The Efficacy And Benefits of Earthworm Extract as A Herbal Medicine: A Literature Review

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Abstract

The role of herbal medicine in patients with chronic diseases is as a supplementary treatment. Some issues that may arise include the high cost of medications and potential side effects, considering that the treatment for chronic diseases is typically long-term. Approximately 7,000 earthworm species are found worldwide, with the majority originating in the Middle East, Europe, and Asia. Earthworms play a crucial role in traditional Chinese medicine, boasting a history of extensive use spanning thousands of years. Earthworms have been utilized as medicine for centuries to treat various diseases. Their presence deserves critical attention in analyzing the nervous, immune, and endocrine systems. The purpose of this research is to explore the potential of this earthworm extract in treating various diseases. The study design is a literature review. The process of data collection involved sourcing articles from three databases, namely Web of Science, PubMed, and Google Scholar. The search utilized the keywords "extract," "medication," and "earthworms." Inclusion criteria for the articles encompassed those published between 2000 and 2023. The results from several collected articles indicate that the benefits and efficacy of earthworm extract involve its role as an anti-diabetic agent and in the treatment of ischemic stroke. For typhoid fever, the use of earthworm extract is possible, but it depends on the method of earthworm extraction used.

Keywords: Earthworms; Efficacy; Medication; Herbal; Extract

1. Introduction

The role of herbal medicine in patients with chronic diseases is as a supplementary treatment. Some issues that may arise include the high cost of medications and the potential side effects, considering that the treatment for chronic diseases is typically long-term. Herbal medicines provide a solution to these problems as they are more affordable and have milder side effects (Hesti Mulyani and Sri Harti W., 2017)(Sumayyah and Salsabila, 2017).

People often utilize natural substances as traditional medicine. Earthworms, as a traditional remedy, have been used by the Chinese community for thousands of years (Ling, S and Gurupackiam, 2017). Cultivating earthworms is relatively easy, efficient, and inexpensive. Compost soil is the main

composition in the maintenance of these earthworms. The media required for breeding are diverse, including soil, cow dung, decomposed banana stems, and organic waste (Albanell E, Plaixats J, 2008).

Approximately 7,000 earthworm species are found worldwide, with the majority originating in the Middle East, Europe, and Asia (Stewart, 2004). Earthworms play a crucial role in traditional Chinese medicine, boasting a history of extensive use spanning thousands of years. While their significance has long been acknowledged, it is only in recent decades, coinciding with advancements in biochemical technologies, that research into the pharmacological effects of earthworms has gained momentum. Scientific studies have confirmed the medicinal potential of earthworms and their extracts. However, it is important to note that only specific earthworm species are deemed suitable for medicinal purposes (Ling, S and Gurupackiam, 2017).

Numerous research studies have been undertaken to substantiate the pharmacological activities of earthworm protein and its coelomic fluid. These investigations have revealed a diverse range of beneficial effects, including anti-inflammatory, anti-oxidative, anti-tumor, and antibacterial properties. The findings emphasize the potential of earthworm-derived substances in addressing various health issues, paving the way for the development of therapeutic applications in these areas (Balamurugan et al., 2009)(Qasim, Halimoon and Majid, 2013). The pharmacological effects of earthworms can be attributed to the presence of various active proteins and compounds. These include fibrinolytic enzymes, lumbrokinase, collagenase, superoxide dismutase, cholinesterase, catalases, glycosidases, metallothionein, calmodulin-binding protein, proteins with proliferation-improving activity, lysenin, antitumor proteins, and other bioactive substances. The diverse range of these components underscores the multifaceted nature of earthworms as a potential source of medicinal resources, with each playing a role in contributing to various pharmacological benefits (Li, Wang and Sun, 2011).

Earthworms contain nutritious elements, with the most significant being protein, ranging from 64% to 76%. Other contents present in earthworms include fat (7-10%), calcium (0.55%), phosphorus (1%), and crude fiber (1.08%). Enzymatic substances found in earthworms include peroxidase, catalase, cellulose, and lumbrokinase (Palungkun, 2006). Lumbrokinase from earthworm extract has been studied in the last few decades. Lumbrokinase consists of a group of bioactive proteolytic enzymes. Previous studies indicate that lumbrokinase has benefits as an anti-inflammatory, antioxidative, anti-fibrotic, antimicrobial, and anti-cancer agent. Lumbrokinase can dissolve fibrin clots by converting plasminogen into plasmin. Lumbrokinase is easily absorbed in the digestive system without disrupting normal metabolic processes (Sun, 2013).

In essence, earthworms are an economical medical resource that involves fewer ethical concerns. They have been utilized as medicine for centuries to treat various diseases. Their presence is deserving of critical attention in analyzing the nervous, immune, and endocrine systems. Therefore, a study was conducted to identify the potential herbal treatment for various curable diseases from earthworm extract, utilizing various findings and previous research sources (Ling, S and Gurupackiam, 2017).

