

Optimizing Swine Nutrition:

Advantages of Including Black Soldier Fly Larvae Ingredients in Swine Diets

Swine are naturally omnivorous animals with the ability to perform well on a variety of feedstuffs. As a monogastric, readily digestible carbohydrates and high quality proteins are ideal, with plant proteins and cereal grains often providing energy but requiring a focus on balancing dietary amino acids. With a dietary crude protein requirement of 12 - 26%, depending on life stage, and a high requirement for lysine due to its concentration in swine muscle, soybean meal is the most commonly used protein source in swine rations (Kellems & Church, 2002). However, the combination of a growing human population and resource constraints requires the industry to consider the inclusion of novel feed inputs. Black soldier fly larvae-derived ingredients provide sustainable and robust nutritional opportunities for pigs of all life stages. One such solution for swine rations is the inclusion of insect ingredients.

Types of Insect Ingredients

Multiple insect species have been used in commercial animal feeds and pet foods, including crickets (*Gryllidae*), mealworms (*Tenebrio molitor*), and black soldier fly larvae (*Hermetia illucens*). Depending on

the species of origin, insect ingredients can take the form of: 1) whole, dried insect, 2) ground meal, 3) insect oil, and 4) insect frass (refuse from insect production including leftover feed, sheddings, etc.).



The meal ingredient can further be represented as full fat or defatted, depending on how much fat is pressed out of the insect before grinding. It is important to note that defatted insect meal is not devoid of fat, but rather, a lower fat ingredient than the original source. Both full fat and defatted black soldier fly larvae (BSFL) meal have been found to be promising protein and energy alternatives in the diets of weaned, growing, and finisher pigs.

Nutritional Benefits

Weaned Pigs

In a two phase trial, growth performance (average daily gain [ADG], average daily feed intake [ADFI], and feed conversion ratio [FCR]), apparent total tract digestibility, and gut morphology of weaned pigs fed a diet using defatted BSFL meal as partial replacement for soybean meal at inclusion levels of 5 or 10% were similar to the performance of pigs fed a control diet. Additionally, increased ADFI for piglets fed the BSFL meal diets during phase two indicates greater palatability of BSFL meal compared to ingredients of plant origin (Biasato et al., 2019). Interestingly, increased palatability of BSFL meal diets was also demonstrated in a separate trial; weaned pigs fed a diet with 4% BSFL meal inclusion demonstrated significantly greater ADFI from day 8 to 21 of a 28 day trial (Jin et al., 2021). Weaned pigs also maintained growth performance (ADG, ADFI, and FCR) when:

- Fed a diet containing full fat BSFL meal as partial replacement of fishmeal and soybean meal at inclusion levels of 4.7, 9.5, or 19.1% (Hakenasen et al., 2020).
- Fed a diet containing full fat BSFL meal at 4 or 8%, or defatted BSFL meal at 5.4%, as partial replacement of soybean meal and oil (Spranghers et al., 2018).

Growing Pigs

Similar results have been demonstrated with growing pigs fed diets containing full fat and defatted BSFL meal. Growing pigs were fed a diet containing either 0% BSFL meal, 50% full fat BSFL, or 36.5% defatted



BSFL meal (Crosbie et al., 2020), and standard ileal digestibility of amino acids were similar across diets and net energy of each BSFL meal diet was comparable to animal proteins and oilseed meals (Crosbie et al., 2020).

Finisher Pigs

Lower inclusions of BSFL meal in finisher pig diets have also demonstrated positive effects. With only 4% inclusion of BSFL meal (replacing soybean meal and oil), finisher pigs demonstrated significantly increased ADG, lower FCR, and similar ADFI compared to both 8% BSFL meal inclusion

and the control (Yu et al., 2019). In addition to high quality nutrition, the inclusion of BSFL meal in swine diets has been demonstrated to have no adverse effects on final pork quality characteristics (Altmann et al., 2019). BSFL meal successfully replaced fishmeal at varying levels (25, 50, 75, and 100%) in finisher pig diets (Chia et al., 2021). Although the higher levels of BSFL meal (50, 75, and 100%) resulted in significantly higher FCR, final body weight and carcass yields also significantly increased compared to the control (Chi et al., 2021).

Value Added Benefits

The inclusion of BSFL meal in swine diets also may optimize gut health. Weaned pigs challenged with *E. coli* K88 experienced half the occurrence rate of diarrhea when fed diets of 8% BSFL meal inclusion as partial replacement for fishmeal compared to the control diet (25% diarrhea rate compared to 50%, respectively; Jin et al., 2021). This optimization may be due to modulation of gut microbiota; finishing pigs fed 4% BSFL meal had significantly higher abundance of *Lactobacillus* spp. (often provided as an alternative to antibiotic treatment for post-weaning diarrhea), lower abundance of *Streptococcus* spp., and as a result, higher levels of anti-inflammatory cytokines (Yu et al., 2019; Zheng et al., 2020).

EnviroFlight® Products

As the first US commercial scale BSFL production facility, EnviroFlight® prides itself on using the best processes and procedures to manufacture our products: EnviroBug – whole dried black soldier fly larvae, EnviroMeal – pressed dried larvae, and EnviroOil – BSFL oil fraction. EnviroFlight® utilizes conventional drying of our BSFL to ensure a consistent and quality whole dried larvae product through even distribution of heat and moisture removal. Internal EnviroFlight data demonstrate that up to 15% EnviroMeal can be an effective alternative to soybean meal to maintain performance of nursery pigs through three nursery feeding phases, indicating this ingredient as a palatable source of nutrition! EnviroOil up to 6% of the diet, replacing poultry fat, improved ADG, feed efficiency and overall body weight of nursery pigs through three nursery feeding phases.

EnviroFlight® processes are first tested in our dedicated research and development facility and with our trusted academic and industry partners, before implementation in our commercial-scale production facility, so you can be sure our processes are tried and true in the USA!

References

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