

PLANTS USED IN TRADITIONAL MEDICINE BY HAYAS OF THE KAGERA REGION, TANZANIA.

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This paper provides a brief account of 31 plants associated with herbal remedies among the Havas, a tribe of Kagera region. Tanzania. Reports from informants were obtained during field studies in June 1987. For each species are given the botanical name, vernacular name, collection number, locality, habit, distribution and medical uses. The data are compared with information from literature for medical uses, and listed isolated constituents and pharmacological effects. The Hayas have had a rich herbal folklore, but this is fading due to increasing acculturation and depletion of plant cover.

Key Words: traditional medicine; Tanzania; Hayas; medicinal plants; contraceptives; chemical constituents; pharmacological effects.

African traditional medicine abounds in medicinal plants, and the tribal people, wherever they exist, still rely chiefly on herbal medicines. Tribes of Tanzania have a rich folklore; a few reports are available on their ethnobotany (Bally 1937; Brenan and Greenway 1949; Chhabra, Mahunnah, and Mshiu 1987, 1989, 1990a,b, 1991, n.d.; Fleuret 1980; Haerdi 1964; Harjula 1980; Hedberg et al. 1982, 1983a,b; Imperato 1966; Kokwaro 1976; Verdcourt 1954; Watt and Breyer-Brandwijk 1962; Weiss 1973, 1979).

The present study was conducted in Kagera region on the use of plants in traditional medicine by the tribe Haya.

LOCATION AND AREA OF STUDY

The Haya live in the Kagera region, situated at the Northwestern edge of Tanzania, west of Lake Victoria (Nyanza). The study was conducted in the Bukoba and Muleba districts, about 2° south latitude. Bukoba is situated at about 1200 mhs and Muleba at about 1900 mhs. The area of study lies at about 2° south of the equator, hence the climate of the study area is much influenced by the easterly winds across Lake Victoria resulting in exceptionally low mean daily and annual temperature ranges of 8° and 2°C, respectively. Variation in mean annual rainfall is moderately low ranging from 800 to 1000 mm. The area is characterized by sedimentary and metamorphic rocks, dominated by red and heavy black fissuring soil. The vegetation is primarily savannah and is frequently subjected to fires. There are light and moderate forests.

MATERIALS AND METHODS

During a three week expedition in June 1987, six villages of the Bukoba and Muleba districts of the Kagera region were surveyed. Interviews were conducted in Kiswahili (the national language). Those interviewed during the survey included older persons whose empirical knowledge was respected by everyone in the area, and traditional healers who prescribe local herbs. Interview data were entered into prepared questionnaires and the Traditional Medicine Research Unit's field note books. Before the study, Party leaders and Government officials as well as outstanding traditional healers in the area were requested to mobilize and organize healers to be interviewed. The healers had to be convinced that their cooperation was of great benefit to the country and, at the same time, that the revelation of their knowledge of medicinal plants to the members of the expedition would not in any way interfere with the continued practice of their art. The unit's staff thereafter visited these healers in their localities and made direct contact with them. The staff queried the healers about their knowledge, methods of diagnosis and treatment of diseases. They were asked for the tribal name of a plant they used for treating disease(s), part of the plant used, preparation and mode of application, and whether the plant was used alone or in combination with other plants. Plant specimens were collected for botanical identification, and each plant was allotted a TMRU number. Samples of the plant parts used by the healers were collected simultaneously for phytochemical and pharmacological screening.

The herbarium specimens were identified by the staff of TMRU and the Botany Department, University of Dar es Salaam, and preserved for reference at the Herbarium of the Traditional Medicine Research Unit (TMRU), Muhimbili Medical Centre and duplicates at the National Herbarium of Tanzania at Arusha. During this expedition a total of 90 traditional healers and elders were interviewed, and 178 plant specimens and 62 plant samples were collected. It was not possible to obtain plant material from all the healers. The number of plants given by each of these healers varied from 1 to 5. The interviews showed that the healers knew more plants than we were able to collect. Several reasons account for the relatively low number of plants obtained from each healer. Not all the plants that the healer knew were available at the time of the expedition when the interviews were performed. Many healers lived far from the village where the interview was performed and were not able to find all the plants they used within a reasonable distance from this place. Moreover, the time during which the expedition could stay in one village was limited. The fact that (i) we obtained a considerable amount of duplication, i.e., the same plants were shown to us by several healers and (ii) most of the plants collected have been reported in the literature to have been used as medicinal plants, indicate that the healers could be trusted for the information they imparted about the plants they use. The present paper reports plants which have not earlier been reported from other regions of Tanzania or have additional information for their use in medicine.

