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SPECIAL EDITION

Rearing Black Soldier Fly

Unlike other flies that are known to transfer germs, or cause diseases, the BSF is not a nuisance and that is one of the endearing qualities of this remarkable insect. Read all about it's benefits when used on the farm. **PAGE 2**

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SUSTAINABLE FARMING

Blacksoldier Fly Rearing: *Why You Should Not Be Left Out*

By Samuel Monene

LIVESTOCK FARMING AND poultry keeping can be costly especially when feeds are not easily accessible. Protein additives such as fish meal, fish oil, soybeans and seed cakes contribute immensely to the high cost of production in poultry, fish and pig rearing, which constitute the fastest growing agribusiness ventures in Kenya and beyond. Even as food production dips owing to factors such as harsh climate conditions, degraded soils, diminishing farmlands and high cost of production, the very proteins that are needed to make the animal feeds, are depended upon by human beings for food. This makes it necessary to devise alternative methods of obtaining proteins for animal feed, which do not compromise availability of food for human beings.

Farmers can turn waste especially fresh produce waste, or animal waste into a resource to change this situation if only they have the technical know-how. One of the emerging technologies to turn this challenge into an opportunity is the rearing of Black Soldier Flies, which are known to feed on household and fresh produce waste, pig manure, leaving behind frass, which is a rich organic soil fertilizer, while at the same time reproducing larvae that is a protein-rich feed for poultry and other animals.

The BSF rearing technology is gradually gaining traction as individual farmers rear the BSF to aid in household waste management

The BSF rearing technology is gradually gaining traction in various parts of the country, as individual farmers rear the BSF to aid in household waste management and production of protein supplement for their pigs, poultry and fish. Other farmers have discovered the opportunity to offer training services to locals around their area at a small fee.

Various institutions and private entities are training farmers on how to establish and run a black soldier fly enterprise. At the International Centre for Insect Physiology and Ecology (Icipe), scientists have opened doors to farmers willing to be trained. The Centre which boasts of equipped scientific labs, breeding cages for the BSF and demo site where farmers are exposed to the process of on farm rearing, trains farmers and interested individuals and groups from across the country. The training takes 5 days after which trainees are offered a starter kit (young larvae) to launch the enterprise. The training covers topics on how to set up the housing system, the right environment for the enterprise, and the process of feeding and harvesting the emerging larvae, and finally how to prepare the larvae as feed for the animals and birds.

The mass rearing of BSF is an enterprise that is steadily growing. As it slowly appeals to farmers, entrepreneurs and investors across the value chain will soon start creating market opportunities. The question is, are you ready to grab the emerging opportunities in BSF rearing, while the industry buds into unending opportunities? Only those who are readily equipped to reap from this technology will enjoy its benefits. Read on to find out all you need to know about Black Soldier Fly rearing, and the benefits from this special edition.

By Roseanne Mwangi

OUT IN NATURE, the Black Soldier Fly (BSF), is inconspicuous. In fact, one is more likely to see the BSF larvae than the fly itself. This means that unlike other flies, that are known to transfer germs, or cause diseases, the BSF is not a nuisance and that is one of the endearing qualities of this remarkable insect. The adult fly doesn't eat, and so it does not need to look for food, flying from place to place. Instead, it identifies a suitable pile of organic waste and settles on it to lay eggs that will then become larvae and grow out to be a black soldier fly in 6 weeks, all things being optimal.

Benefits of BSF larvae

BSF larvae have become increasingly popular as a source of protein for use in animal feed. Here are some of the benefits that come with using these larvae:

- **High protein content:** The larvae have an exceptionally high protein content of up to 70%, making them a great source of protein for animals.
- **Efficient feed conversion:** When BSFL is used as protein in animal feed, the pig, chicken or fish post very efficient feed conversion ratios. It has been observed that pigs eating BSF larvae gain weight and are market-ready up to 4 weeks earlier.

SUSTAINABLE FARMING

The Black Soldier Fly: *Benefits of the fly and farming it*

One is more likely to see the BSF larvae than the fly itself. This means that unlike other flies, that are known to transfer germs, or cause diseases, the BSF is not a nuisance and that is one of the endearing qualities of this remarkable insect. The adult fly doesn't eat, and so it does not need to look for food, flying from place to place. Instead, it identifies a suitable pile of organic waste and settles on it to lay eggs that will then become larvae and grow out to be a black soldier fly in 6 weeks, all things being optimal

