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Purification of turbid surface water by plants in Ethiopia

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For a period of almost 4 years (1981 - 84) I have been working as a botanist in Ethiopia, being employed as a lecturer at the Kotebe Teachers Training College (KTTC) initially and later (for ca. 1 year) with the Plant Genetic Resources Centre / Ethiopia (PGRC/E).

Throughout this time I had a special interest in Ethnobotany. During my fieldwork I found many people in rural areas with an intensive knowledge of wild plants growing in their surroundings. It was actually not unusual to find a 12 year old boy in the small village of Darba (Muger valley, Shoa Administrative Region), for example, with the capability of exactly identifying up to 50 different plants, giving detailed descriptions of their various applications.

It was fascinating to learn, how many different plants are being utilised in Ethiopia, not only in areas such as veterinary or human medicine or health care. The scope of application ranges much further, from plants as insecticides or pesticides, to seasonings and kitchen herbs, perfume and aromatic plants, to areas where plants are being used during religious ceremonies and magic rites. And still I have not covered all plant uses. In view of the rapidly changing living conditions and the consequent risk that all this knowledge could get irrevocably lost along the way, all this information should be recorded by all means. I will, therefore, try to participate in this effort by describing three wild plants with the most interesting and special property of purifying turbid water.

In spring 1983 I first heard about one of these species, which was said to be growing on the shores of Lake Awassa, between the town of Awassa and the Catholic hospital. It was described as a grass-like plant, supposed to possess water-clarifying properties and used to clear the turbid waters of Lake Awassa.

I am now aware that there are species of the genus Cyperus (e.g. Cyperus rotundus L., Family Cyperaceae) growing around this lake which have purifying capacities, but at that time, however, I was unable to detect the plant I had heard of, although I was accompanied by local guides.

Several months later then, in December 1983, on the bank of the Omo river in southern Ethiopia, I was able to finally witness how turbid river water was cleared after being treated with a plant. The locality was called Omo-Mursi, an outpost of the Omo National Park. Here, at the new Ethiopian Wildlife Conservation Organisation (EWCO) ferry on the east side of the river, the Wildlife Scouts had prepared the root of Maerua subcordata (Gilg.) de Wolf (Family Capparidaceae) to clarify the very turbid river-water.

M. subcordata is a much branched shrub, normally less than 1 m high but sometimes up to 2 m; leaves blue-green, egg-shaped to rounded, stiff and leathery; flowers many, greanish-yellow with long filaments; root woody and swollen, water-storing (Göttsch 1984a).

The plant grows well at altitudes between 500-800 m ASL and is widespread over the plaine of the Omo basin and the adjacent areas, as far as the surroundings of Yabello (the

easternmost place I found it). Since it grows abundantly in the wild the plant is not cultivated at all. It is quite a common sight, especially near the Omo river.

The water-refining property of M. subcordata is a well-known feature with all ethnic groups along the Omo river. On various occasions I had the opportunity to observe the Geleb, Karo and Mursi using the plant, the vernacular names for which are, "Kuluf" (Geleb), "Guluf / Gulfol" (Karo) and "Kamogi" (Mursi). The EWCO Scouts used to call the plant by its Amharic name "wuha mataria" (meaning - water refiner).

I never found its application for water-clarification in areas further away from the Omo river, although the plant does occur elsewhere.

The procedure of clarification is as follows:

The swollen root which has a diameter of 3-15 cm, is dug out and its thin bark is scraped off. The underlying tissue is of a soft consistency and has a characteristic smell. Through a number of incisions, the surface area of the barked root can be enlarged. After these preparations the root is stuck on a wooden rod.

A container, filled with 30 - 40 litres of turbid water, is taken and the water is stirred for ca. 10 minutes with the rod. About half an hour later the turbid water becomes almost clear.

I carried out a number of laboratory trials and found out that after 25 minutes all visible clay particles had flocculated from 250 ml of muddy water. The remaining water, however, showed a slightly yellowish discolouration, but had a pleasant taste.

In the Sudan, Dr. Samia Al-Azharia Jahn has been working on a project to clarify water with plants over a number of years. From her many articles published on this matter, three (Jahn 1979, 1981, 1986) are noted in the bibliography below.

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Fig. 1 The clear effect of Maerua subcordata root on turbid water

According to Jahn (1979) special polysaccharides in the root of M. subcordata are responsible for the flocculation of colloid particles. These macromolecules form bridges between particles, increasing their mass as a consequence, thus causing precipitation.

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Fig. 2 Flocculation by bridging of particles due to absorption of polymer segments

The polysaccharides (Sucrose) are also responsible for the slightly sweet taste of the root of M. subcordata.

Dr. Jahn indicates that the root additionally possesses a quaternary ammonium compound, which causes, if excessively used, a slight intoxication (stomach paine, dizziness, vomiting). I was, however, never able to detect these problems along the area of the Omo river. The quantities getting into the water during the stirring, were obviously too small to cause any negative side-effects (Göttsch 1984a, b).

Dr. Jahn has tested a great number of plants with respect to their capacity to flocculate turbid surface water, and found that the seeds of a tree, Moringa stenopetala (Bak. f.) Cuf., Family

Moringaceae (common name - cabbage-tree), which she got from Kenya, contain a very effective ingredient.

I knew this tree from parts of Gamu - Gofa where it is grown intensively and is of considerable economic importance because its leaves are used as a valuable vegetable. But up until that time (1984), nothing was known in Ethiopia of its outstanding water-purifying qualities.