ENUMERATION OF MEDICINAL PLANTS

In the following account the plants are arranged alphabetically under family and species. The data are presented in this order: botanical name/ TMRU collection number (in italics) / vernacular (Haya) names (in bold letters) locality (village)/ plant habit / distribution / brief description of medicinal uses by Hayas/ plant part (s) and reported medicinal. uses in literature / reported constituents / reported pharmacological effects.

ACANTHACEAE

1. *Justicia diclipteroides* Lindau/ *TMRU 3164* / **ikingura**/ Buyekela/ herb/ East Africa/ a decoction of the aerial parts is drunk by women usually one hour before sexual intercourse to prevent conception.

2. *Justicia matammensis* Oliv./ *TMRU 3147* / **kagege** / Tukutuku / herb/ tropical Africa / an infusion of the dried powdered aerial parts of this plant, together with those of *Cassia gracilior* (Ghesq.) Steyaert, *Antherotoma naudinii* Hook.f., *Dissotis brazzae* Cogn., *Indigofera asparagoides* Taub. ssp. *ephemera* Gillett, *Rhynchosia minima* (L.) De. var. *minima* and *Pentas zanzibarica* (Klotzsch) Vatke, is drunk in case of cerebral malaria. This preparation is diuretic and is an abortifacient.

Roots: For inflammation of the testicles and together with the leaves for heart complaints (Watt and Breyer-Brandwijk 1962).

3. *Thunbergia alata* Sims / *TMR U 3148* / **wankula** / Buyekela / herb / native of east and south Africa, widely cultivated and naturalized in tropical regions / a decoction of the aerial parts is drunk by women usually one hour before sexual intercourse to prevent conception.

Leaves: For the treatment of backaches, hydrocele, joint pains (Kokwaro 1976) and early rectum ulcers (Haerdi 1964).

Plant: For conjunctivitis (Haerdi 1964).

The major component of the seed oil has been identified as cis-6-hexadecenoic acid (Spencer et al. 1971). A chemical analysis of the leaves indicated the absence of cyanogenic glycosides and leucoanthocyanins (Gibbs 1974). The aerial parts gave a negative result in antimicrobial tests (Chhabra et al. 1981)

BIGNONIACEAE

4. *Markhamia obtusifolia* (Baker) Sprague / *TMRU 314 9*/ **ng'ubu** / Isamilo/ Tree or shrub tropical Africa / the stembark decoction is drunk and the leaves are chewed and swallowed in case of snake bites. The latex or the stembark infusion is applied over scarifications at the site of bites.

Roots: Against scrofula, hookworm, snake bites and as an expectorant (Haerdi 1964).

Rootbark: As a galactagogue (Watt and Breyer-Brandwijk 1962).

Aerial parts: For stomach troubles (Kokwaro 1976).

The stem juice gave a negative result in antimicrobial tests (Chhabra et al. 1981)

CAESALPINACEAE

5 *Cassia gracilior* (Ghesq.) Steyaert/ TMRU 3150 / **mnkuza** / Tukutukuc/ Herb/ east and south Africa/ See *Justicia matammensis* (Acanthaceae).

6 *Cassia kirkii* Oliv. var. *kirkii* / TMRU 31831 / **kashenganzili** / Kahororo/ herb/ east, west and south Africa/ leaf infusion or decoction is drunk in case of traumatic pains, especially those associated with accidents.

COMMELINACEAE

7 *Cyanotis foecunda* Hassk./ TAIRU 3151 / **katijal**/ Buyekela / herb/ east, central and south Africa, Arabia/ the whole plant decoction is drunk by women to prevent conception.

