Review article

The medical potentials of earthworm extracts and opportunities in Thailand

ศักยภาพทางการแพทย์ของสารสกัดจากไส้เดือนดินและโอกาสในการพัฒนาในประเทศไทย

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Abstract Earthworms play a crucial role in the decomposition of organic matter and enhancing soil fertility. Beyond their ecological benefits, recent studies have revealed the remarkable medical potential of earthworms. Bioactive compounds extracted from earthworms, such as enzymes, peptides, and proteins, have been demonstrated to possess a range of medical properties, including anti-inflammatory effects, antimicrobial activity, wound healing, and tissue regeneration. Moreover, these compounds have shown potential in treating cancer, cardiovascular diseases, liver diseases, bone regeneration, and neuroprotection against degenerative conditions. Given these properties, earthworms represent a valuable biological resource for the development of pharmaceutical treatments and therapeutic products for a variety of conditions, ranging from infectious wounds to chronic diseases. This article aims to compile and analyze relevant research to highlight the medical applications of earthworms, while proposing future research directions revealed that could lead to the sustainable development of medical products for use in Thailand.

***Keywords*:** Earthworms medicine, Bioactive compounds, Anti-inflammatory properties

บทคัดย่อ ไส้เดือนดินมีบทบาทสำคัญในการย่อยสลายอินทรียวัตถุและช่วยเพิ่มความอุดมสมบูรณ์ของดิน นอกเหนือจากประโยชน์ด้านระบบนิเวศแล้ว การศึกษาในปัจจุบันยังพบว่าไส้เดือนดินมีศักยภาพที่โดดเด่นทางการแพทย์ โดยสารออกฤทธิ์ทางชีวภาพที่สกัดได้จากไส้เดือนดิน เช่น เอนไซม์ เปปไทด์ และโปรตีน มีคุณสมบัติทางการแพทย์หลายประการ ได้แก่ ฤทธิ์ต้านการอักเสบ ฤทธิ์ต้านจุลชีพ การส่งเสริมการสมานแผล และการฟื้นฟูเนื้อเยื่อ นอกจากนี้ สารดังกล่าวยังแสดงศักยภาพในการรักษาโรคมะเร็ง โรคหัวใจและหลอดเลือด โรคตับ การฟื้นฟูกระดูก รวมถึงการปกป้องระบบประสาทจากภาวะเสื่อม ด้วยคุณสมบัติเหล่านี้ ไส้เดือนดินจึงเป็นทรัพยากรชีวภาพที่มีคุณค่าสำหรับการพัฒนายาและผลิตภัณฑ์เพื่อการรักษาโรคหลากหลายประเภท ตั้งแต่บาดแผลติดเชื้อไปจนถึงโรคเรื้อรัง บทความนี้มีวัตถุประสงค์เพื่อรวบรวมและวิเคราะห์งานวิจัยที่เกี่ยวข้อง เพื่อแสดงให้เห็นถึงศักยภาพและการประยุกต์ใช้ไส้เดือนดินทางการแพทย์ ตลอดจนเสนอแนวทางการวิจัยในอนาคตที่อาจนำไปสู่การพัฒนาผลิตภัณฑ์ทางการแพทย์สำหรับใช้ในประเทศไทยอย่างยั่งยืน

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INTRODUCTION

Terrestrial earthworms play a pivotal role in maintaining ecological balance, particularly through organic decomposition and soil enrichment. However, research over the past decades has revealed a transformative role for earthworms in medical applications, shifting from their traditional ecological functions. Numerous studies have identified bioactive compounds in earthworm extracts, such as enzymes, peptides, and proteins, which exhibit diverse medical properties, including anti-inflammatory, antimicrobial, wound healing, and immunomodulatory effects. Research by Wang et al. (2019) identified that enzymes like lumbricin and lysozyme in earthworm extracts effectively heal chronic wounds by inhibiting bacterial growth and promoting tissue regeneration.

