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Introductory Chapter: Back to the Future - Solutions for Parasitic Problems as Old as the Pyramids

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Additional information is available at the end of the chapter

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1. Introduction

Parasitology is an interesting field of biology, and parasites have been the subjects of some of the most exciting discoveries among infectious diseases. A parasite is an organism that lives on or in a host organism and acquires its food from or at the expense of its host. There are three main classes of parasites: protozoa, helminths, and arthropods. All through history, the worldwide prevalence of selected parasitic diseases shows that there are more than enough existing infections for every living person to have one. Some serious parasites such as malaria, schistosomiasis, and African sleeping sickness have forward incalculable millions to their graves. In company with their bacteria, fleas destroyed a third of the European population in the seventeenth century [1].

Silently suffering, domesticated animals [2, 3] and birds [4, 5] are subject to a wide variety of parasites often in greater numbers than in humans for the reason that they are usually confined to the same pastures, pens, or farms, so that the infective stages of parasites turn out to be exceedingly dense in the soil, and the burden of parasites within each host grows to be overwhelming. Moreover, most wild animals can tolerate their parasite burdens fairly well, but crowdedness and malnutrition could subject infected herds to quick extinction unless a means of control of their parasites can be established in the near future [1].

Some other problems include food-borne illness and zoonosis, any disease or infection that is naturally transmissible from vertebrate animals to humans and vice versa, such as trichinosis, echinococcosis, and toxoplasmosis [6–9]. Furthermore, new zoonoses were recognized from time to time; Lyme disease, a bacterial infection transmitted by ticks, was long present in deer and white-footed mice, but recurrent transmission to humans was revealed in the 1970s [1]. Toxoplasmosis, a protozoan parasite transmitted by cats, increases rates of suicides and car accidents and leads to changes in personality profile exaggerated by schizophrenia; cultural

changes could occur in populations where this parasite is very common, owing to mass personality modification regarding cultural aspects related to ego, work, rules, money, and material possessions [10].

2. Global burden of parasitic infection

Parasites bring about chronic debilitating, periodically disabling disease, are responsible for the overwhelming financial loss. In situations where it is prevalent, the number of hours of productive labor lost multiplied by the number of sufferer's yields a figure that can be charged as a loss in the manufacture of goods, in the production of crops, or in the earning of a gross national product [1]. Studies of 2010 and 2013 are enormous indicating that 832,900 yearly death estimates for parasitic infection including malaria, 584,000; cryptosporidiosis, 100,000; amebiasis, 55,000; leishmaniasis, 51,600; schistosomiasis, 11,700; Chagas disease, 10,300; cysticercosis, 1200; and food-borne trematodiasis, 7000. The human population experienced a full amount of 2.5 billion Disability Adjusted Life Year (DALYs) in 2013, which is a large number of suffering but represents a significant reduction, ~25%, since 1990. DALYs are nearly the sum of Years of Life Lost (YLL) by the reason of premature mortality and Years Lost due to Disability (YLD) for people living with a health condition or its consequences [11].

3. Man-made problems

Without recognizing the ecological and environmental consequences, favorable conditions for parasites had been created, for instance, millions of people, especially children, die each year from preventable diseases through proper sanitation facilities. Urbanization is another problem as population shifts from rural to urban areas and high population densities commonly overload water and sewage capabilities of even major cities. Nightsoil (manure) is often used as fertilizer on food crops usually aggravates parasitic problems. Moreover, there are several examples of national and international efforts to enhance productivity and standard of living in less-developed countries that inadvertently increased parasitic diseases. Despite opposite advice from their own agricultural experts, The World Bank loaned the government of Brazil funds to pave highways into the Amazon region to inhabit poor urban workers for farming. As a consequence, the prevalence of malaria increased and spread to new foci when the migrants returned to the cities after their farms failed. Smaller dams for drainage and agriculture have promoted transmission of schistosomiasis, onchocerciasis, dracunculiasis, and malaria. In the same token, construction of the Aswan High Dam, an embankment dam built across the Nile, between 1960 and 1970, on the Nile River to control floods, provides water for irrigation and generates hydroelectricity, which is pivotal to Egypt's industrialization, resulted (unfortunately) in increased schistosomiasis in Egypt [1]. The unauthorized introduction of crayfish to the Nile Delta, Egypt, controlled snails biologically and broke the life cycle of *Schistosoma* spp.; however, it has helped in the decline of local fish populations (personal communication with Prof. Dr. Adel Shaheen, Department of Fish Diseases and Management, Benha University, Egypt).

4. Looking back for going full speed ahead

As the purpose of our book is to dig deeply and smoothly for the current alternative antiparasitics, it is wise to look back for ancient and traditional solutions to get the most of them and to go full speed ahead. In fact, many of the important parasites encountered today not only existed but were widespread in their distribution before written records began, and our early ancestors must have been aware of the presence of the largest and most common worms and of some of the diseases caused by parasites. Humans created high cultures in all continents, such as the peoples of the Egyptians, Sumerians, Babylonians, Mongolians, Chinese, Mayas, Aztecs, Incas, and so on. Medicinal plants had been time-honored everywhere and upgraded from generation to generation orally or through written documents (e.g., on dried/fired clay plates, papyrus), which was lost during wars and/or at the fall of high cultures after centuries of Excellency, so that only portions of all knowledge were retained until today.

Being the cradle of civilization, Ancient Egypt became synonymous with power, wealth, and technological advancement. I prefer taking about Ancient Egyptian Medicine, not only because I am very proud to be one of their ancestors and enthralled by eco-friendly alternatives in the interim but also because a great part of their stories are well documented and preserved, and they gave us the ever-standing pyramids, the mummies, the first solar calendar, hieroglyphics, and many more. Although abundant on historic ruins, the writings of Egyptians themselves were virtually indecipherable until the Rosetta stone was discovered in 1799 during Napoleon's conquest of Egypt. This basalt Stela bore a tribute to Ptolemy V (196 B.C.) carved in hieroglyphics and repeated in demotic, or simplified, characters, and also in Greek, providing Jean-Francois Champollion necessary keys to decipher the language [12]. It is said that when the young Frenchman realized the value of such stone, he fainted.

