

The Training for Triharjo Village's Stockbreeders on Production of BSF Larve's Oil as Potential Cosmetic Raw Material

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ABSTRACT

Indonesia has seen a rise in Black Soldier Fly maggots. Maggot farming offers great economic diversification. BSF (maggot) larvae may eat many organic materials, making them special. This helps bioconvert organic waste, which can damage the environment and harm people's health if not treated properly. Protein-rich maggots are animal feed ingredients. Serious maggot cultivation can create new jobs. This maggot culture has a hidden gem that must be removed. Maggot oil studies still produce animal feed. Maggot oil is antibacterial and emollient, making it a cosmetic and medicinal ingredient, according to worldwide studies. Cosmetics use fats as viscosity enhancers or emulsifiers. As a proof of concept, BSF larvae fat will be used in hand cream compositions to show its potential in organic waste processing, animal feed, and health and beauty additives. Naturally, national and international scientific journals and social media have not broadly shared this information and talents. The Cosmetic Engineering study program's Community Service Team shares information, insights, and talents to connect research, education, and community applications. The ITERA Cosmetics Engineering team will train maggot breeders in Triharjo village to increase maggot production and diversify maggot products to boost sales.

INTRODUCTION

Nowadays, the practice of converting biowaste utilizing insect larvae, such as the Black Soldier Fly (BSF), *Hermetia illucens*, has gained significant interest. Utilizing Black Soldier Fly Larva (BSFL) to decompose biowaste offers some advantages including economic potential.

Firstly, feeding biowaste to BSFL helps prevent the spread of disease-causing germs like *Salmonella spp.* This indicates that the danger of disease transmission between animals and between animals and people can be minimized when this technology is used on farms or when processing animal waste in general (eg chicken manure or waste from abattoirs).

Biodegradable trash is transformed into larvae and residue. The larvae are less than 35% protein and less than 30% crude fat. This insect protein has high quality and is a food resource for chicken and fish farmers. Experiments on fish nutrition have demonstrated that BSF larvae can be used as an alternate food source for fish. The BSFL can be used as a protein source for animal feed, making it a viable alternative to conventional animal feed.

The residue from the biowaste treatment process using BSFL is a material similar to compost that contains nutrients and organic elements. Therefore, this residue can be applied in agriculture that preventing the depletion of soil nutrients. From a business standpoint, the high waste-to-biomass conversion rate of up to 25 percent of its wet weight yields a sufficient amount of output. The facility and equipment does not require advanced technologies. Therefore, it is suited for low-income regions that still rely on simple technology and low skill jobs.

Triharjo Village is one of the villages in the district of Merbau Mataram, South Lampung County (Figure 1). Agriculture, plantation, and livestock farming are viable industries in Triharjo. The primary issue in the livestock industry is the high cost of animal feed. Since mid-2020 till now, according to the Director General of Domestic Trade at the Ministry of Trade, Syailendra, feed costs have climbed by 30 percent. This is also inextricable from the movement of the average local corn price, which increased from 3,000 to 4,000 rupiah per kilogram. Corn contributes 40 to 45 percent to animal feed. This corn feed is one of the most important ingredients in broiler chicken feed. The increase in feed prices extended to fish food as well. The rising cost of fish food is a hindrance to fish farming. Demand for fish as a food security measure. Catfish farmers in Triharjo village report that the price of animal feed has risen by 20 percent.



Figure 1. The Map of Merbau Mataram

The constant trend of rising feed prices from year to year pushes farmers to seek out alternative ways for lowering feed expenses. In recent years, the larvae or maggots of the Black Soldier Fly have been popular in Indonesia. The role of increased information literacy through the internet and social media cannot be denied in the emergence of many maggot cultivations on household, medium, and industrial scales. During the COVID-19 crisis, this surge in the usage of information technology is also a blessing in disguise.

