

Effectiveness of *Cymbopogon nardus* L. Essential Oil as Antifungal for Black Fungus (*Mucormycosis*) Infection in Male Mice (*Mus musculus* L.)

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This paper combines the disciplines of biology in the fields of microbiology and animal physiology. This paper discusses the effectiveness of *Cymbopogon nardus* L. essential oil as antifungal in male mice (*Mus musculus* L.) infected with black fungus. Mucormycosis is a fungal infection with a high rate of transmission. There are data that there is a significant increase in the incidence of mucormycosis in patients with uncontrolled diabetes mellitus, other immunosuppressive conditions and corticosteroid therapy are risk factors for mucormycosis. So, in this paper, we will look at the effect of administering *Cymbopogon nardus* L. essential oil on the infection caused by the black fungus. Previously, infection from black fungus was observed in mice induced by diabetes mellitus, this is based on the fact that people with diabetes mellitus tend to have a high risk of developing Mucormycosis or this black fungus infection. It is hoped that the activity of the fungi can be reduced by the antifungal compounds contained in the essential oil. The use of oil from *Cymbopogon nardus* L. is because *Cymbopogon nardus* L. is a plant that is easy to find or familiar in the community and the number is also large.

Plant extracts can be used as biofungicides. One of the important compounds in plant extracts is essential oil. Most essential oils from several plants are active as antibacterial and antifungal (Agusta, 2000; Picheansoonthon and Yupparach, 2007; Nurmansyah, 2001 and 2010). Lemongrass or *Cymbopogon nardus* L. belongs to the Graminae family. This plant is generally used as a producer of essential oils. The main content of citronella essential oil is citronella, geraniol and metal heptanol (Soetrisno, 1972). Essential oils are volatile compounds produced by certain tissues of a plant, either from roots, stems, leaves, bark, flowers, seeds, and even flower pistils. Essential oils act as antibacterial and antifungal by interfering with the process of forming membranes or cell walls so that they are not formed or formed imperfectly. So that the use of essential oils is expected to be able to reduce or cure infections caused by black fungus in Mice.

Fungal infection in patients with diabetes mellitus caused by diabetes mellitus (DM) is a group of metabolic diseases with characteristic hyperglycemia that occurs due to defects in insulin secretion, insulin action or both (Powers, 2005). Skin sugar levels (skin glucose) is 55% of blood sugar levels (blood glucose) in ordinary people. In diabetics, the ratio increases to 69-71% of already elevated blood glucose. In patients who have been treated any ratio exceeds 55%. Skin sugar is highly concentrated in the intertriginous and interdigital areas. This facilitates the development of dermatitis, bacterial infections (especially furuncles), and fungal infections (especially candidosis). These conditions are called skin diabetes. Conditions of hyperglycemia also cause disruption of the mechanism of the immunoregulatory system. This causes a decrease in the chemotaxis, phagocytosis and bactericidal ability of leukocyte cells so that the skin is more susceptible to infection (Manaf, 2009). Fungus are normally found in the human body, but in certain circumstances, for example, in DM patients, their growth becomes excessive, causing infection. Raihany's research shows a significant relationship between DM and fungal infection. According to Al-Mutairi et al (2006). Skin manifestations found in 30-71% of patients with diabetes mellitus both type 1 and type 2 and the most common types of skin manifestations in diabetic patients at the department of dermatology, Al-Farwaniya Hospital, Kuwait are fungal and bacterial skin infections. Research conducted by Foss (2005) found that the most common type of skin manifestation in diabetic patients at the University Hospital Sao Paulo, Brazil is dermatophytosis. According to Mahajan, Kuranne and Sharma (2003), skin infections are the most common skin manifestations followed by vulgaris at Suchetha Kripalani Hospital, New Delhi, India.

Diagnostic for mucormycosis such as radiologic features is nonspecific and have wide range of types. The most common features that can be identified for pulmonary mucormycosis are presence of nodules, consolidations, reverse halo sign, large perilesional halo and cavitation. Reverse halo sign characterized by peripheral consolidation with central ground glass and large perilesional halo characterized by ground-glass halo around lesion that very extensive and bigger than the lesion itself (Prakash, 2019). Histopathological examination for mucormycosis is important but not always reliable to differentiate with *Aspergillus*. Mucorales have primitive coenocytic hyphae which are fragile because of lack of regular hyphae-septations. They make aggressive tissue grinding can render fragile fungal elements become non-viable. The important differentiation between Mucorales and *Aspergillus* is on their hypha type. Mucorales hypha have wide diameter and non-septate while *Aspergillus* hypha is narrower and have many septation (Skiada, 2018). In a study conducted by Periadnadi (2014) on the effectiveness of *Cymbopogon nardus* L. essential oil as an antifungal against the fungus *Colletotrichum* sp. which attacks red dragon fruit (*Hylocereus polyrhizus*) it was found that the essential oil of *Cymbopogon nardus* L. has the potential as a biofungicide to control the fungus *Colletotrichum* sp. at a concentration of 750 ppm, indicated by the increasing dose of C. nardus oil given, the average increase in mushroom diameter was slower. This indicates that C. nardus can be used as an antimicrobial agent.

Therefore, it is hoped that *Cymbopogon nardus* L. essential oil can be effective in curing or reducing black fungus infection in male (*Mus musculus* L.) mice. With the content of antifungal compounds owned by essential oils so that it can be effective in healing from the fungal infection. As a plant that is easy to find and in large numbers, this is a finding that has the potential and benefits for the community or the students themselves. Moreover, mucormycosis is a fungal infection that is easily transmitted. In this case, people with diabetes mellitus have the potential to be infected with this black fungus. Therefore, it is necessary to diagnose this mucormycosis, and it is necessary to determine the characteristics of the infecting fungus. So that the efforts made to see the effectiveness of *Cymbopogon nardus* L. essential oil can be maximized.

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