Additionally, Luo et al. (2018) demonstrated that extracts from *Eisenia fetida* possess potent antimicrobial properties, inhibiting bacterial and fungal infections. Zhang et al. (2019) found anti-cancer properties in earthworm extracts, showing inhibition of stomach and intestinal cancer cell growth. Furthermore, Kang et al. (2018) revealed that hemolysin protein in earthworms could enhance blood circulation and prevent clot formation, highlighting its potential for treating cardiovascular diseases. For liver diseases, Li et al. (2020) reported that earthworm extracts aided liver regeneration in cirrhosis patients by promoting liver cell growth and reducing inflammation. Studies by Wang et al. (2021) also showed potential for scar treatment, promoting new skin cell formation and reducing scar irregularities, while Liu et al. (2019) highlighted that earthworm extracts stimulated new bone cell growth, beneficial for osteoporosis. In neuroprotection, Xu et al. (2020) reported that earthworm extracts protected neurons from inflammation and prevent neurodegeneration, especially in Parkinson's and Alzheimer's diseases. These bioactive compounds present in earthworms demonstrated potential for developing pharmaceutical products for diverse ailments, from infected wounds to chronic diseases and cancer. This review consolidated both domestic and international research to showcase the medical potential of earthworms and presented future research directions for further development.

Classification of Earthworms: The Key to Discovering Bioactive Compounds and Drug Development

Studying earthworm species is crucial in medical research, as each species exhibits distinct physiological traits and abilities to produce bioactive compounds. Understanding these species not only directs research accurately but also aids in selecting species with the highest therapeutic potential, such as anti-inflammatory, antimicrobial, and tissue regeneration properties.

In this section, the authors have summarized various earthworm species, which helps us understand the diversity and potential of each species in drug or medical product development. International studies highlighted the *Eisenia fetida* species from the Lumbricidae family, which has attracted particular attention due to its anti-inflammatory, antimicrobial, and tissue-regenerative properties, making it widely used for chronic wound healing and cardiovascular treatment in other countries (Domínguez et al., 2010).

In Thailand, the families Megascolecidae and Moniligastridae exhibit high biodiversity, with endemic species found in the genera *Pheretima* and *Drawida*, unique to Thailand and neighboring regions. These species serve as valuable biological resources for medical research as they may harbor bioactive compounds not yet explored in previous studies. Similarly, Megascolecidae, particularly the genera *Amynthas* and *Metaphire*, are significant in medical research. Species like *Amynthas aspergillum* and *Metaphire posthuma* exhibit enzyme and peptide production capabilities effective in treating inflammation and tissue regeneration, making these species valuable in therapeutic research (Blakemore, 2013; Domínguez et al., 2010). Table 1 summarized Thai earthworm families, genera, and associated medical research.

Table 1. Earthworms in Thailand by Family, Genus, and Related Medical Properties

Family	Genus	Species Found	Related Medical Properties and Research
Megascolecidae	*Amynthas*	*Amynthas aspergillum*, *Amynthas corticis*	Soil quality improvement and extraction of bioactives with anti-inflammatory and antimicrobial properties
Megascolecidae	*Metaphire*	*Metaphire posthuma*	Potential in extracting active compounds for therapeutic use
Lumbricidae	*Eisenia*	*Eisenia fetida*	Development for chronic wound healing and cardiovascular treatment
Lumbricidae	*Lumbricus*	*Lumbricus terrestris*	Studies in bioactive production and organic decomposition in soil
Moniligastridae	*Drawida*	Species in the *Drawida* genus	Found in high-moisture environments, potential for producing bioactives for infected wound treatment and tissue regeneration
Acanthodrilidae	*Dichogaster*	Species in the *Dichogaster* genus	Found in high-moisture soil; enhances soil fertility, researched for producing antifungal and antimicrobial compounds for medical use

Bioactive Compounds from Earthworms

The study of bioactive compounds from earthworms has garnered considerable attention in recent years due to the critical role these organisms play in organic matter decomposition and soil quality improvement. Additionally, earthworms have been found to be a valuable source of bioactive substances with significant medical potential, including enzymes, peptides, lysozyme, and proteins, which possess anti-inflammatory, antimicrobial, and tissue regeneration properties. Some widely studied compounds include Lumbricin I, a peptide with antimicrobial properties that inhibits bacterial and fungal growth, and lysozyme, an enzyme that destroys bacterial cell walls and protects against infections. Furthermore, antimicrobial peptides (AMPs) derived from earthworms demonstrated a high potential for inhibiting the growth of antibiotic-resistant bacteria, such as *Escherichia coli* and *Staphylococcus aureus*, and pathogenic fungi like *Candida albicans*, responsible for human infections. These characteristics make AMPs highly promising candidates for developing antimicrobial drugs for human infection treatment.

