International Journal of Contemporary Sciences (IJCS)
Vol. 1, No. 2, 2023 : 71-78

Farmakoantartika Literature Study: Bioactivity of *Pagodroma nivea* on Fossil Deposits from Mujito

Yuneka Saristiana[1*], Fendy Prasetyawan[2], Ratna Mildawati[3], Faisal Akhmal Muslikh[4], Anis Akhwan Dhafin[5], Susilo Margining Raharjo[6], Candra Arifin[7], Abd Rofiq[8]
[1,2,,5,6]Universitas Kadiri, [3]STIKes Ganesha Husada, [4]Institute Ilmu Kesehatan Bhakti Wiyata, [7,8]Akademi Kesehatan Agra Husada
Corresponding Author: Yuneka Saristiana yunekasaristiana@gmail.com

A R T I C L E I N F O
Keywords: Literature Study, Bioactivity, Fossil, *Pagodroma nivea*, Mujito

Received : 2 December
Revised : 16 December
Accepted: 29 December

A B S T R A C T
This report investigates the biodiversity of marine animals, focusing on extinct sponge species near Lesbos Island based on Aristotle's descriptions. Mujito, introduced in the literature review, is from the GeoMaud expedition in Antarctica. Various instrumental analysis methods, such as ESI mass spectrometry and NMR, contribute to a comprehensive understanding of the compounds, particularly in the context of Alzheimer's research. The pharmacantarctic literature study concludes that Antarctic Mumijo, particularly from Mujito fossil deposits, holds significant biomedical potential. It exhibits organic components like wax esters with notable biomedical activities, particularly in treating bone diseases. Additionally, Mumijo's composition resembles non-fossil samples, with wax esters dominating and unique components like α-glyceryl fatty alcohol ethers indicating neuroprotective potential. The research suggests promising applications in Oriental medicine, addressing wounds, skin diseases, tuberculosis, respiratory diseases, and neurological conditions like Parkinson's and Alzheimer's. Overall, Antarctic Mumijo showcases diverse biomedical prospects, emphasizing its organic components' therapeutic value

INTRODUCTION

Report on the high biodiversity of marine animals, originating from Aristotle in ancient times. Aristotle provided an extensive description of sponge species near the island of Lesbos that have since become extinct. Furthermore, the report also mentions the use of substances such as tar in traditional medicine, known as Mumijo in various regions including Russia, India, Mongolia, and others (Aristotlelis, 1961).

Asian Mumijo is found as deposits on walls and caves with a chemical composition that includes minerals, proteins, lipids, steroids, carbohydrates, alkaloids, and amino acids. Medical applications of Mumijo involve stimulating the immune system, anti-allergic activities, healing of gastric ulcers, bone fracture recovery, protection against radiation, and nootropic properties. Additionally, the term Mumijo is not only limited to the black substance from Asia but is also used for paleo-environmental records, such as subfossil stomach oil deposits from Antarctica originating from Petrel birds (Garedew, 2004).

The report notes the composition of Petrel bird stomach oil and highlights its potential as a paleoclimate biomarker. This research also reports the chemical composition of Antarctic Mumijo fossil samples, noting neuroprotective effects and cell growth stimulation, particularly associated with the presence of α-glyceryl ether. However, the complexity of Mumijo also allows potential applications as antimicrobial, antiviral, antitumor, antiallergic, immunomodulatory, or anti-inflammatory drugs, similar to active compounds found in fungi, propolis, "Kampo" compounds, and traditional Arab remedies (Schepetkin, 2003).

LITERATURE REVIEW

Mujito

This material originates from Dr. Ulrich Wand of the Alfred-Wegener-Institut Bremerhaven and was collected during the "GeoMaud" - Geoscience Expedition to Queen Maud Land in Antarctica from November 1, 1995, to August 25, 2005. The location is situated in Oasis Schirmacher (11°35′E; 70°45′S). The material consists of Antarctic yellow rocks, as seen in the picture below, compared to deposits of brownish tar obtained from Samarkand, Turkestan. (Source:http://www.bgr.bund.de/cln_011/nn_322990/DE/Themen/MeerPolar/Polarforsch-ung/Projekte/Antarktis__Projekte/GEOMAUD.html).

