International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

Vol. 39 No. 2 July 2023, pp. 429-433

Fatty Acid And Hematology Profile Of Black Soldier Fly (Hermetia illucens L.) Maggot Oil In Wound Healing

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***Abstract*— Maggot Black Soldier Fly (BSF) oil is a extract from larval BSF that has the potential to heal wounds. However, the underlying mechanism of wound healing has yet to be scientifically explained. This study aims to clarify that BSF maggot oil has the potential to accelerate wound healing by improving hematological performance. This study used adult male mice consisting of a control group (G1), a group treated with povidone-iodine 10% (G2), a group treated with BSF maggot oil once daily (G3) and a group treated with BSF maggot oil twice daily (G4) after wounding. Furthermore, the wound healing rate was determined and the hematological profile was observed on day 9. The results showed that BSF maggot oil contains 10 types of fatty acids consisting of SFA (Saturated Fatty Acid), MUFA (Mono Unsaturated Fatty Acid), and PUFA (Poly Unsaturated Fatty Acid) which play a role in the wound healing process. Hematology analysis showed that BSF maggot oil can significantly increase the amount of hemoglobin concentration and mean corpuscular hemoglobin concentration (MCHC). However, it was not significant in affecting leukocyte, erythrocyte, hematocrit, and MCV (Mean Corpuscular Volume) profiles. Therefore, BSF maggot oil could potentially accelerate wound healing by increasing physiological resistance. This finding can be used as a scientific basis for further use.**

Keywords—Black Soldier Fly, Fatty Acid, Hematology, Wound Healing

I. INTRODUCTION

A wound is a breakdown of tissue units/components, where specifically there is damaged or missing tissue substance. Wounds often occur on the skin, causing epithelial damage or damage to the normal anatomical structure of the tissue [1]. Wound healing is a complex process that involves interactions between cells and between cells and the matrix in three interrelated phases. These are the inflammatory phase (lasting the first 0-3 days), the proliferation phase (lasting 3-14 days) and the remodeling phase (lasting up to 1 year) [2].

Wound healing is influenced by several factors, including the type of medication used. Medicinal materials can come from animals or plants. One of the animal-derived medicinal materials that can be used for wound healing is BSF maggot. This is because the protein content in BSF maggot is 40-50% and the fat content ranges from 29-32% [3]. Protein plays a role in the formation of new tissue in wounds. This is because the protein intake in the body is well fulfilled, and the wound healing process will be faster. On the other hand, a lack of protein in the body will result in longer wound healing [4]. Fatty acids can also help the process of rebuilding collagen and epithelial tissue in wounds [5].

Based on the description above, researchers are interested in studying the potential of BSF maggot in wound healing in mice with BSF oil preparations applied topically.

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II. RESEARCH METHODS

2.1. Animal Test

The test animals used were white mice of the Balb/c strain obtained from Pondok Tikus, Lubuk Begalung, Padang, West Sumatra. The body weight of the mice used was in the range of 20-25 grams and the age of 2.5 months. Mice were acclimatized in the laboratory for one week at room temperature and 12-hour light/dark cycle and given BP-2 feed and drink ad libitum.

2.2. Extraction of BSF Maggot Oil

BSF maggots were obtained from Minagot Sumbar, Bukit Belimbing Indah Complex, Kuranji District, Padang City, West Sumatra. BSF maggots are fed with a diet dominated by vegetable waste. The BSF maggot was sun-dried and pulverized using a grinder. Then maggot powder was macerated with n-hexane solvent for 24 hours. The extract was filtered using filter paper with a thickness of 0.2 mm. Then the extract was concentrated using a rotary evaporator with a temperature of 60ºC, the extract was preserved in the refrigerator at 4ºC until use.

2.3. Wound Conditioning in Mice

Before wounding, the hair around the back of the mice was removed with an area of 3x3 cm with a hair thresher (veet brand) and then cleaned with 70% alcohol. Mice are anesthetized with 10% ether by inhalation. Then the mice's back was slashed with a length of 2 cm and a depth of 0.2 cm using a sterile knife [6].

2.4. Fatty Acid Analysis

The compounds of BSF maggot oil were analyzed using GC-MS (Gas chromatography-mass spectrometry) analysis.

2.5. Hematology Level Calculation in Mice

A total of 500 µl of blood was applied to the analyzer column and hematology levels were calculated using an automatic hematology analyzer [7].

2.6. Data Analysis

Data are presented as mean and SE. Data were analyzed by one-way Analysis of Variance (ANOVA) and if there was a difference, it was followed by DNMRT test with 95% confidence level. Data analysis was done with the SPSS version 24 program.