2. Methods and Material

This study employs a literature review methodology. The process of data collection involved sourcing articles from three databases, namely Web of Science, PubMed, and Google Scholar. The search utilized the keywords "extract," "medication," and "earthworms." Inclusion criteria for the articles encompassed

those published between 2000 and 2023, presented as original articles, complete in text and openly accessible, utilizing quantitative research approaches, and not confined to specific regions or countries. The gathered data will undergo analysis, leading to the formulation of conclusions based on the findings.

3. Result and Discussion

Based from the gathered and analyzed articles, the findings are presented as follows

Table 1. List of articles

No.	Authors	Title	Method	Result
1.	(Jin et al., 2013)	Preparation of pegylated lumbrokinase and an evaluation of its thrombolytic activity both in vitro and in vivo	True Eksperimental	In this study, it was found that Lumbrokinase LK-mPEG-SC5000 significantly reduced the incidence of thrombus formation in mice in vivo compared to the control group ($p<0.01$).
2.	(Prayitno, 2002)	Testing the Effect of Earthworm Powder (Lumbricus Rubellus) Infusion on Blood Glucose Levels in Female White Rats with Hyperglycemia Due to Alloxan	True Eksperimental	In this study, it was found that Lumbrokinase LK-mPEG-SC5000 significantly reduced the incidence of thrombus formation in mice in vivo compared to the control group ($p<0.01$).
3.	(Veronica, 2002)	Testing the Infusion Effect of Earthworm Powder (Lumbricus Rubellus) at a Dose of 2g/kg BW on Blood Glucose Levels in Female White Rats with Alloxan-Induced Diabetes.	True Eksperimental	The findings from this research demonstrated a notable reduction in blood glucose levels. The contrast in the reduction of blood glucose between the control group and the intervention group with earthworm powder was 43.93%, and the p-value was below 0.05.
4.	(Nabani et al., 2023)	Testing the Effectiveness of Earthworm Extract (Lumbricus Rubellus) against Salmonella Typhi Bacteria, the Cause of Typhoid Fever	True Eksperimental	According to the linear regression analysis of the data, it can be inferred that both the decoction and infusion methods of earthworm (Lumbricus rubellus) boiled water extracts exhibit a highly significant impact ($r = 0.969$, $r = 0.917$) on the growth of Salmonella typhi bacteria.
5.	(Septianda et al., 2012)	Effect Of Earthworms (Lumbricus Sp.) Extract Antibacterial Activity Against The Bacteria Salmonella Typhii	True Eksperimental	The antibacterial activity against Salmonella typhii showed no effect when using earthworm (Lumbricus sp.) extract at a concentration of up to 3200 mg/mL.

Based on the table above, from the five research articles on earthworms, several benefits and related aspects of earthworms can be identified.

3.1 The Use of Earthworms as A Treatment for Ischemic Stroke.

The use of earthworms as a treatment for ischemic stroke is an interesting topic for research. Some studies indicate that certain compounds in earthworms have the potential to have a positive impact on ischemic stroke conditions. For example, some fibrinolytic enzymes in earthworms may play a role in reducing blood clot formation and improving blood flow to the affected area(Jin et al., 2013). Lumbrokinase exhibits a dual fibrinolytic effect, functioning both as an activator of plasminogen to trigger its activation and directly as a fibrinolytic agent, leading to the breakdown of fibrin and thrombus. Its main impact lies in the proteolysis of fibrinogen and fibrin, and it is recognized for its relatively challenging ability to hydrolyze other plasma proteins like plasminogen and albumin (Gayatri A, 2013).

Lumbrokinase exhibits potential for serving as both a fibrinolytic and antiplatelet agent in addressing various thrombotic diseases, as evidenced by several animal studies. In an initial investigation, Kim and colleagues administered Lumbricus rubellus earthworm powder orally to rat models with arteriovenous shunt, delivering doses of 0.5 grams/kgBW/day and 1 gram/kgBW/day over an 8-day period. The study concluded that the earthworm powder proved effective in preventing and/or alleviating thrombotic conditions. Similarly, Lee et al. conducted research comparing the antithrombotic and fibrinolytic effects of lumbrokinase SPP-501 (derived from the earthworm Eisenia andrei) with urokinase and t-PA in a rat venous thrombosis model. SPP-501 was administered orally once daily for 14 days at doses of 5, 15, and 45 mg/kg/day. At the study's conclusion, the results indicated reduced thrombus weight, shortened euglobulin lysis time (ELT), and inhibited platelet aggregation in animals receiving SPP-501 (Gayatri A, 2013).