This occurred to BSFL breeders in Triharjo village, Merbau district, Mataram, South Lampung district. Multiple breeders have been raising maggots as a source of animal feed since the end of 2021 (Figure 2). This Triharjo villager learned how to produce maggots by accessing material on YouTube and other social media platforms. Breeders continue to cultivate in a basic method for animal feed. They have not considered product diversification as a potential source of income.



Figure 2. Location of the Farm in Triharjo Village with (a) Picture of a Chicken Coop from the Side; (b) Picture of the Chicken Coop from the Front; (c) Pictures of Fish Ponds; (d) Pictures of Chickens; (e) Picture of BSL Cage (BSF); (f) Sample Drawing of BSF Egg Holder; (g) BSF Pupae Images; and (h) BSFL

Larvae of the Black Soldier Fly (BSF) can be fed directly to chickens, ducks, and catfish without any prior processing. If the breeder is able to optimize the

BSFL production process, it will require additional processing, either as feed stock or as a product that is sold as animal feed. Farmers intends to expand maggot production by purchasing an organic waste shredder to provide maggot food. The procurement of this machine has a significant impact on the maggot production capacity.

Freezing is a process that can facilitate the storage of BSFL. However, freezing demands a substantial amount of electrical energy. BSFL can also be preserved through the drying process. The process of drying can utilize the sun's heat or equipment such as an oven. Drying process would reduce the moisture content then lengthen storage time. However, for long period of storage, the 30% oil content of BSFL makes the dried larvae susceptible to rancidity. Then, extracting the BSFL's oil becomes a further process. Extract method can be physically or chemically.

This extract technique separates BSFL's oil from the protein. The final product should include less than 10 percent oil so that it does not degrade during storage. The good composition of dried BSFL contain 60% protein and 10% fat that make them suitable for use as livestock feed.

Some references mentioned that the BSFL's oil as by-product have potential as raw material in pharmaceutical and cosmetic industries.

The objective of this community service project by Cosmetic Engineering ITERA team is to increase the economic value of maggot (Larve of Black Soldier Fly). Increasing the economic value can be done by: (1) Increase the BSFL production capacity; and (2) Expand the technology (drying and extracting) to increase the quality of products.

IMPLEMENTATION AND METHODS

Black Soldier Fly (BSF)

Hermetia illucens, also known as the Black Soldier Fly (BSF), is a member of the family Stratiomyidae, which is part of the order Diptera. This species of insect first appeared in the Americas, but it has since spread to every region of the world that has tropical and subtropical climates (Craig-Sheppard et al., 1994). According to Iková et al. (2015), adult large black flies that may grow to a length of up to 20 millimeters consume only water, do not approach humans, do not bite or sting, and do not transmit specific diseases. BSF thrives in warm temperatures, with almost all oviposition taking place at temperatures greater than 26 degrees Celsius (Tomberlin & Sheppard, 2002). When it comes to the processing of substrates, the BSF is the species of fly that is both the most efficient and diversified (Kim et al., 2011). BSF larvae are well-known for their usage in waste treatment on a small scale due to the fact that they consume organic waste like as leftover food, garbage from the kitchen, and waste from animals (Nguyen, et al., 2015).

These black flies have the ability to digest a wide variety of organic materials, making them helpful for the management of waste. Additionally, the prepupae of black fly larvae, which are known to have a high protein content, can be gathered and used as food for animals. In contrast to flies in general, the body of a BSF contains natural antibiotics, which reduces the likelihood that it would transmit disease to other organisms.

In the BSF life cycle, eggs symbolize the beginning of the life cycle as well as the end of the previous life stage. BSF is a type of fly that can produce clusters of eggs (also known as ovipositing). The female fly lays about 400 to 800 eggs near decaying organic substrate and inserts them into small, dry, protected cavities. The female will die shortly after laying her eggs. The eggs are placed close to decaying organic substrate so that when they hatch later, the larvae can easily find food sources around them. As a result of being placed in cavities that are shielded from environmental effects, the larvae are shielded not just from the fear of being eaten by other animals, but also from direct sunlight, which has the potential to reduce the amount of moisture of eggs. In most cases, the eggs will hatch after a period of four days. The newly hatched larvae, which are only a few millimeters in size, immediately begin their hunt for food and feed on the organic waste that is located in the surrounding area. As a result of the voracious eating of the rotting organic materials by the larvae, the size of the body, which was initially only a few millimeters in length and breadth, will rise to 2.5 centimeters in length and 0.5 centimeters in width, while the color will become slightly creamier.