III. RESULT AND DISCUSSION

3.1. Fatty acid profile of Black Soldier Fly Maggot oil

Fatty acids are essential for the formation and maintenance of cell membranes within the stratum corneum, the skin layer that provides a barrier against the environment and regulates permeability [8,9]. Fatty acids also have lubricating, emollient and anti-inflammatory properties, which help restore the skin's natural oils and protect it from environmental damage [10].

Fatty acids are carboxylic acids formed by hydrogen and carbon atoms. Based on the presence of double bonds, fatty acids are classified as saturated (having no double bonds) or unsaturated (with double bonds). Among unsaturated fatty acids, there is also a classification that takes into account the number of unsaturations: monounsaturated fatty acids (MUFA) are present with one double bond on the acyl (the main food source is olive oil) and polyunsaturated fatty acids (PUFA) contain two or more double bonds [11].

Table 1. Fatty acid Compounds of Black Soldier Fly Maggot oil

Fatty Acids	**Classification**	**Area%**
Lauric	Saturated Fatty Acid (SFA)	32.25
Miristat	Saturated Fatty Acid (SFA)	16.57
Palmitic	Saturated Fatty Acid (SFA)	16.97

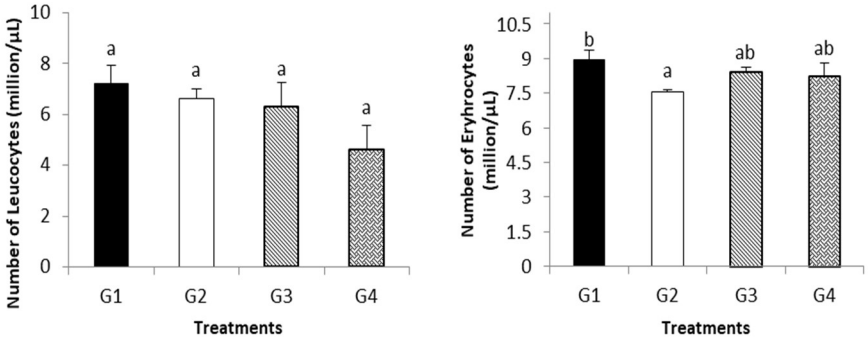
Stearic	Saturated Fatty Acid (SFA)	4.13
Capric	Saturated Fatty Acid (SFA)	0.20
Total		70.12
Palmitoleate	Mono Unsaturated Fatty Acid (MUFA)	6.81
Oleic	Mono Unsaturated Fatty Acid (MUFA)	18.52
Total		25.30
Linoleic	Poly Unsaturated Fatty Acid (PUFA)	4.30
Arachidonate	Poly Unsaturated Fatty Acid (PUFA)	0.10
Eicosapentanoate	Poly Unsaturated Fatty Acid (PUFA)	0.15
Total		4.55

The highest fatty acid component in BSF maggot extract is lauric acid (SFA), which is 32.25%. Lauric acid has unique properties that are easily absorbed into cells and increase metabolism. In addition to increasing metabolism, cells will work more efficiently to form new cells and replace damaged cells to accelerate the healing of the disease [12]. Then oleic acid has the highest percent area for MUFA components (18.52%). These fatty acids include can be synthesized by all mammals, including humans, and thus represent important essential fatty acids to be considered in drug formulations for use in wound healing Linoleic (4.30%) and oleic acids can modulate the closure of surgically-induced skin wounds. A mild increase in wound closure was observed in animals treated with linoleic acid along with a peak in nitric oxide production at 48 hours postoperatively. However, oleic acid may inhibit nitric oxide production in the wound area [13].

Fatty acids alter the structural and immunologic status of the skin as it constitutes the stratum corneum, and can alter skin permeability. Fatty acids can also interfere with the maturation and differentiation of the stratum corneum and inhibit the production of proinflammatory eicosanoids, reactive species (ROS and RNS), and cytokines, thus affecting the inflammatory response and the likelihood of wound healing [14,15,16].

3.2. Hematology profile of mice treated with incision wounds

Based on the observation of hematological values (Fig 1), total leukocyte, MCV, and hematocrit values showed non-significant data between the four treatments. Erythrocyte values showed significant results between treatments G2 and G1. The MCHC value showed a significant difference between G1 and G3. Leukocytes and their differentiation function as a defense of the mice's body. White blood or leukocytes are one of the most active blood cells of the body's defense system [17,18]. White blood cells function to recognize and fight microorganisms in immune reactions and help the process of inflammation and healing. The irrelevance of the dynamics of leukocyte changes in the treatment group mice indicates that BSF maggot oil does not modulate the body's defense or immunity components in wound healing [19].