- **Reduced waste:** The larvae feed on organic waste such as food scraps and manure, reducing the amount of waste that ends up in landfills.
- **Reduced environmental impact:** As the BSF larvae have proven to be effective in closed circular systems, their use as animal feed can help reduce greenhouse gas emissions and the use of fossil fuels associated with the production and transportation of traditional feeds, while contributing to reduction of emissions from manure heaps as well.
- **Health benefits:** The high protein content and the antimicrobial peptides that are found in the BSF fats can help improve the growth and overall health of the animals consuming them.
- **Economic benefits:** Using BSF larvae as animal feed can result in cost savings due to their efficient feed conversion and reduced waste, as well as the reduced resources required in acquiring protein supplements for poultry and livestock. Also, farmers practicing BSF farming have other business opportunities within the enterprise such as training and sale of young larvae or pupae to interested farmers. It is also possible to produce BSF larvae in a large scale for sale, a potential market that is slowly budding in Kenya's pig farming industry.
- **Palatability:** This is the aspect of improved taste. Did you know that when street pigs are seen burrowing in piles of organic waste, they are not eating the organic waste, but rather nosing out the BSF larvae that is growing in the depths of the waste? The smell and taste of BSF larvae have been discovered to be very appealing to the animals that eat them. This means that when it is used in animal feeds, BSF larvae improve the taste and digestibility of the feed by the animal, thus promoting growth. This is then carried forward in the food pyramid, making the meat of BSF fed chicken or pigs very delicious for humans as well.

BLACK SOLDIER FLY WRITER BIO

Roseanne Mwangi is a practicing expert in BSF rearing and the MD at The Insectary which deals with waste management through insect rearing

Additionally, from the substrate, we get the rich soil amendment known as frass. This is the remnant of the waste stream that has been presented as food for the larvae. It also contains residue that the larvae leave behind as they grow from the small larvae in instar 1 to the mature ready-for-harvest larvae of instar 5.

Through each of the instars, the larvae shed their exoskeleton and also leave their excreta into the organic waste residue, transforming this residue to compost like soil substance. This biofertilizer is proving to be extremely valuable in improving the health of the soils it is applied to.

Finally, rearing BSF especially for pig farmers is proving to be a perfect way to achieve circular economy. As has been noted, pig manure is one of BSF's favorite substrates, yet the emerging larvae, can be used by pig farmers as a source of protein for their pigs. The pig manure resulting from the whole process is much richer than the manure initially used as a substrate.

SUSTAINABLE FARMING

Introduction to Black Soldier Flies (BSF)

The Black Soldier Fly larvae contribute significantly to environmental sustainability and have a great economic potential. They are big consumers of organic waste, efficiently converting it into biomass, making them valuable for applications in animal feed production

By Roseanne Mwangi

THE BLACK SOLDIER Fly is found in tropical, subtropical, and temperate regions of the world and flourishes in areas with decomposing organic matter. Its global distribution across continents underscores its adaptability to diverse ecosystems, making it well-suited for farming in various regions throughout the country. The Black Soldier Fly larvae contribute significantly to environmental sustainability and have a great economic potential. They are big consumers of organic waste, efficiently converting it into biomass, making them valuable for applications in animal feed production. Additionally, the byproducts of their waste consumption, known as frass, serve as an excellent organic fertilizer, further contributing to sustainable agriculture practices and products that can be traded.

Physical Characteristics of Black Soldier Flies

Adult Black Soldier Fly (BSF) Characteristics

The adult Black Soldier Fly (BSF) is a slim, 20mm long, black, small headed, translucent-segmented fly that is docile and doesn't have mouthparts for chewing. As an adult, it subsists on water, to mate and lay as many eggs as it can, after which it quietly dies. When females lay eggs near waste, they take precautions to avoid direct contact with it, placing the eggs above or to the side to prevent consumption along with the waste. When the eggs hatch, they become larvae.