COMPOSITAE

8 *Aspilia holstii* O.Hoffm./ TMRU 3152 / **kanyarnuza** / Bujuku/ shrub or herb/ tropical Africa / decoction of roots and the leaves is drunk and used to bathe for the treatment of convulsions. especially in children.

Roots: For lumbago. sciatica. neuralgia and together with the leaves as a galactagogue (Watt and Breyer-Brandwijk 1962).

9 *Bidens gracilior* (Hoffm.) Sherff. / TMRU 3187 / **rwongera** / Kahororo/ herb/ tropical Africa / a decoction of the leaves of this plant. together with those of *Harungana madagascariensis* Poir. is drunk in case of malaria and fevers. A warm infusion of the pounded twigs of this plant. together with those of *Dissotis debilis* (Sond.) Triana var. *debilis*. is drunk against cardiac palpitations.

10 *Bidens pilosa* L./ TMRU 3153 / **kakurura** / Tukutuku / herb/ a common weed. probably of American origin, widely spread in the tropics / the leaves of this plant are wrapped in a banana leaf, then roasted and the paste thus obtained applied on wounds for fast healing

Roots: For malaria (Kokwaro 1976).

Leaves: Against constipation. intestinal worms. stomachaches (Kokwaro 1976). conjunctivitis (Kokwaro 1976: Watt and Breyer-Brandwijk 1962), rheumatic pains. earaches. inflammation. colic (Watt and Breyer-Brandwijk 1962). Flowers: Against diarrhoea (Watt and Breyer-Brandwijk 1962).

Plant: Against burns (Haerdi 1964) and dysentery (Watt and Breyer-Brandwijk 1962).

Phytosterin-B (Lin et al. 1967). hydrocarbons and phytosterols (Chen. Lin. and Hong 1975), conjugated polyacetylenes (Bondarenko et al. 1985: N'Dounga et al. 1983; Towers et al. 1984) from the whole herb and chalcones (Hoffman and Hoelzl 1988) from the leaves have been isolated and identified. The conjugated polyacetylene showed anthelmintic and protozoacidal activity (N'Dounga et al. 1983). paralyzed irreversibly the cercariae of schistosomal and echinostomal trematodes (Graham, Graham and Towers 1980: Towers et al. 1984), displayed antimicrobial activity (Bondarenko et al. 1985) and has been found to be phototoxic to fibroblast cells (Arnason et al. 1980: Watt et al. 1979). Phytosterin-B showed hypoglycemic activity (Lin et al. 1967). The consumption of the leaves has been found to be a promoting factor in the etiology of esophageal cancer (Mirvish, Rose. and Sutherland 1979: Mirvish et al. 1985).

EUPHORBIACEAE

11. *Acalypha stuhlmannii* Pax / TMRU 3155 / **mwiza** / Tukutuku / herb / east and south Africa/ an infusion of the dried powdered aerial parts is mixed with wheat porridge and eaten for the treatment of diarrhoea.

12 *Phyllanthus amarus* Schumach. et Thonn./ TMRU 3156 / **m'mbondo** / Tukutuku/ herb/ widespread in the tropics / an infusion of the aerial parts is drunk and the leaves are chewed against persistent coughs
Leaves: For stomachaches (Kokwaro 1976).

GUTTIFERAE

13 *Harungana madagascariensis* Poir./ TMRU 3154 / **mujumbo** / Bujuku / tree or shrub / tropical Africa, Madagascar, Mascarene Islands/ See *Bidens gracilior* (Compositae).
.Leaves: For the treatment of headache (Kokwaro 1976), haemorrhages, diarrhoea, gonorrhoea, sore throats and fevers (Watt and Breyer-Brandwijk 1962).
Stembark: Against malaria (Kokwaro 1976) and tapeworms (Watt and Breyer-Brandwijk 1962).
Betulinic acid, friedelin, euxanthone, five anthraquinones and an orange dye, harunganin from the stem bark (Hegnauer 1966) and beta-sitosterol, quercetin, diisopropyl 4,4'-methylene-dicarbanilate and a pigment, madagascarin from the leaves (Buckley et al. 1972) have been isolated and identified by chemical and spectroscopic means. The component acids of the seed oil have been determined and their potential value evaluated (Gunstone et al. 1968).