The credit should be given to Champollion for opening doors to a wider understanding of Ancient Egypt. So set back and be ready to travel back to ancient time, to hear the voices from the past, from the land of legend and mystery, known as "*The Mother of the World*," we have a story to tell. Set against the exotic backdrop of the Egyptian desert, the Step Pyramid of Djoser hearken our memories back to the days of pharaohs. The wind whispers to you some of the Egyptian secrets. The Step Pyramid was the first monumental stone building constructed in Egypt in the Third Dynasty by Imhotep (/im'houtep/), means the one who comes in peace and he served as the Vizier of Djoser during the 27th century B.C. Ancient Egyptian medicine dates back to the days of Imhotep, the earliest known physicians, architects, and engineers [13].

5. Ancient Egyptian medicine

Ancient Egypt was not exclusively characterized by the construction of giant pyramids but as an epitome of medical knowledge that had a profound impact on Greek medicine and subsequently spread worldwide. If you were sick during the time of the pharaohs, no worries! There was a specialist doctor for your illness and the credit is given to Imhotep who diagnosed and treated well over 200 diseases that dealt with the abdomen, rectum, bladder, eyes, and more. He is known to have practiced surgery as well as dentistry. The Edwin Smith

Papyrus (carries the name of the man who purchased it from an Egyptian dealer in 1862) is the only medical papyrus of its time to reflect a scientific approach to medicine. Many Egyptologists credit the text to Imhotep, albeit he lived one millennium earlier, as the Papyrus is believed to be based on texts written earlier than 1600 B.C. [13].

To see the full vivid picture, the ancient Egyptians were very clean people who loved life and wanted to live their lives free of disease and pain. They bathed and purified their bodies often and shaved their body hair. Amusingly, they believed that human body consisted of passages that behaved like irrigation canals. When such canals became blocked, the person became sick. Therefore, they practice medicine in health and in sickness for preventative and curative health care. The first school dedicated to medicine dates all the way back to Egypt's first dynasty. Physicians studied at schools called "*The House of Life*," and they were dedicated to one disease or one part of the body, and Egyptian doctors were everywhere. They were highly advanced in their awareness of the human body, suffering, and sickness; even the Greeks were green with envy of their expertise [13]. Proceeding their age, they designed the enema when they noticed the bird *Ibis* filling its beak with water and then injecting the water through its anus to wash its intestine. They also administered medications, with recommended doses, in the form of pills, cakes, suppositories, ointments, drops, gargles, fumigations, enemas, and baths. In addition, the liquid vehicles were water, milk, beer, and wine, each sweetened with honey, and the ingredients were expected to remedy a variety of problems and control flies and other insects as well [12].

Enchantingly, the green color used in eye makeup probably came from copper salts, which have an antiseptic effect, but whether they were effective inadvertently in preventing or treating the eye infections common in Egypt cannot be ascertained. Copper preparations, interestingly, are the main agents of the present century against trachoma [12], the world's leading cause of preventable blindness of infectious origin caused by the bacterium *Chlamydia trachomatis*, spread through direct personal contact, shared towels and cloths, and flies. This progressive culture was the perfect stage for innovative remedies as herbs (discussed briefly later on), minerals, metals, and oils. The Egyptian pharmacopeia included antimony, copper, salt, alum, carbon from charred wood, iron (possibly from meteorites), natron, malachite, desert oil, red ochre, and animal remedies, such as honey, white oil, ox fat, and goose fat [14].

6. Old and current: parasitic problems as old as pyramids

Illness is not a new thing, and sufferings and losses due to parasitic diseases are old as the Egyptian pyramids (**Figure 1**). Ancient Egyptians were aware of the impact of the environment on the everyday life, especially the River Nile (called *H'pī* or *Iteru*, meaning "river" and also called *Ar* or *Aur*, means "black," in reference to the black silt left behind after the yearly flooding), which is the longest river in the world approximately 4258 miles (6853 km) long and got its name from the Greek word "*Neilos*", means valley. Such a great river is a pleasant place to start in considering the health of the Egyptians, as the Nile is, the everlasting, the life- and health-giving source of water for drinking, cooking, washing, irrigation, and trading, till the degree that the negative confession said "*I have never stopped [the flow of] water*". By the way, there is a traditional Egyptian proverb says "*Once you drink from the Nile, you are destined to return*". In contrary, the other side of the story indicated that the Nile River, like other rivers, harbors parasites and other creatures that lead to illness [15], such as bilharziasis, filariasis, and



Figure 1. Solutions for parasitic problems as old as the Egyptian pyramids.

malaria. Before we proceed, it is worth to mention that many of the pharaoh's written orders that urged farmers to combat pests and protect the environment from pollution. Consequently, Egypt was one of the first countries that paid special attention to environmental problems and its impact on the individual who is considered the most important wealth. The Egyptians did not like pests which plagued them but accepted them as a legitimate part of creation;

*Who creates that on which the mosquito lives,
worms and fleas likewise,
who looks after the mice in their holes
and keeps alive the beetles in every timber.*

From the Hymn to Amen-Re, c.1600 BCE

After Jan Assmann

Ägypten - Theologie und Frömmigkeit einer frühen Hochkultur, p.73

6.1. Bilharziasis (aaa)

Schistosoma spp., the most famous trematode, has ancient roots in Egypt. Since the discovery of calcified *Schistosoma haematobium* eggs in a mummy by Ruffer [16] in 1910, *Paleoparasitology*, the study of parasites from the past and their interactions with hosts and vectors, has evolved. People waded through standing water, for the most part in the agricultural irrigation channels; parasites such as the *Schistosoma* infective stage could enter a human host, through feet or legs, and then lay eggs in the bloodstream. These worms caused a lot of damage as they traveled through various internal organs, bringing about sufferers weak and susceptible to other diseases [15]. Being experienced with bilharziasis, and called it "aaa," ancient Egyptians mentioned it 28 times in the Ebers, Berlin, Hearst, and London papyri. Ebers 62 says the disease is caused by *harrart* (*cercaria*). This is a parasitic worm with a complex life cycle alternating between two hosts, humans and that live on riverbanks [14]. This would explain the sentence by someone who, aware of the mode of infection, said, "I have not waded in the water" [17], as is reported in the negative confession in Chapter 125 of the Book of the Dead.