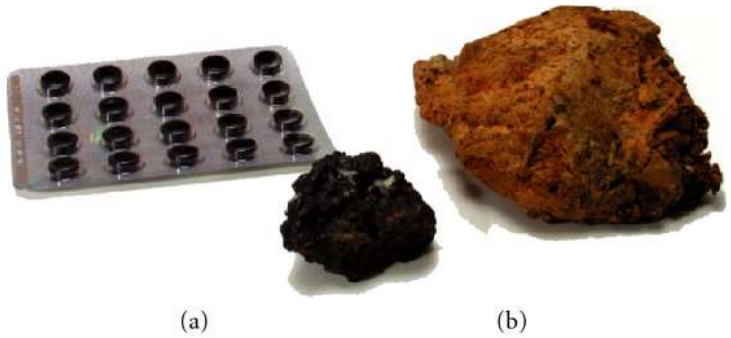

Figure1. Mumijo Samples.
(a) Mumijo from Samarkand (Turkestan) (black).
(b) Mumijo from Antarctica (yellow).

Materials

In this research, the primary materials utilized involve β Alzheimer fragments [A β 25–35] (A 4559), 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (thiazolyl blue; MTT; M 2128), and additional chemicals obtained from Sigma (St. Louis, MO, USA). These three components are crucial elements in the experiments, with A β 25–35 serving as the representative Alzheimer's fragment under scrutiny, MTT as the marking agent or cell response assessment, and supplementary chemicals from Sigma serving as the chemical substances supporting the research process (Warham, 1976).

Instrumentation

This research involves a series of instrumental analysis techniques to characterize specific compounds. Electrospray ionization mass spectrometry (ESI) is employed with the API 2000 mass spectrometer. Nuclear magnetic resonance (NMR) resonance experiments are conducted using the Varian Unity INOVA 500 spectrometer, and chemical shifts are measured by referencing residual solvent signals (CD3OD: δH = 3.31, δC = 49.0; CDCl3: δH = 7.26; δC = 77.0). Medium-pressure liquid chromatography (MPLC) analysis is carried out using Büchi 861 equipment with a SiO2 column (230-400 mesh) (Warham, 1976).

High-performance liquid chromatography (HPLC) separation is performed on Knauer 501 equipment with a refractive index detector. GC-MS spectra are generated using Hewlett-Packard 5890 gas chromatography with a split/splitless injector and connected to the HP 5970 MS Mass Selective Detector

(MSD) using electron impact ionization (EI) at 70 eV ionization energy. HPLC separation is conducted with Varian Prostar 210 equipment equipped with Varian 350 refractive index detector or Varian 325 UV detector. By employing these various techniques, the research can provide a comprehensive understanding of the properties of the investigated compounds (Müller, 2004).

METHODOLOGY

This research began by delving into the background of the use of mumijo in traditional medicine. In the foundational literature, Aiello *et al*. (2011) discussed mumijo as a traditional remedy originating from fossil deposits in Antarctica, with a focus on its beneficial chemical composition and bioactivity. The introduction of this study details the importance of understanding this natural resource as a potential traditional medicine that has not been fully explored. To gather data, this research utilized tools and materials that were thoroughly described in the adapted research method from the mentioned journal. The careful and structured data collection process is expected to provide a deeper understanding of mumijo as a traditional remedy.

The results of this research reflect findings consistent with Aiello *et al*.'s (2011) study, validating the chemical composition and bioactivity of mumijo. Furthermore, the conclusions of this research highlight the importance of further development of this traditional remedy in the context of modern drug development. These conclusions are supported by consistent findings with the literature that served as the basis for the research. Thus, this study not only confirms previous findings but also contributes new insights into the understanding and potential utilization of mumijo as a medically valuable traditional remedy.