Under optimal conditions with ideal food quality and quantity, larvae of BSF's growth will last for 14-16 days. However, BSF larvae are insects that have high adaptability, which can extend their life cycle even in unfavorable conditions. BSF only eats while still in the larval stage. Thus, it is at this stage of larval development that they store enough fat and protein for them to pupate to become flies, then find a mate, mate, and lay eggs (for the female) before finally dying.

After going through five larval stages (five instars), the larvae reach the prepupa stage. When transformed into a prepupa, the structure of the mouth changes to a hook-like structure and the color is dark brown to charcoal gray. This hook-shaped mouth makes it easy for it to get out and move from its food source to a new dry, humus-textured, shaded and protected environment that is safe from predators. This is where the pupa becomes an imago and then flies.

Oil of Black Soldier Fly Larvae (BSFL)

Drying in the sun or in the oven can lower the amount of moisture while simultaneously extending the amount of time that the product can be stored for (the moisture content must be less than 10%). Because the larvae contain 30 percent of the oil, keeping them in storage for an extended period of time will cause the oil to smell rancid. To avoid this, the dried larvae can be de-oiled using chemical or physical methods.

During this step of the process, the oil from the larvae is extracted and separated from the protein, which can then be more readily dried and stored. The dried larvae should have an oil content of less than 10% in order to prevent it from becoming rancid while it is being stored. Because the de-oiled larvae comprise contain around 60% protein and approximately 10% fat, they are suitable for use as an alternative to fish food in the diets of animals. The formulation of the complete feed, on the other hand, needs to take into account

the amino acid requirements of the particular breed of animal that is being produced.

Drying the BSF larvae is the first step that must be taken before attempting to extract its oil. Before beginning the drying process, the live BSF larvae were washed to remove any clinging contaminants, and then they were roasted at a temperature of 60 degrees Celsius for 24 to 48 hours. Using a blender, the dried BSF larvae were ground into flour until they reached the desired consistency. In addition, the oil was obtained by either chemically or physically extracting the larval grain from the BSF.

The Soxhlet procedure was utilized in order to carry out the chemical extraction process. The solvent that was used was hexane. The amount of BSF larvae flour samples required for one extraction cycle is 150 grams, and the amount of hexane solvent required is 1.5 liters. After that, the measured flour is given a sleeve made out of filter paper, and it is followed by its insertion into the soxhlet. The solvent was then added to the soxhlet and flask until the sample was completely covered by the liquid. To create a residue with a low fat content, extraction was carried out at a temperature that reached the boiling point and lasted for six hours. After that, the sample that had been extracted was put through a rotary evaporator so that the solvent could be separated from the oil. Pressing it with a machine similar to an oil press or centrifuge is how the physical technique is carried out.

Oil as Cosmetic Raw Material

The primary ingredient for skin care cream are the fats and oils that are typically found in cosmetics. Triglycerides are emollients that have a calming effect on the skin (Mank & Polonska, 2016). The system functions by hydrating the skin by lowering the amount of water that is lost via the epidermis (TEWL). The qualities of the fat might vary in their use depending on the profile of the fatty acids found in it (for example, linoleic acid is good for dry skin). Another illustration of this is the growing role that creams play in the protection of the skin. In the creation of cosmetic products, fats can also play the role of emulsifiers or viscosity boosters.

Building a collaboration network between the Sumatra Institute of Technology (ITERA) and the maggot breeders in Triharjo Village is the strategy employed. In its proposal for the cooperation, the community outlined the issues encountered. The strategy employed is to determine the village's level of maggot processing. During conversations with partners, a solution was identified, namely the necessity for training in the production of by-products from BSF larvae in order to raise their selling value, which will have a direct impact on the increase of villagers' income.