LABIATAE

14 *Leonotis mollissima* Gürke/ TMRU 3157 / **kitalante** / Kahororo / shrub or herb / East and South Africa/ leaf decoction is drunk in case of stomachaches and convulsions in children, while in the latter case, they are also bathed with the decoction.
Roots: Against dizziness, malaria, heart troubles (Haerdi 1964), dysentery and intestinal disorders (Kokwaro 1976);
Leaves: Against encephalitis (Haerdi 1964) and snake bites (Watt and Breyer-Brandwijk 1962).

MALVACEAE

15 *Hibiscus palmatus* Forsk./ TMRU 3158 / **chelanget** / Buyekela / herb / widespread in tropical and south Africa, Arabia, India/ decoction of the aerial parts is drunk by women to prevent conception, while that of the leaves to prevent neonatal complaints.

MELASTOMATACEAE

16 *Antherotoma naudinii* Hook.f./ TMRU 3159 / **igiri** / Tukutuku / herb / tropical Africa, Madagascar / See *Justicia matammensis* (Acanthaceae)/
a chemical analysis of the herb indicated the absence of phenols, flavones and anthocyanins (Hegnauer 1969).

17 *Dissotis brazzae* Cogn./ TMRU 3160,3161, 3162 / **kanyantoke, kinulilizi, tulo** / Buyekela, Tukutuku / herb / east and south Africa / leaf decoction has an anaesthetic effect and is drunk to induce sleep and as an anthelmintic. See *Justicia maiammensis* (Acanthaceae).

18 *Dissotis debilis* (Sond.) Triana var. *debilis* / TMRU 3163 / **kituntunu** / Kahororo / herb/ East and South Africa / decoction of the twigs of this plant, together with those of *Syzygium cordatum* Hochst., *Crotalaria microcarpa* Benth. .. *Kotschya africana* Endl. and *Anthospermum herbaceum* L. f. var. *herbaceum*, is drunk as an antimalarial. See also *Bidens gracilior* (Compositae).

MYRTACEAE

19 *Psidium guajava* L./ TMRU 3184 / **mushana** / Kahororo / tree or shrub / native of tropical America, now widely cultivated and naturalized in other tropical and subtropical countries/ twig decoction is drunk in case of malaria and fevers, and when mixed with honey for the treatment of diarrhoea. especially in children

Leaves: For the treatment of sprains, diarrhoea, intestinal haemorrhages, coughs and pulmonary disorders (Watt and Breyer-Brandwijk 1(62).

Stem-bark: Against diarrhoea (Nad kami 1976) and externally for anal prolapse in children (Chopra, Nayar, and Chopra 1956)/

Flavonoids, leucocyanidin and tannins from the roots (Sasaki et al. 1966; Trivedi and Misra 1984), fruits (Misra and Seshadri 1968) and heartwood (Mishra and Misra 1981) have been isolated and their structures elucidated. The essential oil of the fruits and leaves has been studied by gas liquid chromatography and mass spectrometry (Askar, El-Nemr. and Bassiouny 1986; Idstein, Bauer, and Schreier 1985; Idstein and Schreier 1985; MacLeod and Gonzalez de Troconis 1982; Oliveros-Belardo et al. 1986; Shiota 1978; Smith and Siwatibau 1975; Stevens, Brekke, and Stem 1972; Wilson and Shaw 1978; Zheng et al. 1987; Hegnauer 1969). Terpenes (Bhati 1967; Osman, El-Garby, and Sheta 1974; Soliman and Farid 1952),. tannins (Okuda et al. 1982, 1987; Okuda, Hatano, and Yazaki 1984) and saponins and sapogenins (Varshney and Shamsuddin 1964) from the leaves; vitamins (Campos 1943; Hartzler 1945; Miller and Robbins (1934; Padula and Rodriguez-Amaya 1986), flavonoids (Seshadri and Vasishta 1964) and organic acids and sugars (Wilson. Shaw, and Campbell 1982) from the fruits; tannins (Petard 1952; Primo 1945), polyphenols (Seshadri and Vasishta 1963, 1965) from the stembark; lipids and proteins (Habib 1986) from the seeds and polyphenolic compounds (Mair, Pandiyan, and Ven katasubrananian 1987) from the flowers have been isolated and characterized / Oral administration of the leaf extract has been shown to inhibit hyperglycemia (Maruyama et al. 1985). Alcoholic and aqueous extracts of the leaves showed an antibacterial activity (Chhabra,Uiso, and Mshiu 1983; El-Khaden and Mohammed 1958).