Paul Ghalioungui (1908–1987), born in Mansoura, Egypt, to a Greek Orthodox family, is famous for being an Egyptian endocrinologist, historian of Egyptian medicine, Egyptologist, and an authority on Pharaonic medicine; he wrote a vivid history of Egyptian medicine in several languages such as English, French, Arabic, German, and Spanish [18]. According to Ghalioungui [19], the male adult worm is 1 cm and the female double this length but much thinner than the male. In order to see the worms, it is essential to dilute the blood in water before clotting. A magnifying lens is considered crucial. Even though there is no proof that such lenses existed at that time, Elseesy [20] mentioned that the ancient Egyptians, who manufactured glass and fiberglass, also invented the magnifying lens. Elseesy opines that the penile sheaths are shown in some tomb murals, whether they were anticipated to prevent urination in water or to block the access of the parasite through the urethra, also have the same hygienic measures and effect. Schistosomiasis of the rectum is painful and may explain the high percentage of ancient Egyptian remedies for the anus. It is noteworthy here that the ancient Egyptians treated *aaa* with antimony chloride and such modern medicine up to about 40 years ago treated schistosomiasis using antimony tartrate [20]. **Table 1** presents more information about hepatoprotectives. Ancient Egyptians knew a lot of things about the *Schistosoma*'s mode of infection, symptoms, and, surprisingly, treatments. They should be giving the credit for such discoveries, *aaa*, but the credit is given in Egypt again but to Theodor Bilharz, a German physician stationed in Egypt and became the first chief of the surgery at the Kasr-el-Aini Medical School and Kasr El Aini Hospital of Cairo. In 1851, he formally discovered, during an autopsy, the causative agent of hematuria and linked the parasite to urinary schistosomiasis, and then he identified it as *Distomum haematobium*. By the way, Bilharz discovered, in Egypt and in the same year, the dwarf tapeworm worm *Hymenolepis nana* living in the small intestine of an Egyptian male. At the age of 37, Bilharz died in 1862 from complications of typhoid fever after return to Cairo from an expedition to Massawa, a city on the Red Sea coast of Eritrea. He is buried in Cairo leaving a great legacy as *Bilharzia* is another term for schistosomiasis and The Theodor Bilharz Research Institute (TBRI) in Giza, Egypt, is named in his honor. The mission of TBRI is targeted toward control, diagnosis, and management of endemic diseases particularly urinary and hepatic schistosomiasis and their complications.

6.1.1. An unforeseen solution of schistosomiasis

Having an ancient root in Egypt, there was a long history of schistosomiasis control. Although the Aswan High Dam, the extension of perennial irrigation, and the increase of the Egyptian population afforded conditions favorable for its transmission, the national schistosomiasis control program that was gradually expanded after 1918, together with increased awareness, urbanization, diversification of the economy, and the changes in the rural villages, resulted in the accelerating decline of schistosomiasis [21]. Traditionally, Egyptians were consuming chicory in large amounts; it has been discovered that it purifies the liver and the blood and it helps in case of schistosomiasis.

Biologically, the unauthorized introduction of the crayfish, *Procambarus clarkii* known as freshwater lobsters, to the Nile Delta for aquaculture is a significant feature during the early 1980s leading to shocking consequences. The crayfish rapidly spread, became invasive, and

colonized many areas. By 1996, it was estimated that 4.6 metric tons/year of *P. clarkii* could be harvested from the Nile; actually, crayfish could prey upon *Bulinus truncatus* and *Biomphalaria alexandrina* snails in the wild and was, therefore, likely a source of inadvertent biological control of schistosomiasis transmission [21]. Another biocontrol agent of nuisance snails in Egypt is the juvenile and adult black carp, *Mylopharyngodon piceus*, which is a species of cyprinid fish, feeding exclusively on snails. If you pass by a place having such fish, you will hear the sound of crushed snails; therefore, it is called “the snail carp” in Egypt.” Black carp is formally introduced in Egypt by the General Authority for Fish Resources Development for controlling the intermediate hosts for human parasites as *Schistosoma* spp. as well as parasites relevant to cultures of freshwater fishes (personal communication with Prof. Dr. Adel Shaheen, Department of Fish Diseases and management, Benha University, Egypt and an expert in Aquaculture and Fish diseases in the African Union AU-IBAR).

Thus, crayfish and black carp played a biological role in reducing transmission of schistosomiasis and enabling praziquantel, the drug of choice to treat patients from the 1980s onwards distributed and funded By U.S. Agency for International Development (USAID), to make a dent in the prevalence rates by reducing transmission and re-infection in the meantime. In contrary to the situation in most other African countries where rates have increased, there is, fortunately, a great decline in schistosomiasis rates in Egypt in recent decades due to the intensive schistosomiasis control and water supply programs [21]. Hopefully, similar control measures cover all *Schistosoma* infested regions.

6.2. Mosquito-transmitted diseases

6.2.1. Filariasis

Filariasis is transmitted by mosquitoes and defined by swelling and thickening of the skin. Lymphatic filariasis was common along the Nile. While there are no written records, the swollen limbs of a statue of the Egyptian Pharaoh Mentuhotep II from about 2000 B.C. suggest that he was suffering from elephantiasis [22]. Some tomb pictures of servants illustrate enlarged male external genitalia and examination of the scrotal skin from the Leeds mummy, Natsef-Amun, evidenced the existence of filarial worms [14].

6.2.2. Malaria

The presence of malaria in Egypt from circa 800 BCE onwards has been confirmed using DNA-based methods [23] and antigens produced by *Plasmodium falciparum* (causing tertian fever) in mummies from all periods were detected, and all mummies were suffering from malaria at the time of their death (Nunn, 1997: 73). Elseasy [20] comments that the vast areas of land covered with River Nile water in the form of lakes and canals were indeed good media for the diseases. Herodotus wrote that the builders of the Egyptian pyramids (circa 2700–1700 BCE) were given large amounts of garlic [17] probably to protect them against malaria. The Pharaoh Sneferu, the founder of the Fourth dynasty of Egypt, who reigned from around 2613 to 2589 BCE, used bed-nets as protection against mosquitoes and Cleopatra VII, the last Pharaoh of Ancient Egypt, similarly slept under a mosquito net [18]. Whether the

mosquito nets were used for the purpose of malaria prevention, or for avoiding the discomfort of mosquito bites, is unknown. The ancient Egyptians were using essential oils (having insect repellent effect) for medicinal benefits, beauty care, spiritual enhancement, and in literally all aspects of their daily life. More information about insect control is presented in Section 6.5 and **Table 1**.