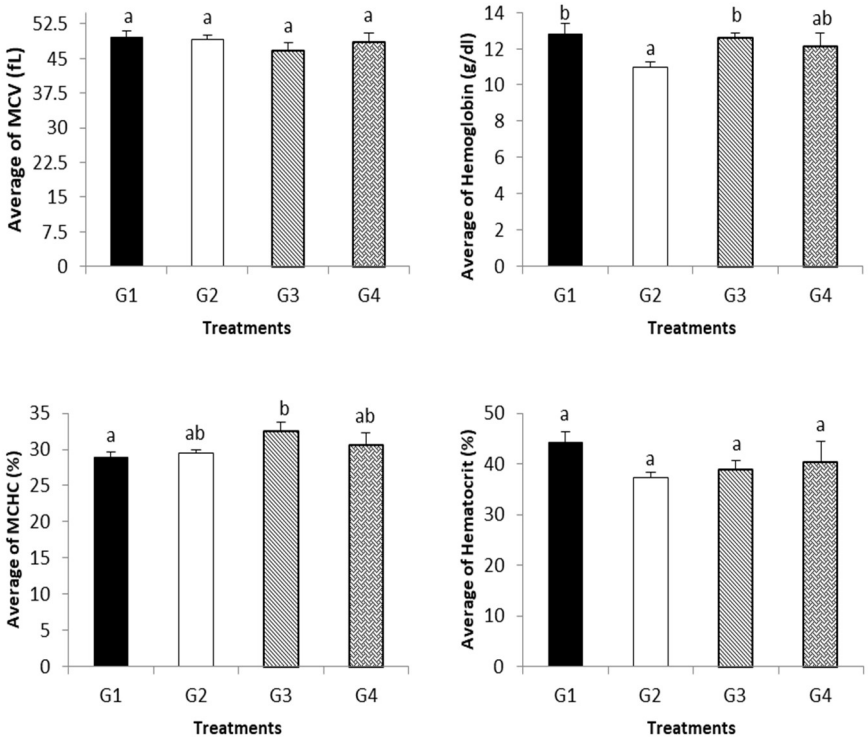


Figure 1. Average values of leukocytes, erythrocytes, hemoglobin, MCHC (Mean Corpuscular Hemoglobin Concentration), Hematocrit, and MCV (Mean Corpuscular Volume) in mice suffering from wound. G1 (Control), G2 (Povidone iodine 10%), G3 (BSF maggot oil once daily), G4 (BSF maggot oil twice daily). *) significant ($p<0.05$)

From the graph, the erythrocyte counts treated with BSF maggot oil were not significantly different. The number of erythrocytes is very much functional in terms of homeostasis of oxygen supply to body cells. Erythrocytes are very important cells for living things because of the hemoglobin content in them. Under physiological conditions, erythrocytes are always in the blood vessels so that they can carry out their function as oxygen carriers [20]. Meanwhile, the hemoglobin value showed significant results between G3 and G1 treatments. Hemoglobin functions as a regulator of the exchange of oxygen with carbon dioxide in body tissues and takes oxygen from the lungs then carries it throughout the body to be used as energy material [21]. The erythrocyte component is thought to play an important role as a mechanism for accelerating the healing of wound lesions in mice treated with BSF maggot oil. The increase in erythrocytes and hemoglobin is very good for maintaining body condition so that the body does not lack blood.

IV. CONCLUSION

Based on the results of the study, it can be concluded that BSF maggot oil has the potential to accelerate wound healing because BSF maggot oil contains 10 types of fatty acids consisting of SFA (Saturated Fatty Acid), MUFA (Mono Unsaturated Fatty Acid), and PUFA (Poly Unsaturated Fatty Acid) which play a role in the wound recovery process. Hematology analysis showed that BSF maggot oil can significantly increase the amount of hemoglobin concentration and mean corpuscular hemoglobin concentration (MCHC). However, it was not significant in affecting leukocyte, erythrocyte, hematocrit, MCV (Mean Corpuscular Volume) profiles. Therefore, BSF maggot oil could potentially accelerate wound healing by increasing physiological resistance. This finding can be used as a scientific basis for further use.

V. ACKNOWLEDGMENT

Thank you to the Ministry of Education, Culture, Research and Technology of the Republic of Indonesia for the Master's Thesis Research grant (PTM) (Contract Number: T/35/UN.16.17/Pt.01.03/Pps-ptmkesehatan/2022. PIC Dr. Resti Rahayu).

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