The Fascinating Story of Endod: The Trials, Tribulations and Successes

By Fekadu Fullas

Background

Perhaps, no other single African medicinal plant has brought to the limelight the trials, tribulations and successes of a so-called Third World research to such an extent as has endod, which is also known in Ethiopia by the vernacular name sebeti. The name endod is closely tied to the late eminent Ethiopian scientist Dr. Aklilu Lemma. Before getting into the story of the discovery and development of endod as a molluscicidal plant, it is pertinent to shed some light on the plant itself, and its other multiple medicinal attributes.

Endod (scientific name: Phytolacca dodecandra) is mostly a shrubby plant which rises from a woody base. The stems of this scrambling plant can reach up to nine meters in length. The plant is widely distributed in tropical Africa and Madagascar. It is native to East Africa. It has also been introduced into Asia and tropical America. In Ethiopia, it is commonly found at altitudes of 1,500 to 3,000 meters above sea level, almost in every region of Ethiopia. Endod grows in evergreen bush habitats, near forest edges, disturbed places and habitations.

P. dodecandra has been used in traditional medicine in East Africa for a variety of complaints. For example, the roots are used in small amounts as a purgative, taeniafuge and cathartic. However, high intake of endod has been associated with a number of adverse reactions, including fatal toxicity. Endod has also been used in birth control. The leaves and roots are poisonous. Sheep and cattle have died from eating the leaves during drought. The juice can be used to kill mosquito larvae. In Ethiopia, the powder, made from the debarked roots, is suspended in water and drunk for the treatment of syphilis and rheumatic fever. The powder, obtained from the leaves, is mixed with chicken fat and applied topically to the skin to treat vitiligo (Amharic name: lemts), while a decoction of the root powder is cooled and drunk as an abortifacient to expel mummified fetus. All the foregoing medicinal claims, and many more, have not been definitively confirmed by scientific studies. This is not tantamount to saying that the traditional claims are untrue. However, considering the toxicity of the roots and leaves, caution should be exercised in promoting their medicinal use. The golden rule here is, as in every other case of traditional medicinal plant use, "verify and standardize" ; verify to confirm claims, and standardize to avoid toxicity. The main thrust of this article is, however, to highlight the tortuous research path that endod berries took before the plant attained international prominence as a potential natural molluscicide.

From Natural Soap to Molluscicide

The African soapberry plant endod has been dubbed as "African wonder weed," and "poor man's medicine," for very good reasons in relation to its place in the control of schistosomiasis. The chemistry, biology and cultivation of endod have been the subjects of over 100 publications. The late Dr Aklilu Lemma and his colleagues alone have published about 60 scientific papers on various aspects of endod.

The stage of the story of endod was set way back in 1964 in the northern Ethiopian town of Adwa. The then-young Aklilu Lemma, just back after acquiring a D. Sc. degree from Johns Hopkins University (Maryland, United States), was conducting a study on the distribution of snails, which were known to be the intermediate carrier vectors in the transmission of schistosomiasis (bilharzia). He made a remarkable observation along a stream where the local women were washing clothes using suds prepared from the powder of endod berries. He noticed that immediately downstream from where the women were washing clothes, there were more dead snails than upstream or further downstream. Suspecting there might be some correlation between the endod and the dead snails, he asked one of the women to pour endod berry suds into a container wherein he had collected live snails from the vicinity. Alas, the snails shrunk, emitted a few bubbles of gas and expired. This landmark observation was the beginning of an up-and-down, intensive and life-long research that spanned decades.

To recap about the disease itself, schistosomiasis is a debilitating disease that afflicts about 300 million people in Africa, Asia and Latin America. It affects principally the liver and bladder. Worldwide, 200, 000 deaths annually are attributed to schistosomiasis. The parasite gains access to the human body through the intact skin, and is carried in the blood stream to infect the liver, spleen, nervous system, intestine and bladder. The eggs are dislodged from the body in the excreta, and carried away in river streams until they reach the host snail. Upon further maturation, they are released from the snail to infect humans, thus completing their life cycle. There is no one single magic bullet which would rid humans of the

disease. It rather takes a multi-pronged approach, including prevention, treatment and good hygienic measures to contain the disease. Preventative approach, when coupled with other measures, is the most effective method for a number of reasons, especially in countries such as Ethiopia where treatment alone, or the importation of chemical pesticides is very cost-prohibitive. On the other hand, using an abundantly growing endod that nature provides, can be a cheap and safe method to arrest the spread of the disease. The berry extract in water is also known to biodegrade easily in two days. It is against this background that the search for natural ways of combating schistosomiasis, and the focus on endod took currency.

After his initial observation in Adwa, Dr. Aklilu went back to Addis Ababa, and established the Institute of Pathobiology at Addis Ababa University to coordinate his research more efficiently. Later, Dr. Legesse Wolde Yohannes joined him, thus starting an enduring collaboration which continued for many years to come. In early field trials, it was shown that a controlled application of endod berry extract to selected streams decreased the transmission of schsitosomiasis from 63% to 33% in the overall local population, and the infection rate among children dropped from 50% to 7% over a five-year period.
Of over 1,000 plant species worldwide that were known to exhibit molluscicidal activity, endod was found to be the most promising and extensively studied plant. It satisfied the criteria of being non-toxic (or slightly toxic), highly potent, water soluble, and originating from a regenerating part of the plant. These were ideal criteria that other plants failed to meet. In the devastating droughts of 1973/74 and 1984/85, however, many endod plants were chopped down or simply dried out. In order to curb the possibility of extinction and genetic erosion, about 500 samples of endod were collected. A specific strain, named Type E-44, was found to provide the best berry yield, the highest saponin (active constituents) content, in addition to its fast growth, and being most resistant to pests.