Despite the African problems, Egypt, currently, almost eliminated malaria; there have been no cases of locally transmitted malaria in Egypt ever since June 14, 2014, because of the effort of The Egyptian Ministry of Health, local government, and health authorities who engaged in intensive malaria control activities in the affected areas as a village of Aswan Governorate, the latest appearance of malaria. They have recently completed active surveillance involving screening and treating, if needed, all villagers for malaria. Moreover, mosquito control activities have included entomologic surveillance, environmental management [23], and distribution of impregnated bed nets (personal communication with Prof. Dr. Azaa Abdel Fattah, Research Institute of Medical Entomology, Egypt, the authorized place doing the entomological part in malaria control).

6.3. Dracunculiasis

Confirmation of the presence of Guinea worm in ancient Egypt comes from the finding of a well-preserved female worm and a calcified worm in Egyptian mummies (205) [22]. The earliest descriptions of Guinea worms are from the Ebers papyrus from 1500 BC and include instructions for treating swelling in the limbs; they appear to refer to both the nature of the infection and techniques for removing the worm. Sometimes ancient Egyptians took in Guinea worms in their drinking water. The female worm would travel to the host's legs in order to lay her larvae, again causing ill health [15]. The solution is to wrap the exposed end of the worm on a stick and pulling it out. Amazingly, this remedy is still used nearly 4000 years later [13]. It worth mentioning that Dracunculiasis is not a problem in Egypt nowadays.

6.4. Enteric helminths

Enteric helminths were well known since ancient times. Evidence of eggs of the tapeworm, *Tenia* spp., was found in the mummy ROM (N AKHT) examined in Toronto, and roundworm infection was found in the mummy PUM II, unwrapped in the United States; the giant roundworm, *Ascaris lumbricoides*, is quite large and can be seen in stool. A piece of advice in Ebers Papyrus says that "Do not eat unless you have an appetite for food." Because they are very clean, externally and internally, Herodotus mentioned that Egyptians were accustomed to cleanse their bodies by having purgatives on 3 days every month to clean their intestines. They applied castor oil as a purgative (applied traditionally in Egypt) and also prescribed it for cases of diarrhea as the goal of therapy was to hasten expulsion of the causative agents of diarrhea [24]. More herbal treatments such as pepper, cardamom, cumin, anise, almond, chamomile, fenugreek (*Helba* in Arabic), barley, cumin, pine oil, pomegranate roots, and so on were used by ancient Egyptians [14]. They also used coriander and onions to help against problems of the digestive system. Powdered cumin mixed with

grease or lard was inserted as an anal suppository to disperse heat from the anus and stop itching; and leaves from many plants, such as willow, sycamore, and acacia, were also used [24].

For different gastrointestinal tract disorders, pomegranate and wormwood are well-known vermifuges in Egypt till now. It worth mentioning here that it is in Egypt where the first published studies have documented that traditionally used myrrh have molluscicidal effects on the intermediate hosts of trematodes as well as trematodicidal properties against *Fasciola*, *Dicrocoelium*, and *Heterophyes* spp. An Egyptian pharmaceutical company now produces a special myrrh preparation and markets it as gelatin capsules (Mirazid®) containing 300 mg of purified Commiphora (*Belsan* in Arabic) extract. The drug ameliorates all symptoms within a week and eliminates all worms within 4 weeks of treatment [25]. **Table 1** presents more information about anthelmintics, antidiarrheal, and laxatives.

6.5. Vermin

Ancient Egyptians suffered also from vermin (varmint or varmit), a plural noun means pests or nuisance animals, that spread diseases or destroy crops or livestock, till the degree of several plagues occurred during the time of Moses, such as plagues of locusts and lice infestations. The Ebers Papyrus mentions a few remedies against a number of pests. Generally speaking, tremendously clean people having rigorous notions of hygiene, the ancient Egyptians put remarkable effort and creativity into their battle against vermin.

6.5.1. Head lice

In response to the frustration and fear caused by lice, ancient Egyptians, men and women alike, typically kept their head shaved smooth. The beautifully lavish hairdos were usually wigs (an artificial covering of hair, and it was a fashion for the rich and the poor at that time), which control head lice in the mean time. Aromatic head louse formula includes one half-cup vinegar, one-half cup water, 12 drops essential oil of cinnamon, 12 drops essential oil of rosemary, and 12 drops essential oil of terebinth. Mix vinegar and water, add the essential oils and blend, and pour onto hair concentrating on areas near the scalp line, particularly near the ears and massage into the scalp. Comb thoroughly and very patiently with a fine tooth lice comb, rinsing or wiping the comb frequently. Even though head lice infestations are rare in the current decade, till the degree that the current youth know nothing about lice, Egyptians still prefer using what their ancestors did and use vinegar, essential oils, and fine-toothed comb for controlling head lice.

6.5.2. Fleas

In fact, a formula for driving vermin from homes has a modern ring as a solution of natron water was sprinkled to eliminate and repel fleas. It is worth mentioning that natron is a salt, and lavishly sprinkling carpets with salt and then vacuuming is a modern remedy against fleas [26].

Traditionally, Egyptians control insects through sprinkling fine salt over carpets or affected areas that dry out fleas as they walk over it and fleas will die over time. As fleas are attracted to light, a homemade light trap suspends a candle or a small light source over a shallow pan or bowl that is full of water and liquid soap. When fleas are attracted to light, they hop right into the bowl and drown. Having no idea about the synchronization phenomenon of flea occlusion, a pet (dog or cat) trap is also used to gather a huge number of fleas when introduced to a deserted house infested with fleas; then such pet was treated with essential oils or an insecticidal shampoo.