20 *Syzygium cordatum* Hochst. ex Krauss / TMRU 3165. 3166 / **mkosho, mnuma** / Kahororo, Tukutuku / tree / a decoction of the pounded twigs of this plant, together with those of *Desmodium adscendens* (Sw.) De. var. *robustum* Schubert, *Tephrosia linearis* (Willd.) Pers. and *Parinari curatellifolia* (Planch. ex) Benth., is drunk against cardiacpalpitation
See also *Dissotis debilis* (Melastomatacae).

Leaves: For stomach disorders, diarrhoea and together with the stembark and roots as a galactagogue (Watt and Breyer-Brandwijk 1962).

Roots: For indigestion (Kokwaro 1976).

Plant: Against tuberculosis and as an emetic (Watt and Breyer-Brandwijk 1962)/

Friedelin, epifriedelinol, bêta-sitosterol, arjunolic acid, gallic acid and ellagic acid from the wood and stembark and leucodelphinidin and leucocyanidiri from the stem bark and leaves have been isolated and characterized (Candy, McGarry, and Pegel 1968; Hegnauer 1969).

PAPILIONACEAE

21 *Crotalaria microcarpa* Benth./ TMRU 3167 / **kiroctuman** / Kahororo/ herb/ widespread in the drier parts of tropical Africa/ see *Dissotis debilis* var. *debilis* (Melastomataceae).

22 *Desmodium adscendens* (Sw.) De. var. *robustum* Schubert / TMRU 3168 / **kirandira** / Tukutuku / herb / tropical Africa / see *Syzygium cordatum* (Myrtaceae).

23 *Indigofera asparagoides* Taub. ssp. *ephemera* Gillett / TMRU 3169 / **kayojwa** / Tukutuku / herb / east and south Africa / see *Justicia matammensis* (Acanthaceae).

24 *Kotschya africana* Endl./ TMRU 3170 / **kyangwe** /Kahororo/ shrub/ east, central and south Africa / twig decoction is drunk against headaches and stomachaches. See also *Dissotis debilis* var. *debilis* (Melastomataceae).

Roots: For skin diseases (Kok waro 1976).

25 *Rhynchosia minima* (L.) DC. var. *minima* / TMRU 3171 / **mnkambi** / Tukutuku / herb / tropical Africa (scarce on the central plateau), Asia and tropical America / root decoction is drunk against gonorrhoea. See also *Justicia matammensis* (Acanthaceae) / C-Glycosylflavones (Besson et al. 1977), hydroquinone diacetate (Krishnamurty, Krishnaswarni, and Rangaswamy 1975), proanthocyanidins (Rangaswarny, Krishnamurty, and Rawat 1974), proteins and amino acids (Prakash and Misra 1988) from the seeds, and orientin, isoorientin, vitexin, isovitexin, C-glycosides and O-glycosides of 2-prenylated flavonoids, apigenin and maringenin from the leaves (Adinarayana, Ramachandriah, and Rao 1985) have been isolated and characterized / An alcoholic extract of the plant showed antimicrobial activity against *Staphylococcus aureus*, *Neisseria gonorrhoeae* and *Shigella boydii* (Chhabra, Uiso, and Mshiu 1983).

26 *Tephrosia linearis* (Willd.) Pers./ TMRU 3172 / **kamilikamo** / Tukutuku / herb / east and south Africa / See *Syzygium cordatum* (Myrtaceae).

PEDALIACEAE

27 *Sesamum angustifolium* (Oliv.) Engl./ TMRU 3173 / **ruzinga** / Buyekela / herb / east, west and south Africa / a decoction of the aerial parts is drunk by women to prevent conception
Leaves: For eye troubles and diarrhoea (Kokwaro 1976).

Roots: As an emetic (Kokwaro 1976).