Trials and Tribulations

The research on endod was not a smooth sailing exercise. It had its own ups and downs. It is generally maintained that science knows no boundaries, so that humankind can benefit from the results it generates. In scientific circles, there exists a big buzz word known as "collaboration." It takes place, and rightly so, between individual researchers, research groups and organizations within a country, or overseas. The idea is that in most cases a single group is not self-sufficient in all aspects of research. Hence, at different levels and in various areas of a given research effort, investigators enlist the assistance of collaborators to carry out a coordinated study. Unfortunately, due to uneven development of science and technology in different parts of the world, this collaboration has taken different meanings. In developing countries (so-called the South) research capability is at its infancy. Therefore, in order to hasten the pace of their research, investigators in this part of the world are compelled to seek the collaboration of their counterparts in the North (the technologically-advanced West). On many an occasion, nonetheless, they have been relegated to a status of sample providers, especially in medicinal plant research. Improvements have been made, albeit unsatisfactorily, regarding the benefits accruable to the custodians (indigenous population and researchers) of local materials and indigenous knowledge. The broader issue of benefit reciprocity and Intellectual Property (IP) rights will be the subject of another article in the future. Here, mention of collaboration is made for the sole purpose of putting the story of endod in some context.

The early players in the interesting saga of endod were researchers from the Tropical Plant Products Institute in the United Kingdom, who happened to show interest in endod and offered to collaborate. Accordingly, they were provided with a sackful of endod berry samples to carry out their study. But whatever their results were, they did not want to reveal them to their counterpart, Dr. Aklilu. They even went to the extent of wanting to patent their findings. It took official diplomatic efforts on the part of Dr. Aklilu to stop the patenting attempt by the UK group. What followed was, no wonder, that the British researchers started downplaying the potential of endod in its possible application for the control of schistosomiasis.
Early on, the Institute of Pathobilogy sought funding from the World Health Organization (WHO) for expanded agricultural production, large-scale field application, and evaluation of endod in Ethiopia. However, despite the fact that in earlier studies endod berries were shown be non-toxic, and that they have been used for centuries as a natural laundry soap, WHO declined to offer financial assistance on the grounds that the studies were not done in reputable laboratories. The implicit assumption here was that no good science comes out of Third World countries.
In 1990, the University of Toledo (Ohio, USA) awarded Dr. Aklilu an honorary doctorate degree

for his pioneering work on endod. During the ceremony, he delivered a lecture on the history and discovery of endod. At the time, it happened that zebra mussels (a type of snails) were quite a nuisance in the Great Lakes of North America. The snails clogged water pipes, thus restricting water flows. Millions of dollars were expended to declog these pipes. The Toledo scientists were wondering whether endod might be of any use for this problem. Dr. Aklilu quickly demonstrated that endod was indeed lethal to zebra mussels, too. Later, more studies were conducted by the University of Toledo with the collaboration of Dr. Aklilu. However, as more promising results were forthcoming, the University of Toledo group wanted to patent their results. Bitter controversy ensued on who the beneficiaries of the patent ought to be.The issue was never settled to the satisfaction of the stakeholders.

Successes

The research on endod had its own high points. After the initial unwillingness to fund the research on endod on the part of foreign institutions, Dr. Aklilu sought other avenues. Interest in endod research was ignited after regional conferences in Africa and elsewhere were held. In the meantime, the chemistry of endod was studied at the Stanford Research Institute in California. Thus, a series of saponins were isolated. The most potent molluscicidal saponins were lemmatoxin and lemmatoxin-C. These compounds were determined to be molluscicidal at 1.5 to 3 parts per million (ppm) concentration. It is also interesting to note that the molluscicidal saponins were shown to be spermicidal, with a potency that is comparable to that of the commercial spermicide Nonoxynol-9. When applied as a slurry of powder in water, endod berries killed the schistosomiasis-transmitting snail at a concentration as low as 20 ppm, a potency which persevered over a wide range of pH values (acidity/alkalinity levels), temperatures, as well as under ultra-violet irradiation in various concentrations of the river-bed mud.
As postulated and proven by Dr. Aklilu even before the reluctance of the WHO to fund further projects, the International Development Research Center (IDRC) in Canada later published a finding that endod berries were indeed non-toxic to humans. In 1989, Dr Aklilu and his colleague Dr. Legesse were awarded the Right Livelihood Award (considered "the alternate Nobel Prize") in recognition of their discovery of the molluscicidal property of endod, and for devising community-based method of controlling schistosomiasis.

As schistosomiasis affects many tropical countries, interest in endod took international dimensions. Endod Research Groups and Networks (for example, Endod Technical Cooperation among Developing Countries {TCDC} Network) were formed. In Ethiopia, an Endod Foundation was established as a repository of information, and as a point of boosting further research.

Conclusion

Endod has a unique place in the control of the transmission of the devastating schistosomiasis affliction. Mollusciciding certain foci with endod, coupled with other appropriate measures, is a potentially important and key component of the strategy in the overall control of the spread of the disease. Now that the best strain is known and cultivable, and that the chemistry and biology of endod are well established, local technology of extraction should be initiated and expanded to achieve optimal yield of active components with the eventual objective of direct application in the field.

If there is any lesson that the fascinating story of endod imparts, it is the fact that good science indeed comes out of Third World countries. Scientists in this part of the world do work against all odds in an environment where local technology is not well developed (for example, lack of adequate laboratory facilities and skilled manpower) and in the face of unfounded outside biases, should they decide to seek external cooperation. The solution, of course, should be to strive for self-reliance and strengthening of regional collaboration with like-minded investigators. In fact, it is fair to conclude that endod has met most of the challenges so far, although more remains to be done, and the long journey that was begun in 1964 appears to be not yet complete.