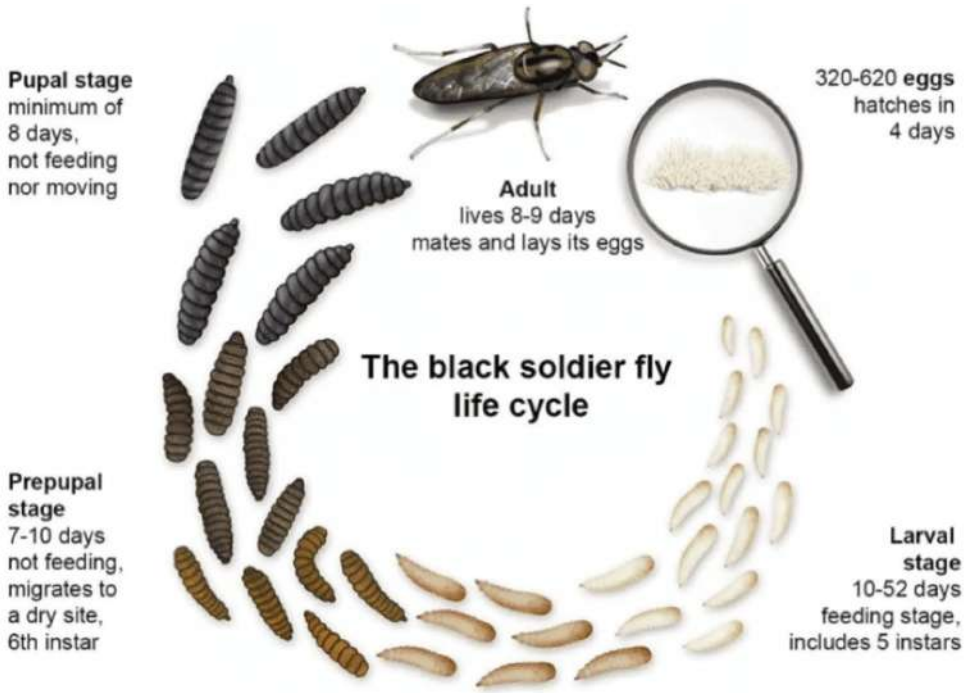
BSF Larvae Characteristics

- Upon hatching, larvae engage in 360-degree cellular consumption, being approximately 1.8 mm long and exhibiting a dull white to cream color.
- The larvae prefers a moist (60% to 90%) warm (27 to 34 degrees C) and dark environment where they can grow to the optimum weight and size.
- Larvae pass through five instars, requiring approximately 13 - 19 days for development, with avid feeding on organic waste throughout. At instar 5, they are considered mature for harvest.
- They repel other flies and insects by secreting chemicals that warn other fly species and by so doing, reduce the presence of common houseflies.

BSF Pupae Characteristics

- Instar 6 is characterised by a wandering pre-pupal stage that lasts 7–10 days at 27°C, during which the larvae stop eating and migrate away from the food source.
- Pre-pupae under natural conditions change color, which can be exploited for sorting purposes.
- Providing pre-pupae with moist wood shavings or other wet light materials enhances their weight during pupation and maintain internal humidity which results in a higher rate of adult emergence. Pupation which takes about 7 – 12 days then takes place.

BSF Life Cycle



The BSF life cycle varies between environments such as regions with varying temperature, humidity, light intensity, quality and quantity of available food. The females lay between 320 and 1000 eggs, on a dry substrate in a humid environment so as to limit the water losses of their eggs.

Eggs are laid into tight rows, generally in a gap to hide them from predation and close to a potential food source. As soon as larvae have hatched (0.66 mm long), they use surrounding organic matter as a food source. The duration of the larval stage lasts for 4 weeks in nature, and can be optimised to 3 weeks in farmed systems depending on food availability. Temperature is a key parameter for larval development and survival rates, the optimum temperature being in the 25-33°C range for enhanced metabolic activity that accelerates their growth. The growing larvae perform successive moults that separate five larval stages. At the prepupal stage (6th larval stage/ Instar) the larvae change from beige to dark brown and start to harden. The last stage, the Pupae stage, they are immobile and appear "dead".

When females lay eggs near waste, they take precautions to avoid direct contact with it, placing the eggs above or to the side to prevent consumption along with the waste

After 7 -10 days as Pupae, new flies emerge. The reproductive behavior of the BSF involves complex mating rituals. Adult flies engage in aerial displays and communicate through specific wing movements and pheromones to attract potential mates. Mating takes place about 2 days after emergence of the fly, and another 2 days after mating to lay eggs. An emerged fly's lifespan is about 10 days, its life expectancy being unquestionably dependent on access to water and on its body size that represents the internal availability of needed energy reserves to live long.

Flies require light, and Larvae do best in dark environments as they are photophobic. Both flies and larvae require adequate airflow for optimised growth and development.

BSF UNIT SET-UP

Steps in Setting Up a Black Soldier Fly (BSF) Unit

By Samuel Monene

Site selection

THERE ARE KEY considerations to make when planning to establish a Black Soldier Fly Unit for optimal production. The first step is site selection, for the caging system. The set up of the system can be done indoors or outdoors.

Indoor Facilities - For controlled environments and year-round production, indoor facilities can be advantageous. They allow for better regulation of temperature, humidity, and light conditions. Indoor setups are especially useful in regions with extreme weather conditions.
Outdoor setups – Outdoor setups on the other hand, are suitable for areas with mild climates and ample space. They take advantage of natural sunlight and can accommodate larger-scale operations. However, outdoor units may be subject to seasonal variations, requiring careful consideration of local climate conditions.

Climate and other Considerations

Temperature and Humidity: Choose a location or implement climate control measures to ensure that the temperature and humidity levels fall within the optimal range for Black Soldier Fly breeding and development.
Wind and Rain Protection: If setting up an outdoor unit, consider windbreaks and rain protection to create a stable environment for the Black Soldier Fly colony.
Ventilation: Adequate ventilation is crucial to prevent overheating and ensure a continuous supply of oxygen. Consider adding mesh or perforated panels to allow for sufficient airflow.
Drainage: Proper drainage is essential to prevent waterlogging, especially in outdoor setups. Containers should have drainage holes to allow excess moisture to escape, preventing conditions conducive to bacterial growth or larvae drowning.
Stackable Design: For space efficiency, consider stackable container designs. This allows for vertical expansion and can be particularly useful in indoor facilities with limited floor space.