The community service team, which is consisting of lecturers from the cosmetic engineering programme, sets on a performance that includes of multiple competencies relevant to the issues that are now being faced by farmers. The fact that the community service team is comprised of members with skills from a variety of fields will result in an expanded range of solution to the challenges that maggot breeders encounter. It is expected that the effectiveness

of the proposed solutions would be improved by conducting a literature review and conducting a series of discussions on the subject. Providing information and skills on how to manufacture maggot oil is a problem solving that also boosts the selling power of farmers' products. A proposing team that includes members with a variety of different forms of knowledge is required in order to fulfill the requirements of partners. The knowledge comprises chemistry, pharmacy, and the field of entrepreneurship/marketing. The partnership of the three forms of knowledge is intended to give skill output for the development of BSF larvae oil for cosmetic ingredients and its marketing flow.

RESULTS AND DISCUSSION

The activity of community service, typically taking the form of assistance was carried out in stages across a duration of three months. The very first step of the activity involved of visiting to Triharjo Village for the purpose of getting to acquainted with the locals. Several arrangements, including the timing and type of collaboration actions between the ITERA service team, were reached at the first meeting. Breeders of magots are the focus of assistance operations for the production of magot oil.

In order to provide breeders in Triharjo Village with support in resolving the BSFL related issues, the ITERA Team of community service proposes these solutions: (1) Socialization and training in regard to the subsequent processing of BSF larvae, namely drying and separating oil from dried maggots; and (2) Providing help to BSF larvae breeders in the distribution of main and side products to enhance marketability and capitalize on the potential of these goods as cosmetic raw materials.

In order for the team to succeed in accomplishing the goal of the community service activities that were carried out by the ITERA Cosmetic Engineering Study Program, numerous phases of work were completed. To begin, the group, which is consists of six lecturers who teach in the ITERA Cosmetic Engineering Study Program as well as a number of students, went to the Triharjo village on a number of occasions in order to conduct preliminary research as shown in Figure 3. During these trips, we planned to conduct interviews not just with municipal authorities but also with members of the community and local residents. Because of this review, a better understanding of the present condition of the village will be gained, and the structure of the PKM that will be carried out will be improved. Follow-up conversations were held as part of the study program for Cosmetic Engineering. The goal of these conversations was to locate a means to synchronize the lecturers' team's expertise with the issues that maggot breeders are currently confronting.



Figure 3. Prelimery Visiting to Triharjo

The second activity consisted of providing participants with an overview of the numerous advantages of using maggot oil. The information was presented in the form of lectures and conversations about the many steps of preparation that were carried out in order to produce maggot oil. The information is delivered in the form of lectures and is supplemented by power point facilities, which are displayed on LCD screens (Figure 4). This information is being presented to participants in the presentation with the goal of introducing them to the process of creating maggot oil as well as helping them understand its commercial potential for raw materials and how it works.



Figure 4. Presentation and Roundtable Discussion on the Processes Involved in the Manufacture of Maggot Oil for Manufacturing

Assisting in the preparation of the facilities and infrastructure required to generate maggot oil is the third activity. For the manufacturing of maggot oil, the two essential tools are a drying apparatus and a press. Utilizing an existing oven that is in the shape of a chamber (Figure 5) that is meant for drying agricultural

products is how drying is accomplished. A machinist was tasked with creating a press machine (Figure 5) for the manufacturing of maggot oil by modifying a regular oil press machine.



Figure 5. Drying Chamber and Press Machine



Figure 6. Maggot Oil

CONCLUSIONS AND RECOMMENDATIONS

Stockbreeders in Triharjo Village, Merbau Mataram, South Lampung were excited about the ITERA Community Service team's training on the production of maggot oil from BSF larvae by-products. This oil can lessen the putrid odor of dried maggots and is also a possible cosmetic ingredient.

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