M. stenopetala is a tree up to 10 m tall, bark smooth, pale-blackish-grey; diameter at breast height ± 60 cm; crown strongly branched; leaves bright green, bipinnate; petals and filaments white, anthers yellow, flowers very fragrant, very young fruit bright green, twisted, later more or less torulose, but when mature smooth and only slightly twisted, papery, reddish with grey farina (Verdcourt 1985). The wood is very soft and of no particular use.

The vernacular names are
in Konsoigna - shalchada, shelagda
in Gidoligna - aleko, halako
in Amharigna - Shiferaw

The Konso area in Gamu-Gofa Administrative Region can be considered as the area where M. stenopetala was most probably first cultivated. From here its cultivation has spread into neighbouring areas where it is being used intensively as well. I found the tree around Arba Minch and Gidole and also in Jinka and its surroundings (Gamu-Gofa) and as far north as Soddo in Wollaita (Sidamo Administrative Region). It would be of great interest to collect more information on the distribution of M. stenopetala in the whole region. I found no evidence in the literature that the tree has been grown for food production in other areas of Africa.

From Kenya for example M. stenopetala is reported as a wild tree (e.g. growing around Lake Baringo, Jahn 1981), but in Ethiopia (and here in particular in Gamu-Gofa Administrative Region) it is only found under cultivation. Obviously it has been introduced here by early immigrants (from Kenya?).

In Konso the tree is densely planted within the villages and generally more widely spaced in the fields and terraces between 1,400-1,900 m ASL. It is used to shade the field terraces and the villages, and to reduce soil erosion. But the main reason for its cultivation is the leaves, which serve as a most popular vegetable.

M. stenopetala is raised from seed, and after 5-6 years the first leaves can be harvested. The leaves are boiled and eaten with any warm meal. They are rich in vitamins and are mainly harvested in the dry season when other vegetables are scarce. During the rainy season there are only a few leaves left on the tree which do not taste good. The leaves are an important trading product in the local markets (Engels & Göttsch 1991).

Parts of the tree are also used medicinally. A tea, prepared with the dried leaves, can reduce the blood-sugar values in light cases of diabetes (Dawit Abebe, pers. comm.), and it is said that an extract of leaves can treat indigestion and even the cure of amoebic dysentery has been reported. A root extract can help against unconsciousness (Aschalew Hunde, pers. comm.; Engels & Göttsch 1991).

According to Jahn (1981) the seeds of the Moringa family are very efficient water-coagulants, and toxic side effects have not been noted. The substances effective in flocculation can be gathered by chromatography, as they are assumed to be proteins.

Experiments have shown that the active substances are kationic polymers, which bring about the same effectiveness as the best technical water-clarifying agents (e.g. alum, which is used in waterworks; Barth et al. 1982). Flocculation is initiated by an electrostatic process, i.e. bridging between negative colloid particles and kationic polymers. This process can be accelerated through continuous stirring, resulting in a 3-dimensional aggregation. Since germs are often found on the colloid surfaces, flocculation of these particles, therefore reduces the number of germs. Within the Moringa family, M. stenopetala can be considered as the most effective water-clarifier. The seeds are crushed, tied up in a cloth and agitated in a container of surface water.

Moringa oleifera Lam., a closely-related species of similar effectiveness, has been tested by Jahn (1981). In trials she found that a concentration of 200 mg of powdered seed / litre did reduce the turbidity (total solids 8,000 mg / litre) after one hour by 98 %. To clarify 40 litres of water, about 30 crushed seeds are needed. One mature tree can produce about 5,500 seeds per year, sufficient for about 7,000 litres of water. In Ethiopia Moringa oleifera has so far been found in Hararghe Administrative Region.

Considerably more research work is, however, required to finally determine the effectiveness and application of Moringa seeds. This was unfortunately not possible at the PGRC/E, and in 1984 my contract was running out, so I just collected information, which I later published in two short papers (Göttsch 1984a & b). Once again in Ethiopia in 1987 I met Dr. Dawit Abebe of the "Coordinating Office for Traditional Medicine" (COTM), and discussed with him the possibility to promote the introduktion of M. stenopetala to clarify water in the rural areas of Ethiopia. It was obvious to us that much more information was needed on the agronomy of the tree and the best means to produce and apply the powdered seed.

Ato Aschalew Hunde, a pharmacist working for the Ministry of Health at the COTM was inspired by the above mentioned papers, and started to collect further information on M. stenopetala, and to carry out trials in order to test the effectiveness of its seeds. In the meantime he has completed his work and submitted his preliminary results, which are very promising, for publication to the Ethiopian Pharmaceutical Journal. (Aschalew Hunde & Adinew Adam, in press)

In October 1988, the Ethiopian Herald published an article describing how the "Coordinating office" had engaged itself in research on water-clarifying plants. Dr. Yilma Desta, head of the office, was cited in this article, stating: ...."as many diseases are water-borne in this country, these plants which are found to be both, water-clarifying and at the same time anti-bacterial, the research is very profitable" (Melaku G/Yohannes 1988). This statement is self-explanatory. Even if the water will not be free from germs after treatment with the Moringa seeds, the number of germs is considerably reduced and the water is at least free of particles. This is an important improvement of the water-quality, obtained without the implementation of any technical tools, without expenses but merely with the help of a local tree, which at the same time, produces a valuable vegetable. In view of the fact that the people of the Ethiopian rural areas are dependent on turbid surface water to a great extent, wide-spread application of this greatly under-utilised and relatively unknown tree would be most desirable. And if the administrative institutions of these areas and especially the agricultural extension services

could be convinced in this direction, the Ethiopian rural people could definitely face better living conditions in the future. And I feel most satisfied having contributed to this!

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