ingredients offers a unique portfolio of fully traceable insect fat, dried proteins, and frozen insects from black soldier fly (BSF) production for use in pet food. Entobel is based in Vietnam, which offers high ambient temperatures, excellent possibilities for low-cost production, and a stable price and quality all year round. IQI supplies BSF oil, meal, and frozen larvae to the European market, and black soldier fly larvae meal for adult dog food and treats to the US market, following its recent approval by AAFCO (Association of American Feed Control Officials).

For more information on these different BSF ingredients and the finest ingredients for the pet food industry, please visit our [website](#) or contact us directly.

Want to know more?

[IQI white paper 'Possibilities for moving towards a more sustainable pet food industry'](#)

[Effect of using insects as feed on animals: pet dogs and cats](#)

[International Platform of Insects for Food and Feed \(IPIFF\)](#)

[North American Coalition for Insect Agriculture \(NACIA\)](#)

[Entobel Natural & Functional Ingredients](#)



ABOUT IQI TRUSTED PETFOOD INGREDIENTS

IQI Trusted Petfood Ingredients is a global provider of premium-claim ingredients to the top brands in the pet food industry. Founded in 1994 as a trading company in raw pet food materials, today IQI offers an extensive variety of services to aid and assist our customers and suppliers worldwide. IQI Trusted Petfood Ingredients employs highly skilled personnel, owns and operates a global network of logistical hubs, and relies on a global supply network to obtain the purest natural resources available.

For IQI, quality is key. IQI Trusted Petfood Ingredients goes to great lengths to ensure the quality of its products and develop innovative new products. IQI also invests a great deal in maximizing the quality of its partnerships. Since this business is all about trust, IQI needs to bond with its partners to succeed. By working closely with both its customers and suppliers, IQI creates full transparency in the supply chain. IQI oversees and controls every step in the process from source to shelf and supplies products that are pure and traceable to their source.



ABOUT GEERT VAN DER VELDEN

Geert van der Velden is IQI Trusted Petfood Ingredients' Innovation Manager responsible for Business Development, generating new products and concepts that meet the needs of existing and new customers. Geert has more than 25 years' experience in the international pet food industry and has gained knowledge and experience in many sections of IQI's business.

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