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Temperature and Humidity Control

To create optimal conditions, introduce heating or cooling elements as required. In colder climates or indoor setups, consider incorporating heating elements to maintain optimal temperatures for the Black Soldier Fly colony. This ensures continuous larval activity and development.

The Procedure of Setting Up the BSF Unit

Stage 1- Obtain a starter population of larvae to start a BSFL production system

Purchase larvae from a local source. The larvae or pupae cost between Ksh1000 and Ksh3000 depending on the composition of the kit, and they are available from farmers who are already rearing the BSF. By starting with eggs, if the air temperature is favorable (near 30°C), you can quickly obtain enough individuals to start a BSF colony. It was observed that the number of eggs laid per female BSF ranged from 206 to 639. An alternative to purchasing a starter kit, is collecting eggs from wild BSF.

Basic procedures for collecting eggs from wild BSF are as follows:

A. **Prepare an attractant**. Options for an attractant include rotting fruit, kitchen scraps, and manure. Using rotten fruit as an attractant involves crushing it to obtain a creamy texture, adding water as needed, and placing it into a bowl or basin.
B. Place the container with the attractant in an outdoor place where BSF are likely to be.
C. **On top of the container, provide a surface for female BSFs to lay their eggs.** Surfaces with cracks and crevices work well. A good way to do this is by placing several stacks of wooden blocks over the container. Create each stack by cutting pieces of wood to a length that exceeds the diameter of the container. Stack several pieces of wood and then secure the stack with a rubber band around each end. You can place toothpicks between the pieces of wood to create space between the layers of wood for adult female flies to lay their eggs.
D. **Monitor the stacks of wood for eggs.** If you don't see eggs, it could mean that wild populations around the attractant are non-existent or low. In that case, try placing the attractant where there are likely to be more wild BSFs. Look for a place with a lot of organic waste, such as near waste dumps.
E. **Hatch the eggs to obtain larvae.** When you are starting a BSF colony from wild BSF eggs, the mating enclosure, described in the next step, is a good place to hatch the eggs. Thereafter, you will be able to produce eggs in the mating enclosure instead of having to collect them outside from wild BSFs.

Stage 2- Establish a mating enclosure

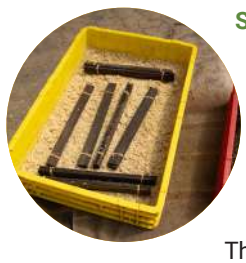
Mating enclosures can range from large screened-in rooms to smaller systems using mosquito nets, or even mesh baskets. Regardless of the scale or design, the mating enclosure must maintain adequate moisture (around 70% relative humidity) and a temperature of 24 to 38°C while keeping the BSF in. Make provisions for adult flies, including a water source and some vegetation or other surfaces on which to hide and mate. A sugar source like honey and also a hydration point will prolong the lifespan of adults. The pupae will not eat any food, so you need only a small amount of food nearby to entice adult female flies to lay eggs.

Stage 3- Collect the eggs

To collect the eggs of the adult female BSF, provide favorable material for laying eggs within the mating enclosure. Small blocks of wood work well and provide both an inviting egg-laying environment and easy egg collection method for the workers. Using small pieces of cardboard may be logical, but the wooden blocks are convenient for collecting eggs and result in higher quantities of eggs. At this stage, it is important to note that BSF do not lay their eggs directly on (or in) a food source, but nearby to one. Blocks should therefore be near a food source. To collect eggs, remove the blocks, separate them from each other, and carefully scrape off the eggs with a toothpick or other small, pointed item. Eggs can be of different ages if workers do not remove the blocks each day. By having eggs of different ages, the larvae will hatch and grow at different stages, requiring added sorting and separation before maturity. It is therefore helpful to have larvae at uniform age and maturity when producing larger batches of BSFL.

Stage 4- Transition from eggs to larvae

Transfer the collected eggs to a proper food source where they will hatch and crawl to the feedstock provided. This could be in a separate area. Use a mesh screen to separate the eggs from direct contact with the food source. Eggs will hatch within four days of laying. At this stage, while larvae are small, you can use plastic trays to hold small quantities of feed/waste and larvae. Ensure the depth of the substrate should be 2 to 3 inches.



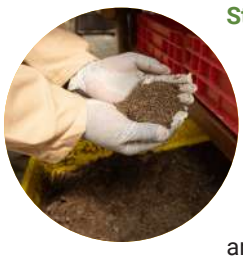
Stage 5- Select a proper feedstock

One advantage of BSFL is their ability to consume many types of waste. Use low-cost, or even free waste by-products. BSFL prefer foods high in fats, proteins, and starches. You can mix waste resources together to ensure a balanced, or 'complete' feed source. This helps 'bulk up' the feedstock to ensure

higher yields of larvae produced. For example, you could boost the protein content of plant waste by adding chicken manure.