Plant: Against diarrhoea, bums and wounds (Watt and Breyer-Brandwijk 1962)

Iridoid glycosides, sesamol and monomethoxysesamin have been isolated from the herb and characterized by chemical and spectroscopic methods (Hegnauer 1969).

ROSACEAE

Parinari curatellifolia (Planch. ex) Benth./ TMRU 3174 / **mnazi** / Tukutuku/ tree/ east, central and south Africa! the rootbark decoction is drunk to prevent an abortion. See also *Syzygium cordatum* (Myrtaceae)

Stembark: Against malaria, as a blood tonic and cardiac stimulant (Watt and Breyer-Brandwijk 1962)

The seed oil has been chemically analyzed and the following principal fatty acids obtained: alpha elaeostearinic acid, oleic acid and linolic acid (Hegnauer 1973).

RUBIACEAE

29 *Anthospermum herbaceum* L. f. var. *herbaceum* / TMRU 3175 / **enganyoil** / Kahororo/ herb! east and south Africa, Arabia/ See *Dissotis debilis* var. *debilis* Triana (Melastomataceae).

30 *Pentas zanzibarica* (Klotzsch) Vatke/ TMRU 3176 / **kashenda** / Tukutuku / herb / east and central Africa! See *Justicia matammensis* (Acanthaceae)!

Roots: Against gonorrhoea and syphilis (Kokwaro 1976).

Plant: Against headaches, fevers and rheumatic pains (Watt and Breyer-Brandwijk 1962).

SCROPHULARIACEAE

31 *Buchnera hispida* Buch.-Ham./ TMRU 3177 / **olorokilele** / Tukutuku / herb / tropical Africa, Madagascar, India / the whole plant is cooked with bonny beef without salt, then the soup mixed with stiffporridge and eaten as an antimalarial.

INDEX TO MEDICINAL PROPERTIES AND DISEASES

Abortifacient- 2, 5, 16, 17, 23, 25, 30; abortion prevention-28; anal prolapse-19; anthelmintic-17; backaches-3; blood tonic-28; burns-10, 27; cardiac palpitations-9, 13, 18, 20,22,26,28; cardiac stimulant-28; colic-10; conjunctivitis- 3, 10; constipation- 10; contraception-1, 3,7,15,27; convulsions (children)- 8, 14; coughs- 12, 19; diarrhoea- 10, II, 13, 19, 20,27; diuretic - 2, 5, 16, 17,23, 25, 30; dizziness-14; dysentery-10, 14; earaches-10; emetic-20, 27; encephalitis-14; expectorant- 4; eye troubles-27; fevers-9, 13, 19,29,30; galactagogue-4, 8, 20; gonorrhoea-13, 25, 29, 30; haemorrhages- 13, 19; headaches- 13, 24, 29, 30; heart complaints-2, 14; hookworms- 4; hydrocele-3; indigestion-20; inflammation-2, 10; intestinal disorders- 14; intestinal worms- 10; joint pains-3; lumbago-8; malaria-2,5,9, 10, 13, 14,16,17,18,19,20,21,23, 24,25,28,29,30,31; neonatal complaints- 15; neuralgia-8; pulmonary disorders-19; rectum ulcers-3; rheumatic pains- 10, 29, 30; sciatica-8; scrofula-4; skin diseases 24; sleep inducer-17; snake bites-4, 14; sore throats-13; sprains- 19; stomach troubles-4, 20; stomach-aches- 10, 12, 14,24; syphilis- 30; tapeworm- 13; traumatic pains-6; tuberculosis-20; wounds-10,27.

INDEX TO GENERA

Acalypha -11; Antherotoma - 16; Anthospermum-29; Aspilia-8; Bidens-9, 10; Buchnera-31; Cassia-5, 6; Crotalaria-21; Cyanotis=s l vDesmodium=s Tl; Dissotis=s il . 18; Harungana=Y s; Hibiscus-l 5; Indigofera-23; Justicia - 1, 2; Kotschya - 24; Leonotis - 14; Markhamia -4; Parinari -28; Pentas -30; Phyllanthus-12; Psidium-19; Rhynchosia-25; Sesamum-27; Syzygium-20; Tephrosia-26; Thunbergia-3.

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LITERATURE CITED

Adinarayana, D., P. Ramachandraiah, and K. N. Rao. 1985.

