Control of Schistosomiasis Using Berries from Phytolacca Dodecandra (ENDOD)

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Schistosomiasis (bilharzia) is a parasitic disease affecting an estimated 200-300 million people in the tropics and subtropics. Humans are directly infected through skin contact with water inhabited by vector snails. The disease has spread rapidly as a consequence of increased development of wetlands and irrigated lands for agriculture as well as increased mobility of people.

Schistosomiasis control is based on a combination of several methods including treatment of human infection with nontoxic drugs like praziquantel (Biltricide™), hygienic measures and snail control. Snail control has been shown to be essential in order to prevent re-infection after treatment of humans. Water contact studies and focal snail surveillance and control has become a favoured method also for monitoring of schistosomiasis in an ecological system.

Endod is the Ethiopian name of the soap berry plant Phytolacca dodecandra, which occurs throughout Sub-Saharan Africa and parts of South America and Asia. The plant is a rapidly growing climber with hanging branches and an average height of 2-3 m which under favourable climatic conditions bears fruit twice a year. The small berries have traditionally been used in Ethiopia as a soap for washing clothes, after having been dried, powdered and mixed with water to develop a foaming detergent solution. P. dodecandra and related other Phytolacca strains have long been recognised for their various medicinal and related uses.

The molluscicidal properties of endod was discovered in northern Ethiopia (Adwa) in 1964 by Aklilu Lemma. Dead snails were observed in a river immediately downstream from where local people were washing clothes with local available endod, whereas upstream and further downstream from these laundry sites live snails were abundant. Subsequent studies in Ethiopia by the team of the Institute of Pathobiology and elsewhere have established endod as a potent plant molluscicide, killing all actual schistosomal snail vectors at concentrations similar to other known chemical- and plant compounds. In a project in Adwa from 1969 to 1973 an Ethiopian group of scientists demonstrated the effectiveness of the use of locally grown endod as a single schistosomiasis control method in a community based project (Lemma et al., 1978). By a cost of USD 0.10 per year per head the overall prevalence in the 17 000 inhabitants were reduced from 63 % to 34 % and in the one to five years old children from 50 % to 7 %, while unchanged in a nearby untreated comparison village. The early Adwa project is the only large-scale schistosomiasis control experience with endod. Similar studies have awaited the results of the toxicological investigations, which only recently have reached an acceptable stage, after which there is now a renewed emphasis on trials using endod for snail control.

Early toxicity studies in Ethiopia showed that endod did not have mutagenic or carcinogenic properties against a variety of plants and animals, and that the applied extracts were easily biodegradable. There was, however, as with all other known molluscicides, a toxic effect on small fish and tadpoles at molluscicidal concentrations. Because fish and frogs were seen to rapidly escape endod-treated sites to avoid the irritation, these negative effects were regarded as minimal. Egg masses were not found to be affected by endod, and during the five-year trial in Adwa no apparent effect was noted by the monitoring of aquatic ecology. Later toxicity studies in internationally recognised laboratories have verified the absence of other unwanted environmental or toxic effects of endod. All these late studies have been guided by the advice of an endod Toxicology Expert Group that met in New York under the UN Development Programme in 1986 (UNFSSTD/IDRC, 1986).

Chemical studies of the endod berries have led to the discovery of a new compound, an oleanolic acid glucoside, named Lemmatoxin. Chromatographic separations of the crude saponins in endod demonstrates the presence of a dozen compounds similar to Lemmatoxin, of which five now have been chemically characterized in the University of Copenhagen. The Endod Toxicology Expert Group (UNFSSTD/IDRC, 1986) developed a procedure for preparing a standard water extract of endod (endod-S) for testing of chemical structures and toxicity.

Detailed investigations of the agronomic aspects of endod to select and breed plants with favourable growth characteristics and molluscicidal effects have been going on in Ethiopia since 1974. Among 65 different varieties of endod from different parts of Ethiopia, three strains have been selected for exceptional growth, molluscicidal potency, yield and resistance to insect pests and drought. The E44 strain has proven to be the most favourable. One important
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discovery was that the green, unripe berries contain more active saponins than the pink ripe berries, thus reducing the time before harvest and the damage by birds eating ripe, sweet berries. A problem which is still unsolved, is the attack of certain insects (Gitona sp.), for which ongoing research focus on endod varieties with particular resistance to these insects. Agronomic studies are presently ongoing in African countries, i.e. Ethiopia, Uganda, Zambia, Zimbabwe, Swaziland, to investigate the potentials of local varieties of endod versus the best Ethiopian strain (E44), also comparing agroclimatic constraints. The cost effectiveness of endod has also been partly studied. In Ethiopia, the best strain (E44) has produced 3 000 kg per hectare per year. To treat the water needed for 1 200 hectares of irrigated sugar cane, only 1/2 hectare of endod would be required. Endod might thus be cost-effective as a molluscicide compared to the expensive synthetic pesticides recommended by WHO.

People of all ages in Ethiopia are familiar with the plant and its various uses. Some people have planted endod bushes along fences near their houses, but the plant is largely disappearing from unprotected areas due to land clearing. Regional differences in distribution and use of the plant are apparent. Berries are used as soap whenever available, but very little is traded at markets due to low social status of the endod soap. Common medicinal uses of the plant are treatment of skin itching (ringworm), abortion, gonorrhea, leeches, intestinal worms, anthrax, and rabies.

Many endod bushes were cut down in Ethiopia during the droughts in 1973/74 and 1984/85. It is therefore important to preserve the genetic variation that is still available and launch a breeding program to achieve cultivars with high berry and saponin yields, pest resistance, and ability to grow under the agroecological conditions of lowlands. The genetic variation of endod and possible genetic markers for important plant characteristics are presently being investigated.

Endod plants grow best under direct sunlight in its natural habitat. In areas where the evapotranspiration is very high, partial shade by other bushes or trees is necessary to avoid sunburn. Unfortunately, wilting of leaves is the main limitation for cultivation of endod at lower elevations (below 1 600 m) in Ethiopia where schistosomiasis is endemic.

The discovery of the effect of the endod soap on the vector snail for the schistosome parasite, has spurred our effort to find ways to reintroduce endod as a soap and promote its direct application in the locations where people get infected. Increased cultivation of endod and the use of berries for washing might be possible if information about schistosomiasis and its control is disseminated among the people. Preference for commercial soap and lack of land for cultivation are the major obstacles in increasing the use and availability of endod.

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