Stage 6- Scale up production

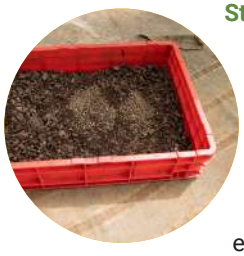
As larvae hatch and feed, they need to be 'scaled up' into larger containers for adequate production. During this step, provide more feedstock for larvae to eat. How much feed to add will depend on larvae instar, and temperature. Check larvae at least once a day to ensure there is always an adequate food supply for growing larvae. When you add new feed, make sure to mix the old feed and new feed evenly throughout the container or add old feedstock and larvae on top of a bin with new feedstock. Larvae are light fearing and thus will move downward to the new feedstock.



Stage 7- Harvest the larvae

Over a period of 13 to 18 days, larvae will feed voraciously, eating twice their own body weight each day. Harvesting larvae before reaching maturity (shortly before the pre-pupae stage) requires sorting, sizing, or separation of larvae from their feed material. For larvae that are fed directly to livestock, removal from the feed source is unnecessary. Sorting and sizing are common for larger production systems but these activities are labor intensive. For easier separation, we recommend:

- By the end of their production cycle, transfer larvae to a finer-textured feed source. Uniformly small food particles will then be easy to separate from the larvae.
- Use various sizes of screens to facilitate sorting and sizing.



Stage 8- Raising Pupae for Reproduction

At the pre-pupal life stage, BSF migrate from their food source in search of a dark, quiet place to transform into a mature fly. If checked regularly, it can be convenient, and provide a steady supply of pupae for reproduction. Transport these pupae to the mating enclosure before flies emerge.

WASTE MANAGEMENT

Food for BSF Larvae – *Is all waste equal?*

Waste management has become a growing concern in modern society, with landfills overflowing and environmental impurities escalating. Amidst all these escalating challenges of waste management fueled by the needs and actions of a growing population, a remarkable ally in the form of the black soldier fly *(Hermetia illucens)* emerges

By Roseanne Mwangi

AS THE GLOBAL human population continues to increase, so does the inevitable byproduct of our existence; waste. The correlation is direct, and as humans have proven, left on their own, the resultant waste that follows in their wake is huge to say the least. Waste management has become a growing concern in modern society, with landfills overflowing and environmental impurities escalating. Amidst all these escalating challenges of waste management fueled by the needs and actions of a growing population, a remarkable ally in the form of the black soldier fly (Hermetia illucens) emerges.

This insect lives on organic waste in a way that allows for a healthy symbiosis between itself and man. It is not a nuisance and so you will seldom see it live. In nature, it seeks out waste heaps and settles on them to lay eggs, after which it quietly dies. As an adult fly, the black soldier fly doesn't eat, it subsists on water alone. It is when it is at the larvae stage that it is a voracious feeder, taking in nutrients from the waste material and converting them to protein in its biomass, and leaving behind valuable organic soil amendments used as fertilizer. This transformative eco-warrior acts on all manner of organic waste streams.

Through research and on-farm trials, different kinds of waste have proven to be suitable for the growth of Black Soldier Fly Larvae. BSF with its insatiable appetite and efficient waste conversion capabilities, thrives on the diverse menu of organic

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waste and animal litter such as kitchen waste of fruits and vegetable peels and leftover food, farm waste -of harvest residue and post harvest loss, market waste, processing waste from food factories and farmyard manure to name a few. Of these waste streams, a preference has been noted; the BSF larvae have an affinity for pig manure which is very interesting. As manure is a common agricultural by-product that attracts houseflies (Musca domestica) if left unattended, by using BSF larvae, the challenge is eliminated.

Agricultural waste from farms and markets such as spoilt fruit, underdeveloped produce that is unsuitable for market and agro processing industries residue such as cotton seed hull ,avocado pulp, potato peels etc have also proven to be suitable for the growth of the larvae. This not only helps in waste disposal but also transforms agricultural waste into a resource. Industries and brewery companies generating the waste in bulk can now benefit from BSF larvae. By diverting the waste streams to the larvae, companies can reduce their environmental footprint while potentially creating additional revenue streams.

Setting up an effective BSF system requires careful consideration of several key factors. It all begins by selecting a suitable location with ample sunlight and high-temperature conditions. Larvae require an average temperature of 25-30 degree celsius for optimal growth. Design a container suitable for the larvae that has proper ventilation to avoid mold growth

Setting up an effective BSF system requires careful consideration of several key factors. It all begins by selecting a suitable location with ample sunlight and high-temperature conditions. Larvae require an average temperature of 25-30 degree celsius for optimal growth. Design a container suitable for the larvae that has proper ventilation to avoid mold growth. This is followed by introducing a substrate layer to the larvae for growth. The feed should be adjusted based on the ratio of the larvae population and the volume.