Hemolysin from earthworms has also been proven

to stimulate blood circulation and prevent blood clot formation, which is beneficial for treating cardiovascular diseases. Research has also highlighted the therapeutic effects of earthworm-derived bioactives on liver diseases by restoring liver function in cirrhosis patients and promoting new liver cell growth. Moreover, reports indicated that earthworm extracts could aid in scar and chronic wound healing by stimulating skin cell regeneration and reducing scar formation. This evidence supported the use of earthworm bioactives in developing future medical drugs and products, especially for infection treatment, inflammation prevention, and tissue regeneration. Ongoing research continued to explore the potential of earthworm-derived compounds for innovative medical applications (Luo et al., 2018; Wang et al., 2019; Li et al., 2020). Table 2 summarized bioactive compounds identified in earthworms and their respective medical properties.

Table 2. Bioactive Compounds and Medical Properties of Earthworms

Compound	Medical Property	Earthworm Species	Reference
Lumbricin I	Antimicrobial peptide inhibiting bacterial and fungal growth	*Lumbricus rubellus*	Wang et al., 2019
Lysozyme	Enzyme that destroys bacterial cell walls with antimicrobial properties	*Eisenia fetida*	Luo et al., 2018
Perionin	Antibacterial and antifungal peptide that enhances immune function	*Perionyx excavatus*	Zhao et al., 2017
Interleukin-1β (IL-1β)	Protein involved in immune response with anti-inflammatory effects	*Lumbricus terrestris*	Wang et al., 2017
Interleukin-6 (IL-6)	Immune stimulation and inflammation reduction	*Eisenia fetida*	Li et al., 2020
Transforming Growth Factor-beta	Promotes tissue regeneration and cell growth	*Pheretima aspergillum*	Kang et al., 2018
Tumor Necrosis Factor-alpha	Enhances immune response and inhibits cancer cell growth	*Eisenia fetida*	Zhang et al., 2019
Eisenin	Anti-inflammatory and antifungal peptide	*Eisenia fetida*	Luo et al., 2018

Metalloenzymes	Enzymes involved in protein and organic matter digestion	*Lumbricus rubellus*	Xu et al., 2020
Antimicrobial Peptides (AMPs)	Inhibits growth of microbes like *E. coli* and *S. aureus*	*Perionyx excavatus*	Yang et al., 2019
Hyaluronidase	Degrades hyaluronic acid in the skin, aiding wound healing	*Lumbricus rubellus*	Wang et al., 2021
Phosphatase	Decomposes phosphate compounds and promotes tissue regeneration	*Eisenia fetida*	Edwards, 2005
Lumbrokinase	Blood clot-dissolving enzyme that reduces blood viscosity	*Lumbricus rubellus*	Zhao et al., 2013
Chitinase	Degrades chitin with antifungal effects	*Perionyx excavatus*	Luo et al., 2018
Protease	Protein-digesting enzyme that aids tissue repair	*Eisenia fetida*	Li et al., 2020
Hemolysin	Stimulates blood circulation and prevents blood clots	*Lumbricus rubellus*	Kang et al., 2018
Fibronectin	Promotes tissue regeneration and wound healing	*Lumbricus rubellus*	Zhang et al., 2019
Collagenase	Collagen degradation for scar reduction	*Lumbricus rubellus*	Xu et al., 2020
Nitric Oxide (NO)	Vasodilator that reduces inflammation in blood vessels	*Eisenia fetida*	Li et al., 2020
Histamine	Enhances blood flow and vasodilation	*Lumbricus rubellus*	Yang et al., 2019
Glutathione	Antioxidant that protects cells from damage and reduces inflammation	*Perionyx excavatus*	Luo et al., 2018

Fibrinolytic Enzymes	Blood clot dissolution and prevention of vascular occlusion	*Lumbricus rubellus*	Wang et al., 2020; Sarker et al., 2017
Lubricin	Anti-inflammatory, used in arthritis treatment	*Eisenia fetida*	Zhang et al., 2019
Di Long	Respiratory anti-inflammatory, used in traditional Chinese medicine	*Pheretima aspergillum*	Li et al., 2018
Amino Acids and Proteins	Tissue repair and cell growth	*Metaphire posthuma*, *Amynthas* spp.	Rath et al., 2021; Thakuria & Yadav, 2020
Antimicrobial Compounds	Infection prevention and treatment	*Eisenia fetida*, *Lumbricus rubellus*	Lavelle et al., 2006; Oyeleke et al., 2020
Cellulase Enzymes	Aids digestion and tissue regeneration	*Perionyx excavatus*, *Metaphire posthuma*	Liu et al., 2017;
Antioxidants	Protects against oxidation, maintains tissue integrity	*Eisenia fetida*, *Lumbricus terrestris*	Santiya et al., 2023; Ghosh et al., 2022
Ferredoxin Enzyme	Enhances immunity and cell growth	*Amynthas* spp., *Metaphire posthuma*	Chan et al., 2019; Khan et al., 2019
Peptides and Glycoproteins	Anti-inflammatory, immune-enhancing	*Pheretima aspergillum*, *Eisenia fetida*	Zhang et al., 2019; Lavelle et al., 2006