Flavonoid profiles of certain species of *Rhynchosia* of the family Leguminosae (Fabaceae). *Experientia* 41 :251-252.

Arnason, T., Ci-K. Wat, K. Downurm, E. Yamamoto, E. Graham, and G. H. N. Towers. 1980.

Photo sensitization of *Escherichia coli* and *Saccharomyces cerevisiae* by phenylheptatriene from *Bidens pilosa*. *Canadian Journal of Microbiology* 26:698-705.

Askar, A., S. E. EI-Nemr, and S. S. Bassiouny. 1986.

Aroma constituents in white and pink guava fruits. *Alimenti* 25: 162-167.

Bally, P. R. O. 1937.

Native medicinal and poisonous plants of East Africa. *Kew Bulletin* 1937: 10-26.

Besson, E., L. Chopin, L. Krishnaswami, and H. G. Krishnamurty. 1977.

C-Glycosylflavones from *Rhynchosia minima*. *Phytochemistry* 16:498.

Bhati. A. 1967.

Terpene chemistry. A preliminary study of the new sesquiterpene isolated from the leaves of guava, *Psidium guajava*. *Perfumery and Essential Oil Record* 58:707-709.

Bondarenko, A. S., G. T. Petrenko, B. E. Aizenman, and O. V. Euseenko. 1985.

Antimicrobial properties of phenylheptatriene, a polyacetylene antibiotic. *Mikrobiologichnyi Zhurnal* 47:81-83. In *Chemical Abstracts* 103:35495.

Brenan, J. M. P., and P. J. Greenway. 1949.

Check list of the forest trees and shrubs of Tanganyika Territory. *Imperial Forestry Institute, Oxford*.

Buckley, D. G., E. Ritchie, W. C. Taylor, and L. M. Young. 1972.

Madagascarin, a new pigment from the leaves of *Harungana madagascariensis*. *Australian Journal of Chemistry* 25:843-855.

Campos, F. A. de M. 1943.

Vitamin aspects of guava. *Annaes da Faculdade de Medicina da Universidade de São Paulo* 19:83-92.

Candy, H. A., E. J. McGarry, and K. H. Pegel. 1968.

Constituents of *Syzygium cordatum*. *Phytochemistry* 7:889-890.

Chen, A. H., S. R. Lin, and C. H. Hong. 1975.

Phytochemical study on *Bidens pilosa* L. var. *minor*. *Hua Hsueh* 1975:38-42. In *Chemical Abstracts* 84: 176691z.

Chhabra, S. c., R. L. A. Mahunnah, and E. N. Mshiu. 1987.

Plants used in traditional medicine in Eastern Tanzania. 1. Pteridophytes and Angiosperms (Acanthaceae to Canellaceae). *Journal of Ethnopharmacology* 21:253-277.

Chhabra, S. c., R. L. A. Mahunnah, and E. N. Mshiu 1989.

Plants used in traditional medicine in Eastern Tanzania. II. Angiosperms (Capparidaceae to Ebenaceae). *Journal of Ethnopharmacology* 25:339-359.