6.5.3. *Cowling Insects*

Some ancient Egyptian remedies for household pests include fumigation of the house with incense and myrrh and washing the house with a solution of natron or whitewashing the walls with *bebit* mixed with crushed charcoal. On the other hand, the traditional tricks of the Egyptians include adding bay leaves, as well as the tapering ends of cucumber to infested areas to repel roaches and ants. For killing any by-passing insects, (as fleas, bed bugs, cockroaches, ants, etc), vacuum the carpet and the floor, then mop them with water containing few drops of liquid soap (used for tiles, not dishes), a cup of vinegar, and a cup of kerosene. The odor of this mixture will disappear soon after aeration of the place; the result will surpass your expectations, the carpet, as well as the floor will shine again as new ones, and all crawling insects will die instantly. The other traditional solution is to fumigate the place with juniper for hidden creatures as bedbugs and rodents. To repel roaches and cloth-eating insects, dried levanter in small cloth buckets is added to wardrobe and naphthalene balls in semiopened small plastic bags, for nonstaining clothes, are added to the stored clothes.

6.5.4. *Other vermin*

Ancient Egyptians controlled the other vermin through fat of the oriole which is efficient in combating flies; fat of the woodpecker was used against fly stings; fresh palm wine would protect against gnats; loose ash spread around a grinding mill kills flour eating insects; natron, dried onion seeds or a dried Nile Tilapia were placed in front of the hiding hole of a snake to prevent it from leaving its lair; and fat of a cat spread on sacks and bundles keeps rats away, while grain is best protected from them by burning deer excrement. It worth to mention also that cats were being used by Ancient Egyptians to control rodents and protect grains; rodents were also hunted with ferrets and captured in traps [27]. Being praised for controlling vermin and its ability to kill snakes like cobras, the domesticated cat became an icon of grace and poise. More information was mentioned in **Table 1**. For repelling insects, rodents, and snakes, wormwood (*Sheeh* in Arabic) is the best traditional choice in Egypt by hanging small cloth pockets containing wormwood in the veranda, balcony, and plants to repel pests. Now, dear reader, I could expect that your feelings effortlessly came and went like clouds in a windy sky; therefore, could you please live in the moment, take a deep breath, and blow back after passing by your journey of the vivid story of the ancient and traditional Egyptian control strategies, as it is really time worthy to sharpen the saw and go full speed ahead for the best pest, vermin, control.

Target Effect	Used botanicals
Anthelmintics and vermifuge	Coriander; portulaca (<i>Regla</i> in Arabic); rue; lupinus (<i>Termes</i> in Arabic); sycamore fig (<i>Gemez</i> in Arabic); caper bush; carob (<i>Kharoob</i> in Arabic);,; dodder (<i>pond weed</i> or <i>Hamool</i> in Arabic), lettuce seeds; date palm; camel's hay (<i>Halfa br</i> in Arabic); parley for round worm; and juniper (<i>Arar</i> in Arabic) for tape worm. Some recipes include: coriander, sandal wood and anise; portulaca, cow milk, and honey as herbal tea for 3 days; 1 spoon of carob seeds, 1 spoon of asafoetida (<i>Halteet</i> in Arabic), 1 spoon of honey, 1 spoon of chuffa (groundnut or <i>Hab El Aziz</i> in Arabic), and one spoon of grape juice; small pieces of sycamore fig soaked in barley water; grape wine and frankincense for tape worm; 5 spoons of chuffa, 4 spoons of white oil and honey (used as a drink for one day); 5 spoons of artemisia (<i>Sheeh</i> in Arabic), 5 spoons of dodder, 20 spoons of barley water; and 12 gm of date palm seeds, 12 gm of carob and 25 table spoons of boiled barley. Moreover, the following recipe is used in case of worms and <i>Shistosoma spp</i> : equal amounts of <i>Ammi visnaga</i> (<i>Khela balady</i> in Arabic), Egyptian henbanes (<i>Hyoscyamus muticus</i> or <i>sakran</i> in Arabic), juniper, natron salt, pomegranate roots, and celery was used as herbal tea 3 times per day before meal.
Antidiarrheal (for dysentery)	Carob, pomegranate wine, tamarix (tamarisk, salt cedar), as well as herbal teas of the mixed ingredient as coriander, thyme and honey; and coriander, anise, and sandalwood.
Pesticides and repellents	Black peppercorns found in the nostrils of Ramses II for insect repellents; sulphurwort (<i>Al Qena</i> in Arabic) repel bed bugs; angelica fleas and ash were sprinkled as an insecticide and repellent; yellow sweet clover (yellow melilot) attract bees and repel cloth moth and garlic to repel snakes and scorpions. Some ingredients as myrrh, spartium (scoparius or <i>alretm</i> in Arabic), rosemary, mastic, gum, <i>aloe vera</i> , Bahia rosewood, wild celery, and cardamom were ground and mixed with honey and uses as incense for air and cloth freshener and insect repellent.
Eye preparations	Portulaca; rue (<i>Sezab</i> or <i>Harmal</i> in Arabic); chuffa; carob; tamarix
Topical preparations	For skin problems and scabies: turmeric lotion; <i>aloe vera</i> , caper bush; portulaca, lupines, chuffa, pomegranate peel tea, and castor seed oil.
Laxatives	Linseed, cress (<i>Rashad</i> in Arabic, used also as poultices) and sycamore fig (used also as antifatulent).
Hepatoprotectives	Chicory (<i>Hendbaa</i> , <i>Sen El Assad</i> or <i>Serees</i> in Arabic), turmeric, and olive oil. Equal parts of juniper, lotus, <i>Ziziphus spina-christi</i> (<i>sedr</i> in Arabic), and <i>Citrullus colocynthis</i> (<i>hanzal</i> in Arabic)
N. B. The other antiparasitics used by Ancient Egyptians were discussed in the text.	

Table 1. Some Antiparasitics used by Ancient Egyptians, Adapted from Abdel All [28].