Pharmacological Effects of Earthworm Extract (EE)

Earthworm extract (EE) exhibits multiple pharmacological properties, including antitumor, antithrombotic, antiviral, antibacterial, and anti-inflammatory effects. EE also promotes wound healing, reduces fibrosis, has antioxidant properties, helps regulate blood glucose, and demonstrates anti-aging effects. These bioactive compounds work through mechanisms that reduce the production of inflammation-inducing agents, inhibit cancer cell proliferation, stimulate new cell formation, and dissolve fibrin. This evidence supports EE's potential to be developed into therapeutic drugs for future applications (Zhao et al., 2017; Wang et al., 2020; Luo et al., 2018). Table 3 summarized the pharmacological effects observed in studies involving earthworm extract (EE).

Table 3. Pharmacological Effects of Earthworm Extract (EE)

Effect	Pharmacological Impact	References
Antitumor	Inhibits cancer cell growth, with compounds like Lombricine and G-90 inducing apoptosis in cancer cells	Zhao et al., 2017; Luo et al., 2018
Antithrombotic	Reduces platelet aggregation and fibrin degradation, decreasing vascular occlusions; particularly Lumbrokinase	Sarker et al., 2017; Wang et al., 2020
Antiviral	Reduces viral infection and replication, targeting viral membranes via Lysenin and Fetidin	Liu et al., 2017; Li et al., 2020
Antibacterial	Inhibits growth of gram-positive and gram-negative bacteria via compounds like Lumbricin-I and OEP3121	Yang et al., 2019; Ghosh et al., 2022
Anti-inflammatory	Decreases production of pro-inflammatory agents such as NO, PGE2, and TNF-α	Wang et al., 2020;
Antioxidant	Protects organs from oxidative stress and minimizes free radical damage	Prakash et al., 2018; Luo et al., 2018
Promoting Wound Healing	Accelerates wound closure and stimulates collagen production via compounds like G-90 and HSP70	Yang et al., 2019; Zhang et al., 2019
Anti-fibrosis	Reduces collagen accumulation and prevents fibrosis in organs	Xue et al., 2018
Antidiabetic	Inhibits enzymes DPP-IV and α-amylase to control postprandial glucose levels	Yoshii et al., 2018; Wang et al., 2020
Anti-aging	Slows skin aging and reduces wrinkles by inhibiting elastase, tyrosinase, and MMP-1	Prakash et al., 2018
Anti-ulcer	Decreases gastric acidity and prevents ulcers	Yang et al., 2019

Medical Potential of Earthworm Species in Thailand

Numerous earthworm species in Thailand exhibit significant potential for medical applications, especially those containing proteins and bioactive compounds with medical benefits. Notable species include:

1. *Lumbricus rubellus* (Red Earthworm): This species is well-regarded for its fibrinolytic enzymes, which help dissolve blood clots. Additionally, it possesses anti-inflammatory properties, making it a promising candidate for cardiovascular treatments and

inflammation reduction (Wang et al., 2020; Sarker et al., 2017).

2. *Eisenia fetida*: Commonly used for composting, this species has been studied for its proteins, which may aid in cell growth and tissue repair (Zhang et al., 2019).

3. *Pheretima aspergillum* (Giant Earthworm or "Di Long" in Traditional Chinese Medicine): Used in traditional Chinese medicine for respiratory issues like bronchitis and asthma, this species contains compounds that dissolve blood clots and improve blood circulation (Li et al., 2018).

4. *Metaphire posthuma*: This Thai earthworm species has been studied for its beneficial bioactive compounds, including enzymes that facilitate organic matter digestion and may possess therapeutic properties for specific diseases (Thakuria and Yadav, 2020).

5. *Amynthas* spp.: Found across Thailand, these earthworms are known for extracts with anti-inflammatory properties that aid in skin healing (Rath et al., 2021).

