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Earthworms Indirect Effect on Medicine – A Novel Concept

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Introduction

Since we began reporting on earthworms in medicine over half a century ago (Reynolds and Reynolds, 1972, 1979)[19, 20] and more recently (Reynolds and Reynolds, 2025)[21], we concentrated on direct effect of earthworms in medicine.

Early remedies in old Chinese volumes used species of *Amynthas* and *Pheretima* which they termed as “Dilong” [Emperor Dragon]. They ground up the earthworms and used them as antipyretics or antiaesthetics for a variety of ailments such as hypertension, arthritis, burns and inflammation (Huang, 1956)[5].

Gates (1926)[2] reported that earthworms were ground up into paste-like ashes and used as a tooth powder for something similar to pyorrhea (Ye se kun byoi, യെ സെ കുൻ ബൈ). He also stated that earthworms were boiled and decanted for postpartal weakness and difficulty in nursing an infant (maina meephwanoyeekhun thwaykhan).

Throughout the recent decades, earthworms were ground up as whole organisms or treated to provide extracts, for preliminary studies directly on animals and eventually humans (Gates, 1982; Wojdani et al., 1984; Li, 1988; Zhang, 1988, 1990; Mihara et al., 1991; Yadav and Singh, 2006; Shetty and Biadar, 2025)[3, 30, 7, 32, 33, 12, 31, 26].

In 2024[17], Reynolds suggested a new indirect method where earthworms might indirectly contribute to medical treatment, particularly in the spread of vectored diseases. For many years, the staff at the Oligochaetology Laboratory have pondered this question. The idea centers on destroying or disrupting the vector so the disease cannot spread.

The situation was considered for Lyme Disease because it is a growing problem in the Northern Hemisphere including Ontario where we are located (Figure 1).

Lyme Disease is a bacterial spirochete infection caused by *Borrelia burgdorferi*, and is transmitted to humans through the bite of an infectious blacklegged tick, *Ixodes scapuralis* (Figure 2).

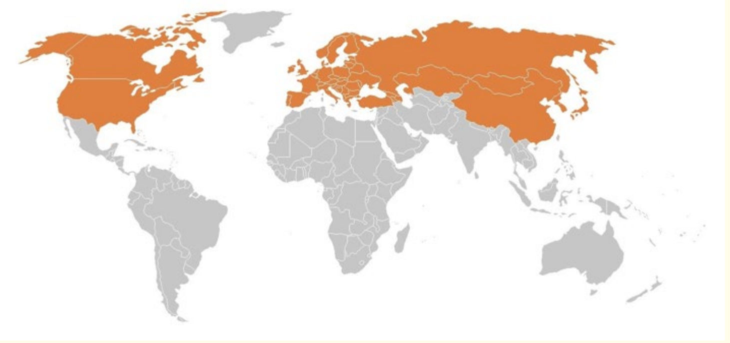

Figure 1: Global distribution of Lyme disease [■] (This image is licenced under creative commons attribution).

Figure 2: Adult *Ixodes scapularis* Say, 1821 also known as the blacklegged , deer or bear tick (Illustration by Iza Valle/Can Geo, from Reynolds, 2024[17]).

Adult black-legged ticks are in fact most active from fall to spring, often after the first frost. In the Northeastern United States and Canada, populations of these adult ticks start growing in early October and will remain active as long as the temperature remains above freezing and the ground doesn't freeze or become covered in snow. The advent of climate change could see their activity period eventually become year round.

Ixodes scapularis has a 2-year life cycle, containing three stages: larva, nymph, and adult (Figure 3). The tick must take a blood meal at each stage before maturing to the next. The tick females latch onto a host and drink its blood for 4-5 days. When the tick has consumed a blood meal, its abdomen is a light grayish-blue colour. The tick itself is naturally black when unfed (Ogden et al., 2006)[14]. Deer (*Odocoileus* spp.) are the preferred host of the adult tick.

After the female is engorged, she drops off and overwinters in the leaf litter of the forest floor. The following spring, the female lays several hundred to a few thousand eggs in clusters (Suzuki and Grady, 2004)]28]. Transmission of *Borrelia burgdorferi* between life stages is common. There is contrary opinion regarding transmission. Rollend et al., 2013)[22] based on their study, believe there is strong evidence that transovarial transmission is not by *B. burgdofferi*, but the antigenically and phylogenetic relative *B. miyamotoi*. Because of the tick's genetics, it is a successful vector of *Borrelia* by limiting the proliferation of the spirochaeta (Chou et al., 2014)[1].