RESEARCH RESULT

Chemical Analysis of Mumijo Extract

In this study, the ester wax fraction was analyzed using GC-MS with the method proposed by Reiter et al. This method enables the analysis of wax composition in its natural state and provides a reliable profile of wax esters. The EI spectrum of wax esters produces a single molecular ion [M]+ and a series of dominant ions [R1CO2H2]+, originating from the rearrangement fragmentation of double-bonded hydrogen in the ester groups. A 28 Da difference in these ions indicates the presence of isomeric wax esters with the same carbon number and degree of unsaturation but differing in the position of the ester groups.

The analysis indicates that, thanks to the abundance of [R1CO2H2]+ ions, the determination of ester isomers in the individual is possible. Fractions D/2 and D/3 were identified as a mixture of glycerol derivatives through NMR, with D/2 as a mixture of acetylated monoglycerides and D/3 as glyceryl ether diacetate. The analysis of the composition of fatty acids, monoglyceride alcohols, and monoalkyl glycerol ether diacetate was conducted by comparing their spectroscopic properties with literature data. ESI mass spectra of both fractions showed a series of [M + Na]+ peaks, while GC-MS analysis of methyl esters provided information on the composition of free fatty acids.

DISCUSSION

Explanation of Mumijo components from Central Asia reveals the presence of inorganic components such as minerals, organic components including proteins, steroids, carbohydrates, nitrogen-containing compounds, and lipids. Through isolation procedures, wax esters are identified as the main organic and bioactive components with potential biomedical activity. However, the mineral content in Antarctic Mumijo has not been determined, opening up potential applications in bone disease treatment.

Chemical analysis of Antarctic Mumijo fossil samples reveals a composition similar to non-fossil samples but with substantial differences. Wax esters dominate, and some components such as cholesterol esters are not detected. Monoalkyl glycerol ethers, especially alkyl diacylglycerol, become the main components in Mumijo. The discovery of pharmacological activities of these components, such as antimicrobial, tuberculostatic, and radiation protection, provides a basis for the medical application of Mumijo in oriental treatments, including for wounds, skin diseases, tuberculosis, and respiratory diseases.

Recent findings indicate that Antarctic Mumijo is rich in (α-glyceryl ether of) fatty alcohols, which have neuroprotective potential. This data illustrates the biomedical potential of Antarctic Mumijo, including the possibility of treating neurological diseases, modulating nerve inflammation, and exerting neuroprotective effects in Parkinson's and Alzheimer's diseases. Additionally,

glycerol-related ethers in shark liver oil, similar to Mumijo components, have been used in therapy and prevention for over 50 years. Overall, Antarctic Mumijo offers biomedical potential through its organic components, such as wax esters and glycerol ethers, demonstrating neuroprotective activity and potential benefits in bone health as well as antimicrobial properties.