Additional species, such as the Blue and Tiger worms, also exhibit potential in medicine due to their bioactivity in organic matter decomposition and their unique compounds (Lavelle et al., 2006; Oyeleke et al., 2020).

International Research on Earthworm-Derived Therapeutics

Studies worldwide have identified earthworms as a valuable source of bioactive compounds for treating various medical conditions, as previously discussed. Research highlights the potential of earthworm extracts in treating heart diseases, liver ailments, skin conditions, bone-related disorders, and neurological conditions such as Alzheimer's. Key findings include:

1. Heart Disease: In China and Japan, studies on Lumbrokinase, an enzyme extracted from *Eisenia fetida* and *Lumbricus rubellus*, demonstrated its efficacy in dissolving blood clots, improving blood flow, and preventing vascular occlusions. Zhou et al. (1988) in China discovered that this enzyme could effectively treat cardiovascular diseases (Zhou et al., 1988; Ryu et al., 1994).

Table 4. Earthworm Species and Lumbrokinase Properties

Species	Bioactive Compound	Medical Application	References
Lumbricus rubellus	Lumbrokinase	Blood clot dissolution, vascular health support	Wang et al., 2020; Zhao et al., 2013
Eisenia fetida	Lumbrokinase	Clot prevention for cardiovascular and cerebrovascular health	Wang et al., 2020

2. Liver Disease: Research in the United States by Li et al. (2020) showed that earthworm extracts help regenerate liver cells in patients with cirrhosis by promoting liver cell growth and reducing inflammation, suggesting potential in future liver disease treatments (Li et al., 2020).

3. Skin Disorders: Earthworm extract has been utilized in studies focused on chronic wound healing

and scar reduction. South Korean research by Wang et al. (2021) found that earthworm extract stimulated skin cell growth and reduced scar formation while repairing tissue damaged by infections (Wang et al., 2021).

4. Hair Loss: Studies from South Korea demonstrated that earthworm extracts stimulated hair regrowth in animal models by enhancing blood circulation to the scalp and supporting hair growth in individuals with hair loss issues (Kang et al., 2018).

5. Bone Health: Research in China by Liu et al. (2019) reveal that earthworm extracts could aid in new bone formation in patients with osteoporosis, indicating potential in treating osteoporosis and other bone-related conditions (Liu et al., 2019).

6. Alzheimer's Disease: Studies in the United States and China suggested that earthworm extracts protected nerve cells from degeneration. Xu et al. (2020) found that these extracts reduced neuronal inflammation and cell death, showing promise in Alzheimer's and Parkinson's treatment (Xu et al., 2020).

7. Cancer: In the United States, Zhang et al. (2019) demonstrated that bioactive compounds in earthworm extracts inhibited cancer cell growth, particularly in gastrointestinal cancers like colorectal and gastric cancers. This research highlighted the potential for earthworm-derived compounds in developing cancer therapies (Zhang et al., 2019).

These findings underscored the medical potential of earthworms, extending beyond specific disease treatments to overall health improvement. Further research remained essential to confirm the efficacy and safety of earthworm extracts in treating various conditions.

Commercially Available Medications Derived from Earthworms

Earthworm-derived medications developed to treat various diseases exhibit diverse properties and are produced from different species depending on the intended therapeutic effects. For example, Lumbrokinase extracted from *Lumbricus rubellus* was used for cardiovascular diseases due to its ability to dissolve blood clots and prevent vascular blockages (Zhao et al., 2013; Wang et al., 2020). Earthworm Extract Powder from *Pheretima aspergillum* had anti-inflammatory properties and prevented liver cell degeneration (Li et al., 2018; Wang et al., 2017). For skin conditions, G-90, derived from *Eisenia fetida*, aided in wound healing, reduced inflammation, and prevented skin infections (Zhang et al., 2019; Sharma et al., 2012). Neuroearth, sourced from *Lumbricus rubellus*, supports nerve repair and reduces inflammation in neurodegenerative diseases like Parkinson's and Alzheimer's (Sarker et al., 2017; Wang et al., 2021). Pulmolong, extracted from *Pheretima aspergillum*, is used in treating chronic obstructive pulmonary disease (COPD) by expanding the bronchi and reducing respiratory inflammation (Liu et al., 2017; Li et al., 2020). These medications illustrated earthworms' potential in producing bioactive compounds beneficial for various medical fields, summarized in Table 5.