A balance between a dry and wet substrate material should be maintained to avoid moisture problems. The substrate should be moist but not water-logged. The larvae should be harvested on time typically 18-22 days from incubation when the protein content is at maximum. While BSF is generally harmless, like any other farming process, good agricultural practices such as wearing protective clothing and a face mask while working with the waste streams is important.

In conclusion, harnessing the power of black soldier fly larvae for waste management presents an environmentally sustainable and economically viable solution. By understanding the type of waste suitable for these insects and implementing effective systems, individuals, and industries can contribute to a cleaner, greener future.

Black Soldier Fly is gaining popularity for its essential amino acid rich protein profile, with levels ranging from 40% to 60% of their dry weight. The levels of amino acid depend on the type of substrate the larvae feeds on in addition to beneficial fats fiber, and micro nutrients such as calcium and iron

ANIMAL FEEDS

Feeding Animals with Black Soldier Fly Larvae

By Roseanne Mwangi

BLACK SOLDIER FLY farming is done for one of two reasons; to aid in waste management, or to produce BSF larvae for use as protein component in animal feeds. Black Soldier Fly is gaining popularity for its essential amino acid rich protein profile, with levels ranging from 40% to 60% of their dry weight. The levels of amino acid depend on the type of substrate the larvae feeds on in addition to beneficial fats fiber, and micro nutrients such as calcium and iron.

Animals that feed on BSF larvae

BSF seems naturally suited as feed for monogastric animals more than it is suited for ruminants.

Poultry

Poultry farming benefits in improvement of productivity and management of flocks when BSF larvae is introduced in their diets. A diet that has BSF larvae as the protein component in layers mash has been seen to assist the birds improve their egg production and maintain optimal performance for much longer. In broilers and free range chicken, enhanced meat quality has been reported. The flies fed to turkeys, ducks and ornamental birds alike, deliver great results in feather quality, among other characteristics.

Aquaculture

Aquaculture has also embraced the inclusion of black soldier fly larvae- an ideal supplement for fish and shrimp diets- reducing dependence on fishmeal derived from wild-caught fish.

Swine

When feeding pigs for growth, BSF larvae with its high protein content is well suited for this. This is because it contributes to rapid muscle development, and in this way promoting high meat quality and overall health. Pork from pigs fed on BSF larvae has the desirable quality of having well marbled meat, a factor that is sometimes used to gauge the quality of the carcass presented at slaughter, and therefore fetches higher price.

Pets

BSF larva is proving to be a good source of protein for pets such as cats and dogs.

Insect oil is also used in special recipes of petfood to address energy deficiencies or diet-based management of health issues such as dry skin and fur. For ruminants such as cows, goats and sheep, defatted BSF larvae is being tested to establish its suitability as an alternative protein source, as ruminants do not work well with fats, and that in many instances the protein for their meals have been plant based, and insect protein is a form of animal protein.

How to incorporate BSF in animal feeding

Introduce it in small quantities initially, gradually increasing as animals acclimatize. For poultry and fish, BSFL can replace all the protein used in the feed, or supplement traditional feeds. It is important to note and keep in mind that BSF doesn't come to replace traditional feeds, but rather to supplement them.

As a protein and fat source, it only provides for part of the dietary requirements and not for all the dietary requirements. In livestock farming, balancing the nutritional needs of animals is crucial for achieving optimal results. In addition to protein and fats, the animal will still need carbohydrates, vitamins and minerals.

This is to say that we need other ingredients representing the other food groups to be fed to the animal at the same time that one is feeding them BSF. The KALRO offers trainings of Trainers on feed formulation using methods such as the Pearson Square among others. Technology is also helping bring knowledge close to the users through tools such as the feed calculator app *www.feedcalculator.org* where a farmer can access an optimised formular that has BSF as the main protein source.

Animals fed on BSF larvae experience enhanced nutritional benefits and have been reported to use less antibiotics, a fact that's been attributed to development of a healthy and strong gut microbiome as a result of feeding on BSF Larvae.

40%

Levels of essential amino acids and rich protein in dry-weight black soldier fly

VALUE ADDITION

Value addition of BSF to make other products

By Roseanne Mwangi

BLACK SOLDIER FLY larvae farming aims at producing protein rich larvae that is very well suited as feed ingredient first for poultry, fish, pigs and pets, and then for other livestock. The protein content of BSF larvae ranges from 40% to 60%, depending on the feeding regime/ waste stream substrate that the larvae has been fed on. BSF is also an excellent source of fat, which can be extracted and used in various applications, such as feed additive, biofuels and cosmetics. BSF's products are unique in that there is no waste at all from the process of farming the BSF Larvae. The two main line of products come from the waste/substrate that the larvae feed on, and the larvae themselves.