7. No worries, Nature helps

Nowadays, farmers and growers are under huge pressure to decrease the use of chemical parasiticide without forfeiting yields or crop quality, in the mean time, parasitic control is becoming increasingly problematical due to the development of resistant populations and the decreasing availability of products. Substitutes for chemical control are needed urgently to be used as part of Integrated Parasite/Pest Management. Such *green movement* was the driving force to search for new environmentally compatible tools in the fight against parasites and vector insects because of the side effects of chemicals such as widespread of environmental contamination, toxicity to nontarget organisms, and negative effects on the health of humans and animals.

Biorational (biological and rational) parasiticides (**Figure 2**) are having limited or no adverse effects on the environment, nontarget organisms including humans. Such parasiticides, optimistically, are gaining popularity in the current climate of environmental awareness and public concern [29]. Biorationals include the following: biochemicals as botanicals [29–40], pheromones [29], photo insecticides [29, 41, 42], fatty acids [43], inorganics [44, 45], and insect growth regulators [29, 46]; biologicals, using competitors and natural enemies [29, 46] such as probiotics along with their prebiotics [47], parasitoids, predators, nematodes, and pathogens (virus, bacteria, fungi, or protozoa); and transgenic pesticides (genetically modified plants or organisms) [29, 46].

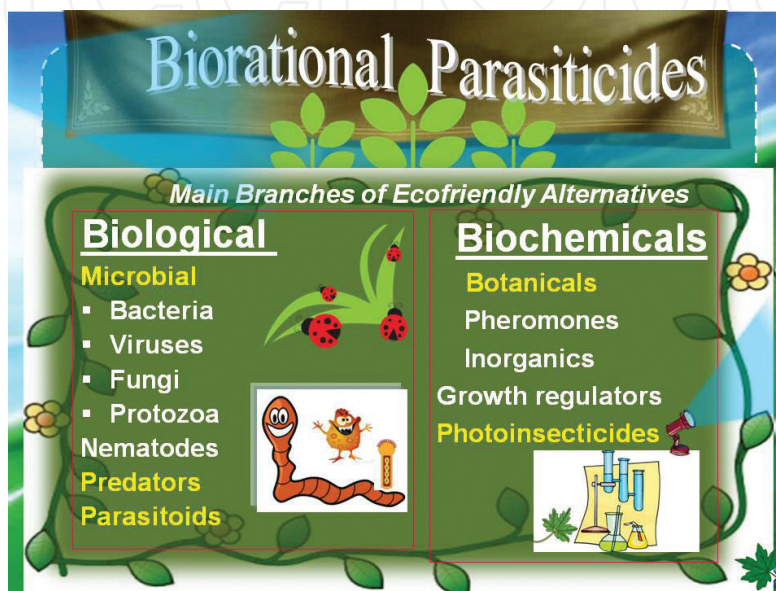


Figure 2. For fun and benefit, we should be ahead of parasites through using eco-friendly alternatives.

Nature is a smart skilled factory created to produce solutions to all our problems through an assortment of natural enemies and secondary metabolites produced by medicinal plants. Natural enemies take part in limiting potential parasite populations, and they are more likely to survive in the case of application of eco-friendly biopesticides [29]. Botanicals including plant extracts and essential oils are the most affordable tools [48, 49] for the poor and the rich since ancient times, as herbs constitute an alternative to conventional medicine in many developing countries. Ethnopharmacology can contribute to the exploration of phytotherapeutic resources for use in local contexts and countries of origin. Microencapsulation and nanotechnology include nanocapsules for vector and pest management and nanosensors for pest detection...etc [29] are used widely in agriculture and food plus their potential uses and benefits for parasite control are enormous as future trends [50–53]. Therefore, most biorationals will be straightforwardly thrashed out the whole time in this book.

8. For fun and Profit, we should be ahead of them

Parasites, from a biological perspective, are exciting, beautifully adapted, and complicated organisms. Recent decades witnessing emergence and re-emergence of disease agents, some

of which are parasitic or transmitted by arthropods. *P. falciparum*, the most dangerous species of malaria organism, has become drug-resistant in many parts of the world, and there are numerous reports of drug resistance in *P. vivax*. Unfortunately, most parasites developed resistance to one drug after another, and many other examples are discussed later on throughout your expedition in this book. Money for research on tropical infections is very scant because pharmaceutical companies are reluctant to spend money to develop drugs for treating people who cannot pay for them, and the less-developed countries have many other urgent financial [1] and security problems.

An important role of parasitologists, together with that of other medical disciplines, is to break the deadly cycle by contributing to the global eradication of major parasitic diseases and pests while making possible more efficient use of the earth's resources especially botanicals; see Khater [29, 48, 54] for more information about their safety, commercialization, resource availability, barriers to commercialization, improving the efficacy, and future trends. Besides having medical, veterinary, and economic importance, controlling parasites naturally is enthralling (fun), which could be pursued for natural and safe products (profit). Despite being smaller than us and exquisitely adapted for life on or within the body of another (bigger) organism, parasites are smaller than us, they are smarter than us as they develop resistance faster than our ability to develop new drugs. Therefore, we should be ahead of them and try to win the never-ending battle via searching for safe and complex alternatives that parasites cannot defeat. All our efforts will be fruitful only when enveloped with hard work and great patience plus passion and ended with profits planned from the far beginning.

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References

- [1] Schmidt GD, Roberts LS. Foundation of Parasitology. 8th ed. McGraw-Hill; 2009. 720p.
- [2] Ramadan MY, Khater HF. Prevalence of *Eimeria* species infecting goats in Kalubya governorate with trials of treatment by natural material (propolis) and toltrazuril. Egypt. Vet. Med. Soc. Parasitol. J. 2009; 5 (1): 1-10.
- [3] Ramadan MY, Khater HF, Abd EL Hay AR, Abo Zekry AM. Studies on parasites that cause diarrhea in calves. Benha Vet. Med. J. 2015; 29(1): 214-219.
- [4] Khater HF. Some studies on enteric helminth parasites of poultry [Thesis]. Benha Branch: Zagazig University, Egypt; 1993.