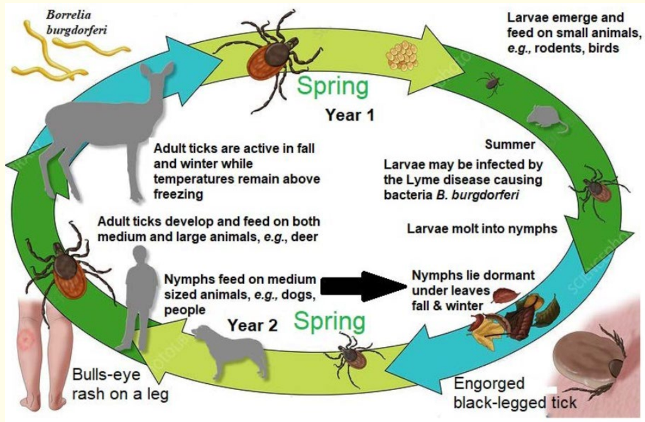

Figure 3: Life cycle of the tick *Ixodes scapularis* (➡ stage where life cycle could be broken by the action of earthworms) (modified from: Monica Schroeder/Science Source/Science Photo Library; Model release not required, Property release not required).

Our theory is, if you can stop the spread of the tick then you will stop the spread of Lyme Disease. Several plants act as tick repellents. If you want ticks to avoid your home, have these plants in your garden or along the periphery of your yard. Here are some of the more common plants used to repel ticks: Catnip (*Nepeta cataria* [9]), Chrysanthemum (*Tanacetum cinerariifolium*), Eucalyptus (*Eucalyptus* spp.) Garlic (*Allium sativum* [9]), Geranium (*Geranium* spp.), Lavender (*Lavandula spica* [9]), Lemongrass (*Cymbopogon* spp.), Marigold (*Tagetes* spp.), Pennyroyal (*Mentha pulegium* [9]), Rosemary (*Salvia rosmarinus* [27]), Rue (*Ruta graveolens* [9]), Sage (*Salvia officinalis* [9]), and Wormwood (*Artemesia absinthium* [9])[4, 24].

From the life cycle diagram (Figure 3), the stage where it can be disrupted is when the nymphs require a leaf litter to overwinter, e.g., suitable habitat with higher humidity and lower temperatures within the leaf litter, as well as protection from exposure over winter. If the litter is removed, this stage will not survive our current winters. One study indicated that removal of leaf litter (detritus and dead leaves) led to a 72%--100% reduction in ticks [24]. This works for residential property, but what about woodlands and ecotones that are too large and impractical for individuals'. Certain invasive European earthworms could solve this problem, particularly anecic and epigeic species which consume leaf litter e.g., *Aporrectodea longa* [29], *Lumbricus terrestris* [11], *Dendrobaena octaedra* [23] and *Dendrodrilus rubidus* [23].

Climate change has made it possible for the "Asian Jumping Worms" (AJW, the Megascolecidae pheretimoid species of *Amynthas*, *Metaphire*, *Pithemira*, etc.) to move northward from the southeastern United State to the American northeast and midwest and eastern Canada (Reynolds, 1978; Reynolds and McTavish, 2021; McAlpine et al., 2022; Moore and Reynolds, 2024) [15, 18, 11, 13].

Although these earthworms only live one season, their overwintering cocoons hatch in spring and rapidly develop into aggressive adults destroying the soil structure, the European earthworm species, and more important the litter layer essential for the overwintering tick nymphs (Figure 4). As shown in Figure 3, if you break the life cycle of the tick the vector for spreading Lyme Disease, the spread of the disease would stop. The AJW have the advantage for easy adaption in an area because their reproduction is pathenogenetic. Therefore, if a single worm or viable cocoon is introduced into an area, a population bloom will quickly follow. Currently, there is no chemical pesticide available for control, only laborious hand picking, which is impracticable in large areas.

Figure 4: Forest floor and plant community at base of trees before (A) and after (B) European earthworm invasion in a sugar maple-dominated forest (Chippewa National Forest, photo by Dave Hansen, University of Minnesota).

Even though earthworms could disrupt the life cycle of the tick vectors, it will probably be decades before the change in climate and the spread of litter-destroying earthworms will have any effect on the proliferation of tick-born diseases.

References

1. Chou S., et al. "Transferred interbacterial antagonism genes augment eukaryotic innate immune function". Nature 518.7537 (2014): 98-101.
2. Gates GE. "The earthworms of Rangoon". Journal of the Burma Research Society 25.3 (1926): 196-221.
3. Gates GE. "Farewell to North American Megadriles". Megadrilogica 4.1/2 (1982): 12-77.
4. Gebremedhin MB., et al. "Current knowledge on chemosensory-related candidate molecules potentially involved in tick olfaction via Haller's Organ". Insects 14.3 (2023): 1-15.
5. Huang H. "Ten key formula families in Chinese medicine". (transl. M. Max). Seattle, WA: Eastland Press (1956): 337.
6. Koffi JK., et al. "Passive surveillance for I. scapularis ticks: enhanced analysis for early detection of emerging Lyme disease risk". Journal of Medical Entomology 49.2 (2012): 400-409.
7. Li Y. "Influence of thrombosing on rabbit". Acta Chinese Medicine and Pharmacology 2 (1988): 46.
8. Lindström A and Jaenson TG. "Distribution of the common tick, Ixodes ricinus (Acari: Ixodidae), in different vegetation types in southern Sweden". Journal of Medical Entomology 40 (2003): 375-378.
9. Linnaeus C. "Species plantarum: Exhibens plants properly known to related genera, with specific references, trivial names, selected synonyms, native places, according to the sexual reproduction system". Volume I. Laurentius Salvius, Holmiae (1753): 560 pp.
10. Linnaeus C. "The system of nature through the three kingdoms of nature, according to classes, orders, genera, species with characters, differences, synonyms, places. Tenth edition, reformatted". Laurentius Salvius, Holms 1 (1758): 824 pp.
11. McAlpine DF., et al. "First reports of invasive earthworms (Oligochaeta: Megascolecidae) of Asian origin in Atlantic Canada". Bio Invasions Records 11.4 (2022): 830-838.
12. Mihara H., et al. "A novel fibrinolytic enzyme extracted from the earthworm, Lumbricus rubellus". Japanese Journal of Physiology 41 (1991): 461-472.