As a biofertilizer - the frass or excreta of BSF larvae is rich in nutrients and can be used as organic fertilizer for plants.

The BSF Larvae itself is the base product of high-quality insect protein of sufficient digestibility that is presented in the biomass of the larvae. This protein has a good amino acid profile that is sufficient for the nutritional needs of most livestock and animals and is also rich in fats.

From the larvae we get the following products:
1. Whole wet larvae
2. Whole dried larvae
3. BSF meal
4. BSF oil

After harvesting, the product achieved is whole wet larvae, also referred to as live larvae. This is washed and blanched in hot water for 50 seconds to kill the larvae and arrest their development at the 5th instar, which is the stage at which they have the highest levels of protein and nutrients. The larvae can be used as wet larvae, and can also be taken for further processing by drying them. The best method of drying them is through hot air drying.

Efficient drying services are required because once a farmer collects his/her BSF larvae, they must decide how best to dry them so that they can store them potentially long-term (outside of freezing). The larvae enter the drying phase of the process coming from a wash to remove residual feed needs to be adequately and well dried before packaging and storage.

Freshly harvested BSF larvae contain ±70% water and ± 30% dry matter and have a high-water activity of 0.9. Water activity is a measure for the free water in the product, which is available for microorganisms, whereas a water activity lower than 0.6 inhibits growth of any bacteria and yeasts. The high-water activity makes the fresh larvae highly susceptible to lipid oxidation, enzymatic degradation, and microbiological spoilage.

Removal of water and thereby reducing water activity inhibits microbial and enzymatic activity and thus, makes the product storable. By evaporation of water, the remaining nutrients in the product become more concentrated, which means dried larvae have a higher protein content compared to fresh larvae. This necessitates acquisition and utilization of an efficient mechanical dryer to ensure best results.

A hot air drier works on the principle of hot air being blown on the product, after the product is washed and blanched at a temperature of 90 degrees, to kill the larvae to arrest the growth of the larvae at the point where they have the highest protein content. This clean wet dead larvae then needs to be dried at once in order to preserve the nutrition quality as well as arrest the decay that is caused by wetness and a moist environment.

The hot air drier works to do these two functions effectively by drying the larvae as individual pieces, and drying the entire quantity at once, without interruption as is sometimes seen when using other forms of drying like solar drier. Uniform drying is critical in order to preserve the freshness of the dried larvae. As it dries, it concentrates the protein and fats while removing the moisture. The fats have the characteristic of making the product go rancid if its not handled well, and this would spoil the entire production.

Dried larvae lose 70 per cent of the body weight of live larvae, and get a concentration level of up to 3 times that of the protein in the live larvae. As such, drying is mainly done in order to ensure transportation and storage. In order to best mix the larvae as feed in feed formulations a further step of defatting is sometimes neccesary. This is because when milled without defatting, a substantial quantity of the BSF protein is left in the machine due to the oily nature of the dried larvae.

Defatting is still quite new in Kenya, and so to navigate this hurdle, the BSF is milled with a grain e.g. maize, in order for the oil and protein to be soaked up by the dry part of the grain. Some applications are also being adapted for use with the larvae, where the wet, cleaned and arrested larvae is mixed with a drying agent such as bran

and passed through an extruder to get it to dry to the desired levels. Through the generous support of friends and associates of BSF, the Association of Insect Farming and its Products (AIFP) is looking to develop a model where hot air drying can be made available to insect farmers who would want the service, in a way that would keep the quality of the product optimal, in order to attract and maintain the interest the insects are generating in the marketplace.

There are various reasons for drying the larvae. Freshly harvested BSF contains 70% water and 30% dry matter. Drying enables longer storage, transportation, and selling of the BSF larvae as the process of drying reduces water activity. Removing water by drying, leaves larvae with a higher concentration of protein, compared to fresh larvae.

To ensure that enough drying has been done, one should calculate the difference in mass between the dried larvae, against the fresh larvae. If the mass of the dried larvae, divided by the mass of the wet larvae is 25-35%, then that means the larvae is dry, it has lost about 70% of water.

Defatting BSF

The whole dried larvae can then be pressed to remove the fats, this process is called defatting. It results in defatted BSF larvae that is in powder form- BSF larvae meal- leaving behind the BSF oil. BSF oil adds to the energy requirements of growing livestock and provides the much-needed oil and sheen for their glow of health.

Then there is chitin which is extracted from the pupae shells of emerged flies and is proving to have very interesting applications in industries, including agriculture, medicine, and biotechnology. Uses include making of biodegradable plastics, and water purification systems. Also, since it has been shown to have antimicrobial properties, it is being applied in the making of wound dressings and medical implants.