- [5] Ramadan MY, Khater HF, Seddiek SA, Abd El-Aty MA. Protozoal incidence in balady chicken flocks after viral vaccinations. *Benha Vet. Med. J.* 2015; **29**(1): 105-111.
- [6] Khalifa NO, Khater HF, Fahmy HA, Radwan MEI, Afify JSA. Genotyping and phylogenetic analysis of cystic echinococcosis isolated from camels and humans in Egypt. *Am. J. Epidemiol. Infec. Dis.* 2014; **2**(3): 74-82.
- [7] Khalifa NO, Khater HF, Nassief MZ. Genetic fingerprint of unilocular hydatidosis in Egyptian camels and humans using nested PCR. *Pak. Vet. J.* 2014; **34**(4): 522-526.
- [8] Ramadan MY, Desoky AF, Khater HF. Seroprevalence and preliminary treatment of toxoplasmosis of pregnant goats in Kalubya Governorate, Egypt. *Acta Sci. Vet.* 2007; **36**(3): 295-301.
- [9] Khater HF, Khalifa NO, Barakat AMA. Serological and molecular studies of ovine and human toxoplasmosis with a trial of treatment of infected ewes. *Sci. J. Vet. Adv.* 2013; **2**(11): 157-168.
- [10] Khater HF, Barakat AMA. Behavioral changes caused by toxoplasmosis (abstract). The Fifth International Conference of the Arab Society for Medical Research; 28-31 October 2016; Sharm El Sheikh, Egypt; 2016.
- [11] Global Burden of Parasitic Disease. [Internet]. Available from: <http://faculty.ucmerced.edu/kjensen5/index.php/research/global-burden-of-parasitic-disease/> [Accessed: 2016-12-18].
- [12] Ancient Egypt [Internet]. Available from: <http://www.healthguidance.org/entry/6310/1/Ancient-Egypt.html> [Accessed: 2016-12-10].
- [13] Ancient Egypt online [Internet]. Available from: <http://www.ancient-egypt-online.com/ancient-egyptian-medicine.html> [Accessed: 2016-12-10].
- [14] Shafik A, Elseesy WR. Medicine in Ancient Egypt. In: Selin H, editor. *Medicine Across Cultures: History and Practice of Medicine in Non-Western Cultures*. Kluwer Academic Publisher; 2003. pp. 27-47.
- [15] Filer JM. Ancient Egypt, BBC Report, Health Hazards and Cures in Ancient Egypt. 2011. [Internet]. Available from: http://www.bbc.co.uk/history/ancient/egyptians/health_01.shtml [Accessed: 2016-12-9].
- [16] Ruffer MA. Note on the presence of "Bilharzia haematobia" in Egyptian Mummies of the Twentieth Dynasty. *BMJ* 1910; **1**: 16.
- [17] Faulkner RO. *The Ancient Egyptian Book of the Dead*. London: British Museum Publications; 1972. 192p.
- [18] Ghalioungui P. [Internet]. Available from: https://en.wikipedia.org/wiki/Paul_Ghalioungui [Accessed: 2016-12-9].
- [19] Ghalioungui P. *The Ebers Papyrus*. Cairo: Academy of Scientific Research and Technology, 1987.
- [20] Elseesy WR. Drugs in ancient Egypt. From a series of 100 articles on Egyptology. *Rose-elYoussef Weekly Magazine* 1999; 3706, June 19.

- [21] Lopez M. A long history of schistosomiasis control. Stanford University [Internet]. 2015. Available from: <http://schisto.stanford.edu/pdf/Egypt.pdf> [Accessed: 2016-12-18].
- [22] Cox FE. History of human parasitology. Clin. Microbiol. Rev. 2002; **15**(4): 595-612. Erratum in: Clin. Microbiol. Rev. 2003; **16**(1):174.
- [23] History of Malaria [Internet]. Available from: https://en.wikipedia.org/wiki/History_of_malaria [Accessed: 2016-12-18].
- [24] Ancient Egyptian Medicine in Sickness and in Health: Preventative and Curative Health Care [Internet]. Available from: <http://www.reshafim.org.il/ad/egypt/timelines/topics/medicine.htm> [Accessed: 2016-12-18].
- [25] Abdul-Ghani RA, Loutfy N, Hassan A. Mini-review. Myrrh and trematodoses in Egypt: an overview of safety, efficacy and effectiveness profiles. Parasitol. Int. 2009;**58**: 210-214.
- [26] A Modern Problem as Old as the pyramids [Internet]. Available from: <http://www.touregypt.net/featurestories/lice.htm> [Accessed: 2016-12-18].
- [27] Vermin [Internet]. Available from: <http://www.reshafim.org.il/ad/egypt/timelines/topics/pests.htm> [Accessed: 2016-12-20].
- [28] Abdel All A. Ancient Medicine. 3rd ed. Dar Agial for Publishing and Distribution: Egypt; 2007. 263 P.
- [29] Khater HF. Ecosmart biorational insecticides: alternative insect control strategies. In Preveen F. editor. Insecticides—Advances in Integrated Pest Management. InTech: Croatia; 2011. pp. 17-60. DOI: 10.5772/27852.
- [30] Khater HF, Shalaby AA. Potential of biologically active plant oils for control mosquito larvae *Culex pipiens* (Diptera: Culicidae) from an Egyptian locality. Rev. Inst. Med. Trop. S Paulo. 2008; **50**(2):107-112.
- [31] Khater HF, Ramadan MY, El-Madawy RS. The lousicidal, ovicidal, and repellent efficacy of some essential oils against lice and flies infesting water buffaloes in Egypt. Vet. Parasitol. 2009; **164**: 257-266. doi:10.1016/j.vetpar.2009.06.011.
- [32] Khater HF, Khater DF. The insecticidal activity of four medicinal plants against the blowfly *Lucilia sericata* (Diptera: Calliphoridae). Int. J. Dermatol. 2009; **48** (5): 492-497.
- [33] Idris M, Abbas RZ, Masood S, Rehman T, Farooq U, Babar W, Hussain R, Raza A, Riaz U. The potential of antioxidant rich essential oils against avian coccidiosis. World's Poultry Sci. J. 2016. doi:10.1017/S0043933916000787
- [34] Khater HF, Hanafy A, Abdel-Mageed AD, Ramadan MY, El-Madawy RS. Control of the myiasis-producing fly, *Lucilia sericata*, with Egyptian essential oils. Int. J. Dermatol. 2011; **50**: 187-194. doi: 10.1111/j.1365-4632.2010.04656.x.
- [35] Seddiek SA, Ali MM, Khater HF, El-Shorbagy MM. Anthelmintic activity of the white wormwood, *Artemisia herba-alba* against *Heterakis gallinarum* infecting turkey poults. J. Med. Plants Res. 2011; **5**(16): 3946-3957.