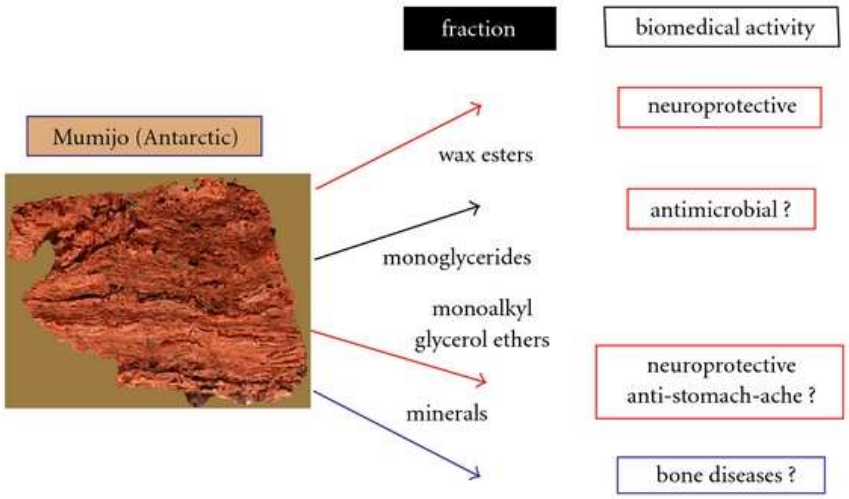

Figure 2. Mumijo Components

The main biomedical activities (established and expected from literature data) of various organic fractions separated from Antarctic Mumijo are discussed. Further potential can be estimated from the inorganic, mineral components, in relation to their function in bone disease repair. The scheme also illustrates cross-sections of Antarctic Mumijo samples (size: 2.5 cm). Layered depositions of waxy organic material are self-evident.

CONCLUSIONS

Conclusion from the pharmacantarctic literature study on the bioactivity of Pagodroma nivea in the fossil deposits of Mujito is that Antarctic Mumijo has significant biomedical potential. Analysis of Mumijo components from Central Asia revealed the presence of inorganic components such as minerals, as well as organic components including proteins, steroids, carbohydrates, nitrogen compounds, and lipids. Wax esters were identified as the main organic and bioactive components of Mumijo with potential biomedical activities, especially in the treatment of bone diseases.

The research also revealed that Antarctic Mumijo has a composition similar to non-fossil samples, with wax esters dominating. Additionally, components such as cholesterol esters were not detected, and monoalkyl glycerol ethers, especially alkyl diacylglycerols, became the major components. The pharmacological activities of these components, including antimicrobial, tuberculostatic, and protection against radiation diseases, provide a basis for the medical application of Mumijo in Oriental medicine, such as for wounds, skin diseases, tuberculosis, and respiratory diseases.

Recent findings indicate that Antarctic Mumijo is rich in α-glyceryl fatty alcohol ethers, which have neuroprotective potential. This data creates

opportunities for the treatment of neurological diseases, modulation of nerve inflammation, and neuroprotective actions in Parkinson's and Alzheimer's diseases. Overall, Antarctic Mumijo offers biomedical potential through its organic components, including wax esters and glycerol ethers, which demonstrate neuroprotective activity and potential benefits in the fields of bone health and antimicrobial properties.

REFERENCES

Aiello, A., Fattorusso, E., Menna, M., Vitalone, R., Schröder, H. C., & Müller, W. E. (2011). Mumijo traditional medicine: fossil deposits from antarctica (chemical composition and beneficial bioactivity). Evidence-based complementary and alternative medicine : eCAM, 2011, 738131. https://doi.org/10.1093/ecam/nen072.

Aristotlelis. (1961). Aristotelis Opera ex recensione Immanuelis Bekkeri. In: Bonitz H, editor. Index Aristotelicus. Berlin, 1870. Berlin, Germany: de Gruyter; pp. 223–259.

Federal Institute for Geosciences and Natural Resources (GBR). (2021). Antarktis__Projekte. Themen. Citited : http:// www.bgr.bund.de/ cln_011/ nn_322990/ DE/ Themen/ MeerPolar/ Polarforsch-ung/ Projekte/ Antarktis__Projekte/GEOMAUD.html

Garedew A, Feist M, Schmolz E, Lamprecht I. (2004). Thermal analysis of mumiyo, the legendary folk remedy from the Himalaya region. Thermochimica Acta.417(2):301–309.

Müller WEG, Batel R, Schröder HC, Müller IM. (2004). Traditional and modern biomedical prospecting: I. The history. Sustainable exploitation of biodiversity (sponges and invertebrates) in the Adriatic Sea at Rovinj (Croatia) Evidence-Based Complementary and Alternative Medicine.1:71–82.

Schepetkin IA, Khlebnikov AI, Ah SY, et al. (2003). Characterization and biological activities of humic substances from mumie. Journal of Agricultural and Food Chemistry. 51(18):5245–5254.

Warham J, Watts R, Dainty RJ. (1976). The composition, energy content and function of the stomach oils of petrels (order, procellariiformes) Journal of Experimental Marine Biology and Ecology. 23(1):1–13.