INNOVATION

Farmer discovers goldmine in black soldier fly rearing

He was introduced to black soldier fly rearing by his uncle. Through internet research on YouTube and other sites, he discovered that there were youths in various parts of the country who were generating wealth from BSF rearing

By Caroline Mwendwa

WHEN EDWIN SILA a 26-year-old from Makueni County learnt of Black Soldier Fly farming from his uncle, an agricultural officer in Makueni County, he enthusiastically took up the idea and invested himself in finding out more about this uncommon enterprise. He was driven by the hope that by farming BSF larvae, he would cut production costs for his pig enterprise. It did not take him long before he discovered Protein Masters, a small group of youths based in Huruma, Nairobi County, who were providing training opportunities to interested parties. He decided to visit them for a day to learn and start his own enterprise back at home. "I was surprised to find out that rearing BSF does not require much capital to start,", says Edwin.

Having bought a starter kit of breeding stock at Ksh2000, he was set to go. He set up a rearing cage by, improvising a mosquito net, and mainly used cow dung and chicken waste as substrates to feed the larvae. For one year and a half, Edwin successfully reared the flies, producing larvae to quantities of about 15kg per month. These he used as protein supplement for his pigs.

Edwin would soon discover that the housing structure made from mosquito net was not appropriate as the holes were large enough to let the insects out, and the heat in the cage was too much. "I also struggled to ensure biosecurity as the earthy floor allowed safari ants into the cages, and they would attack the flies and bite their wings," he says further adding that feeding the larvae with cow dung affected production due to the dung's high fibre content.

Edwin's fortunes turned when in July 2021, he landed an opportunity with the Makueni County Agricultural Sector Development Support Programme (ASDSP) targeting among other beneficiaries, those youths with business ideas in poultry value chain. From the project, he was supported with Ksh750,000 to grow his BSF enterprise.

CONTINUED ON PAGE 12

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CONTINUED FROM PAGE 11

The birth of Biodudu Centre

The support Edwin received from the county project went a long way in helping him establish quality structures that enable the appropriate environment for optimal production. He used the funds to acquire an insect net, a shade net, polythene roll ups, rearing crates, waste handling bins and a hammer mill machine, which is used to mill feed substrate that is provided to the larvae. In addition, he was facilitated to undertake a full week training at Protein Masters. He branded the newly revamped enterprise, 'Biodudu'.

"With the new structures, I have experienced increased production, as the set up provides biosecurity and temperature regulation creating a conducive environment for larvae production and growth," says Edwin. From the training, Edwin learnt that the best substrate to use in feeding larvae is kitchen waste. He has since partnered with hotel owners in Wote Town to obtain kitchen waste mainly potato peels and left-over bread and rice. To these he adds a bit of chicken waste and cow dung. "I use the hammer mill machine to make a thick paste from the organic waste, which I supply to the larvae as substrate," he says.

Higher yields

With improved conditions, Edwin is now making much higher gain as in a month, he harvests up to 100kg of dried larvae, enough to make 25 kilograms of layers mash when combined with other ingredients. The process of drying involves putting the fresh larvae in boiling water for about five minutes and drying them under the sun for three days if the weather is sunny. After drying them, he uses the hammer mill machine to mill them into powder or uses the dried larvae as chicken feed. His layering chickens are the first beneficiaries of the BSF project, as their healthy build and vibrant feathers display the positive effect of feeding on BSF larvae.

Business opportunities

Edwin is making the most of his enterprise by selling various products. Firstly, he has partnered with a farmer within his village who specializes in making chicken feed for her large poultry enterprise. "I found a farmer within my village who is in constant need of affordable protein supplements for her business. She buys one kilogram of dried larvae at Ksh150," he says. This gives him Ksh15000 every month.

Secondly, the frass has a constant market as farmers book it way in advance. In a month, Edwin collects about 600kg of frass and sells one kilogram at Ksh30. "Farmers have discovered the effectiveness of frass obtained from BSF as it is already broken down and contains rich nutrients from the larvae's activity," he says. Another business opportunity that Edwin is drawing from is training farmers and other groups as opportunities arise. He charges Ksh1000, for each person who comes for a full day training at his farm. "Various farmer groups, even those sponsored by county governments and NGOs frequently visit the farm for training," he says.

As new farmers gain interest in this venture, Edwin is continually getting opportunities to set up structures, within and outside his community. "I regularly get calls from new BSF farmers to help with setting up the structures. I have done this for many farmers within my locality, and beyond," says Edwin. The cost of setting up a BSF unit depends on the size of the structure. The smallest unit holds 10 crates and this costs approximately Ksh30,000 to put up. "The structure comes with crates and 4kg of breeding stock," he explains. One of the opportunities Edwin has benefitted from was working with the Micro Enterprises Support Programme Trust (MESPT) to set up BSF units for youth groups in Kwale and Nakuru Counties. Having missed several opportunities to supply companies in need of large quantities, Edwin hopes to scale up the venture to meet the rising demand for BSF larvae.

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