- [36] Seddiek SA, Khater HF, El-Shorbagy MM, Ali MM. The acaricidal efficacy of aqueous neem extract and ivermectin against *Sarcoptes scabiei* var. *cuniculi* in experimentally infested rabbits. *Parasitol. Res.* 2013; **112**: 2319-2330.
- [37] Khater HF, Ramadan MY, Abdel Mageid AD. In vitro control of the camel nasal botfly, *Cephalopina titillator*, with doramectin, lavender, camphor, and onion oils. *Parasitol. Res.* 2013; **112**:2503-2510. DOI 10.1007/s00436-013-3415-2
- [38] Khater HF, El-Shorbagy MM, Seddiek SA. Lousicidal efficacy of camphor oil, d-phe-nothrin, and deltamethrin against the slender pigeon louse, *Columbicola columbae*. *Int. J. Vet. Sci. Med.* 2014; **2**(1): 7-13.
- [39] Khater HF. Bioactivities of some essential oils against the camel nasal botfly, *Cephalopina titillator*. *Parasitol. Res.* 2014; **113**(2): 593-605
- [40] Seddiek SA, El-Shorbagy MM, Khater HF, Ali AM. The antitrichomonal efficacy of garlic and metronidazole against *Trichomonas gallinae* infecting domestic pigeons. *Parasitol. Res.* 2014; **113**(4): 1319-1329.
- [41] Khater HF, Hendawy N. Phototoxicity of rose bengal against the camel tick *Hyalomma dromedarii*. *Int. J. Vet. Sci.* 2014; **3**(2): 78-86.
- [42] Khater HF, Hendawy N, Govindarajan M, Murugan K, Benelli G. Photosensitizers in the fight against ticks: safranin as a novel photodynamic acaricide to control the camel tick *Hyalomma dromedarii* (Ixodidae). *Parasitol. Res.* 2016; **115**: 3747. DOI: 10.1007/s00436-016-5136-9
- [43] Ali AM, Seddiek SA, Khater HF. Effect of butyrate, clopidol and their combination on the performance of broilers infected with *Eimeria maxima*. *Brit. Poultry Sci.* 2014; **55**(4): 474-482.
- [44] Khater HF, Ramadan MY. The acaricidal effect of peracetic acid against *Boophilus annu-latus* and *Argas persicus*. *Acta Sci. Vet.* 2007; **35** (1): 29-40.
- [45] Khater HF, Seddiek SA, El-Shorbagy MM, Ali MM. The acaricidal efficacy of perace-tic acid and deltamethrin against the fowl tick, *Argas persicus*, infesting laying hens. *Parasitol. Res.* 2013; **112**(1): 259-269. DOI: 10.1007/s00436-012-3133-1 <https://www.ncbi.nlm.nih.gov/pubmed/23090722>
- [46] Khater HF. Biocontrol of Some Insects [Ph.D. Dissertation]. Benha Branch: Zagazig University, Egypt; 2003.
- [47] Ali MA, Khater HF, Seddiek SA, Nada MO. Comparative efficacy of synbiotic and dicla-zuril on broilers experimentally infected with *Eimeria acervulina*. *Assiut Vet. Med. J.* 2015; **61**(146): 24-33.
- [48] Khater HF. Prospects of botanical biopesticides in insect pest management. *Pharmacologia.* 2012; **3**(12): 641-656.
- [49] Khater HF. Bioactivity of Essential oils as green biopesticides: recent global scenario. In: Govil JN, Bhattacharya S, editors. Recent Progress in Medicinal Plants. Vol. 37; Essentials Oils II. Studium Press LLC: USA; 2013. pp. 153-220.

- [50] Roni M, Murugan K, Panneerselvam C, Subramaniam J, Nicoletti M, Madhiyazhagan P, Dinesh D, Suresh U, Khater HF, Wei H, Canale A, Alarfaj AA, Munusamy MA, Higuchi A, Benelli G. Characterization and biotoxicity of *Hypnea musciformis*-synthesized silver nanoparticles as potential eco-friendly control tool against *Aedes aegypti* and *Plutella xylostella*. *Ecotox. Environ. Safe.* 2015; **121**: 31-38. *Green Technologies for Environmental Pollution Control and Prevention (Part 1)*.
- [51] Murugan K, Priyanka V, Dinesh D, Madhiyazhagan P, Panneerselvam C, Subramaniam J, Suresh U, Chandramohan B, Roni M, Nicoletti M, Alarfaj AA, Higuchi A, Munusamy MA, Khater HF, Messing RH, Benelli G. Predation by Asian bullfrog tadpoles, *Hoplobatrachus tigerinus*, against the dengue vector, *Aedes aegypti*, in an aquatic environment treated with mosquitocidal nanoparticles. *Parasitol. Res.* 2015; **114**(10): 3601-3610. doi: 10.1007/s00436-015-4582-0.
- [52] Govindarajan M, Khater HF, Panneerselvam C, Benelli G. One-pot fabrication of silver nanocrystals using *Nicandra physalodes*: a novel route for mosquito vector control with moderate toxicity on non-target water bugs. *Res. Vet. Sci.* 2016; **107**: 95-101.
- [53] Govindarajan M, Rajeswary M, Muthukumaran U, Hoti SL, Khater HF, Benelli G. Single-step biosynthesis and characterization of silver nanoparticles using *Zornia diphylla* leaves: a potent eco-friendly tool against malaria and arbovirus vectors. *J. Photochem. Photobiol., B: Biol.* 2016; **161**: 482-489.
- [54] Khater HF. *Spice up Your Life and Garden: Precious treasures in your kitchen*", Kindle Direct Publisher, 2017, P. 135.