13. Moore J-D and Reynolds JW. “First mention of exotic Asian earthworms in the Quebec Province, Canada”. BioInvasions Records 13 (2024): 1–8.
14. Ogden NH., et al. “The emergence of Lyme disease in Canada”. Canadian Medical Association Journal 180.12 (2009): 1221-1224.
15. Reynolds JW. “The earthworms of Tennessee (Oligochaeta). IV. Megascolecidae, with notes on distribution, biology and a key to the species in the state”. Megadrilogica 3.7 (1978): 117-129.
16. Reynolds JW. “Current status of Asian pheretimoid earthworms (Oligochaeta: Megascolecidae) in Canada”. Megadrilogica 28.1 (2023): 1-20.
17. Reynolds JW. “Could earthworms reduce the spread of tick-borne diseases like Lyme Disease?” International Journal of Current Research in Science, Engineering and Technology 7.2 (2024): 51-50.
18. Reynolds JW and McTavish MJ. “New Asian pheretimoid “jumping earthworm” records (Oligochaeta: Megascolecidae) in Canada”. Megadrilogica 26.7 (2021): 83-89.
19. Reynolds JW and Reynolds WM. “Earthworms in medicine”. American Journal of Nursing 72.2 (1972): 1273.
20. Reynolds JW and Reynolds WM. “Earthworms in medicine”. The Vermiculture Journal 2.1 (1979): 6-7
21. Reynolds JW and Reynolds WM. “Earthworms (Annelida: Oligochaeta) as Medicine: A Meta-analysis”. PriMera Scientific Surgical Research and Practice 5.4 (2025): 05-09.
22. Rollend L, Fish D and Childs JE. “Transovarial transmission of Borrelia spirochetes by Ixodes scapularis: A summary of the literature and recent observations”. Tick and Tick-borne Diseases 4(1-2) (2013): 46-51.
23. Savigny JC. “Analyses of the work of the Royal Academy of Sciences during the year 1821, In: physical part”. Cuvier, M. le Baron G. (ed.) Memoirs of the Academy (royale) of Sciences of the (imperial) Institute of France 5 (1826): 176-184.
24. Schulze TL, Jordan RA and Hung RW. “Suppression of subadult Ixodes scapularis (Acari: Ixodidae) following removal of leaf litter”. Journal of Medical Entomology 32.5 (1995): 730-733.
25. Selles SMA., et al. “Acaricidal and Repellent Effects of Essential Oils against Ticks: A review”. Pathogens 10.11 (2021): 1379.
26. Shetty A and Biadar PM. “Evaluation of the wound healing activity of the epigeic earthworm, Eisenia fetida extract”. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences (2025).
27. Skotarczak B. “The role of companion animals in the environmental circulation of tick-borne bacterial pathogens”. Annals of Agricultural and Environmental Medicine 25(3) (2018): 473-480.
28. Suzuki D and Grady W. “Tree: A life story”. Greystone Books, Vancouver (2004).
29. Ude H. “On the dorsal pores of Terricolen oligochaetes, with contributions to the histology of the Liebera tube and to the systematics of the Lumbricidae”. Journal of Scientific Zoology 43 (1885): 87-143.
30. Wojdani A., et al. “Mitogenic effect of earthworm (Lumbricus terrestris) coelomic fluid on mouse and human lymphocytes”. Immunobiology 166.2 (1984): 157-167.
31. Yadav S and Singh VK. “Need for organic farming in cultivation of medicinal crops in India”. In: Recent Progress in Medicinal Plants-Biopharmaceuticals. Stadium Press, Houston, TX (2006): 833.
32. Zhang F. “Killing sperm and its effective ingredients”. Journal of Shanxi Traditional Chinese Medical College 11 (1988): 30.
33. Zhang L. “Pharmacological study and clinical application of earthworm”. Fujian Journal of Traditional Chinese Medicine 2 (1990): 52.