The mechanism of lumbrokinase as an anti-ischemic agent in the brain has been studied in experimental animals. Research indicates that lumbrokinase's anti-ischemic activity is a result of its antiplatelet activity. This occurs by increasing cAMP levels and releasing calcium from intracellular calcium stores. Additionally, it exhibits antithrombotic activity by inhibiting the expression of ICAM-1 (Intercellular Adhesion Molecule-1) and antiapoptotic effects through the activation of the JAK1/STAT1 pathway (Janus Kinase-1/Signal Transducers and Activators of Transcription-1). Lumbrokinase is also suspected to have anti-inflammatory and antiplatelet effects. Its mechanism of action may resemble that of aspirin, inhibiting key enzymes, particularly cyclooxygenase-1 (COX-1), thereby preventing the formation of thromboxane A2. Thromboxane A2 is a potent compound causing vasoconstriction and platelet aggregation, ultimately forming a platelet plug to stop bleeding (Gayatri A, 2013).

3.2 The Use of Earthworms as A Treatment for Diabetes.

According to the phytochemical testing conducted by Ling and Gurupackiam in 2017, earthworm powder is found to contain phenols, terpenoids, glycosides, and flavonoids. These compounds are known as antidiabetic agents and have positive effects as antidiabetic agents (Ling, S and Gurupackiam, 2017). Terpenoids and flavonoids have the ability to inhibit the activity of enzymes that play a role in the sugar metabolism process. Specifically, terpenoids and flavonoids can biochemically inhibit the enzymes α-amylase and α-glucosidase. Both of these enzymes play a crucial role in the formation of sugar within the body (Chelladurai and Chinnachamy, 2018).

Various bioactive compounds, notably phenolics, triterpenoids, and flavonoids derived from diverse plant sources, have been documented for their hypoglycemic effects. These compounds exhibit a positive correlation as agents with antidiabetic properties (Tundis et al., 2010)(Brahmachari, 2011). In a separate investigation conducted by Hridi et al. (2013), it was found that ethanol extracts from Hiptage benghalensis, containing flavonoids and terpenoids, exhibited antidiabetic properties (Fakhar et al., 2013). Additionally, Pradeep (2013) noted that the ethanolic extract of Strobilanthes asperrimus leaves, rich in tannins, flavonoids, and alkaloids, displayed a significant potential for antidiabetic activity (Samal, 2013). These findings suggest that the inhibitory effect on α-amylase activity in Lumbricus rubellus extracts may be attributed to the presence of various phytochemicals such as flavonoids, steroids, terpenoids, and glycosides(Ling, S and Gurupackiam, 2017).

3.3 The Use of Earthworms as A Treatment for Typhoid Fever.

The findings of this study indicate that the earthworm (Lumbricus sp.) extract, at a concentration of 3200 mg/mL, did not exhibit antibacterial effects against Salmonella typhii bacteria. Several factors may contribute to this, including the extraction process of Lumbricus sp. earthworms, which could potentially lead to the deactivation or damage of active antibacterial compounds such as lysozyme, agglutinin, and lytic factor, isolated lumbricin. Another possibility is related to the extraction techniques employed by the researchers,

where the use of the whole body of the earthworm may have played a role in the observed outcomes (Septianda et al., 2012).

In various prior studies, differences in the minimum inhibitory concentration have been observed, stemming from the utilization of varied methods. This variability introduces bias for researchers in determining the minimum inhibitory concentration for their studies. For instance, a study conducted by Waluyo et al. (2007) demonstrated the antibacterial effect of earthworms against Salmonella typhii bacteria. The research involved protein fractionation of Lumbricus pheretima sp. in MOPS solvent through chromatography on DEAE proteins, resulting in three peaks. The third peak, representing a group of proteins, exhibited antibacterial activity. Further fractionation and chromatography of the active protein produced two peaks, with the second peak demonstrating antibacterial activity. This active protein from the second peak was then purified using Native-PAGE, leading to the identification of seven protein bands. Subsequent testing revealed that protein band no.6 exhibited antibacterial activity (Waluyo et al. 2007).

Before considering alternative treatments like this, it is essential to consult with healthcare professionals to receive tailored advice based on individual health conditions. This ensures safety and addresses potential interactions with any ongoing treatments.

4. Conclusions

Based on the identification of the five analyzed articles, there are several benefits and herbal therapies that can be obtained from earthworm extract. The potential benefits of earthworms include the treatment of ischemic stroke and diabetes, as well as potential applications in various other diseases that still need further research. The use of earthworms as a remedy for typhoid fever is still possible; from the published articles, it is known that earthworms have inhibitory effects on the bacteria that cause typhoid fever. However, other research findings indicate that inhibitory effects on bacterial growth may not always be present, depending on the extraction methods used.

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