Table 5. Earthworm-Derived Medications and Their Medical Applications

Medication Name	Application	Source Species	Properties	References
Boluoke, Lumbrokinase	Cardiovascular disease	*Lumbricus rubellus*	Dissolves blood clots, reduces vascular blockages	Zhao et al., 2013; Wang et al., 2020
Pheretin, Di Long	Liver diseases	*Pheretima aspergillum*	Anti-inflammatory for liver, prevents liver cell degradation	Li et al., 2018; Wang et al., 2017
G-90, Earthworm Skin Care	Skin disorders	*Eisenia fetida*	Promotes wound healing, reduces inflammation and infection	Zhang et al., 2019; Sharma et al., 2012
Neuroearth	Neurological diseases	*Lumbricus rubellus*	Supports nerve repair, reduces inflammation	Sarker et al., 2017; Wang et al., 2021
Pulmolong, Di Long	Respiratory conditions	*Pheretima aspergillum*	Expands bronchi, reduces respiratory inflammation	Liu et al., 2017; Li et al., 2020



Figure 1. Lumbrokinase and Boluoke enzyme products derived from earthworms, used to treat vascular blockages.

Source https://m.media-amazon.com/images/I/516xAz6CpXL._AC_.jpg and https://canadarna.com/cdn/shop/products/Untitleddesign-2_1024x1024.png?v=1671177113



Figure 2. Di Long product derived from earthworm extract, used in liver disease treatment.

Source https://www.activeherb.com/img/products/single-herb-extracts/AH717E-dilong-910w.png and https://treasureoftheeast.com/cdn/shop/products/DiLong_800x.png?v=1604342795



Figure 3. Earthworm Skin Care product, formulated from earthworm extract for dermatological treatment.

Source https://www.trendifendi.com/wp-content/uploads/2024/07/Glucomend%E2%84%A2-Diabetic-Wounds-Treatment-Cream.webp

Prospects for Developing Earthworm-Derived Bioactives and Research Directions in Thailand

Research into earthworm-derived bioactives holds significant potential for developing therapeutic agents and medical products. Earthworms, essential in ecosystems for decomposing organic material and improving soil quality, are also a rich source of diverse bioactive compounds suitable for medical applications. These compounds, such as enzymes, lysozymes, peptides, and proteins, exhibit anti-inflammatory, antimicrobial, and tissue-regenerative properties, making them valuable for treating infected wounds, inflammatory conditions, and vascular diseases (Luo et al., 2018; Wang et al., 2019).

Developing these bioactives for medical use requires thorough investigation, with a primary step being the toxicological assessment of these compounds. In vitro assays, such as the MTT assay, help evaluate the effects on normal and cancerous cells, ensuring safety (Yang et al., 2019). Subsequent *in vivo* tests in animal models, like mice, assess systemic effects on organs, including the digestive, vascular, and immune systems, along with efficacy in wound healing and inflammation control (Kang et al., 2018).

Animal trials are also crucial in studying therapeutic impacts on diseases, such as using earthworm extracts for diabetic wound healing, where wounds often resist quick healing due to chronic infection. These trials are preliminary steps toward developing effective treatments for human diseases.

Human clinical trials remain essential to confirm the safety and effectiveness of earthworm extracts in treating various conditions. However, current limitations in Thailand's research highlight the need for continuous studies to validate findings from laboratory and animal models (Wang et al., 2021).

Establishing comprehensive scientific studies encompassing cellular, animal, and clinical testing forms a crucial foundation for the medical use of earthworm bioactives in Thailand. Further research and development of these bioactive compounds into practical medical products will elevate Thailand's capability to innovate safe, effective treatments for its population (Zhang et al., 2019).

Conclusion

This article underscores the potential of

earthworm-derived bioactives in medical research, particularly for their anti-inflammatory, antimicrobial, wound-healing, and tissue-regenerative properties. Studies also reveal the potential of earthworm bioactives in treating chronic diseases like cancer, heart, liver, bone, and neurodegenerative diseases such as Alzheimer's and Parkinson's. Given Thailand's rich biodiversity, the possibility exists for discovering new, yet-unstudied earthworm species with potent bioactives for sustainable drug development. Continuous research in this area is essential, as promising *in vitro* and animal studies require clinical trials to establish the safety and efficacy of these compounds in human applications. Further clinical research and systematic trials will enhance understanding of the medical potential of earthworm bioactives, paving the way for their application in human medicine.

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