- Chhabra, S. c., R. L. A. Mahunnah, and E. N. Mshiu 1990.**
Plants used in traditional medicine in Eastern Tanzania. III. Angiosperms (Euphorbiaceae to Menispermaceae).
Journal of Ethnopharmacology 28:255-283.
- Chhabra, S. c., R. L. A. Mahunnah, and E. N. Mshiu 1990.**
Plants used in traditional medicine in Eastern Tanzania. IV. Angiosperms (Mimosaceae to Papilionaceae).
Journal of Ethnopharmacology 29:295-323.
- Chhabra, S. c., R. L. A. Mahunnah, and E. N. Mshiu 1991.**
Plants used in traditional medicine in Eastern Tanzania. V. Angiosperms (Passifloraceae to Sapindaceae).
Journal of Ethnopharmacology 33: 143-157.
- Chhabra, S. c., R. L. A. Mahunnah, and E. N. Mshiu**
Plants used in traditional medicine in Eastern Tanzania. VI. Angiosperms (Sapotaceae to Zingiberaceae).
Journal of Ethnopharmacology (in press).
- Shao, J. F., E. N. Mshiu, and F. C. Uiso. 1981.**
Screening of Tanzanian medicinal plants for antimicrobial activity.
I. Journal of African Medicinal Plants 4:93-98.
- Uiso, F. C., and E.N. Mshiu. 1983.**
Screening of Tanzanian medicinal plants for antimicrobial activity.
II. Dar es Salaam Medical Journal 10:36-41.
- Chopra, R. N., S. L. Nayar, and I. C. Chopra. 1956.**
Glossary of Indian medicinal plants.
Council of Scientific and Industrial Research, New Delhi.
- El-Khadem, H., and Y. S. Mohammed. 1958.**
Constituents of the leaves of *Psidium guajava*. II. Quercetin, avicularin, and guajaverin.
Journal of the Chemical Society 1958:3320-3323.
- Fleuret, A. 1980.**
Nonfood uses of plants in Usambara.
Economic Botany 34:320-333
- Gibbs, R. D. 1974.**
Chemotaxonomy of flowering plants.
Vol. III. McGill-Queen's Univ. Press, Montreal and London.
- Graham, K., E. A. Graham, and G. H. N. Towers. 1980.**
Cercaricidal activity of phenylheptatriene and alpha-terthienyl, naturally occurring compounds in species of Asteraceae (Compositae).
Canadian Journal of Zoology 58:1955-1958.
- Gunstone, F. D., G. I. Taylor, J. A. Cornelius, and T. W. Hammonds. 1968.**
New tropical seed oils. II. Component acids of leguminous and other seed oils.
Journal of the Science of Food and Agriculture 19: 706-709.
- Habib, M. A. 1986.**
Studies on the lipid and protein composition of guava seeds *Psidium guajava*. Food Chemistry 22:7-16.
- Haerdi, F. 1964.**
Die Eingeborenen-Heilpflanzen des Ulanga-Distriktes Tanganjikas (Ostafrika).
Acta Tropica, Supplementum 8: 1-278.
- Harjuola, R. 1980.**
Mirau and his practice. A study of the ethnomedical repertoire of a Tanzanian herbalist.
Tri-Med Books Ltd., London.

Hartzler, E. R. 1945.

The availability of ascorbic acid in papayas and guavas.
Journal of Nutrition 30: 355-365.

Hedberg, L, O. Hedberg, P. Madati, K. E. Mshigeni, E. N. Mshiu, and G. SamueIsson. 1982.

Inventory. of plants used in traditional medicine in Tanzania.

1. Plants of the families Acanthaceae-Cucurbitaceae.

Journal of Ethnopharmacology 6:26-90.

Hedberg, L, O. Hedberg, P. Madati, K. E. Mshigeni, E. N. Mshiu, and G. SamueIsson 1983a.

Inventory of plants used in traditional medicine in Tanzania. II. Plants of the families Dil-
leniaceae-Opiliaceae.

Journal of Ethnopharmacology 9:105-128.

Hedberg, L, O. Hedberg, P. Madati, K. E. Mshigeni, E. N. Mshiu, and G. SamueIsson 1983b.

Inventory of plants used in traditional medicine in Tanzania. III. Plants of the families

Papilionaceae- Vitaceae.

Journal of Ethnopharmacology 9:237-260.

Hegnauer, R. 1966.

Chemotaxonomic der Pflanzen.

Vol. 4. Birkhâser Verlag, Basel, Stuttgart.

Hegnauer, R. 1969.

Chemotaxonomic der Pflanzen.

Vol. 5. Birkhâser Verlag, Basel, Stuttgart.

Hegnauer, R. 1973.

Chemotaxonomic der Pflanzen.

Vol. 6.

Birkhâser Verlag, Basel, Stuttgart.

Hoffmann, B., and J. Hoelzl. 1988.

New chalcones from *Bidens pi/osa*.

Planta Medica 54:52-54.

Idstein, H., C. Bauer, and P. Schreier. 1985.

Volatile acids from tropical fruits: cherimoya *Annona cherimolia* Mill, guava *Psidium guajava* L., mango

Mangifera indica L. var. *alphonso*, papaya *Carica papaya* L.

Zeitschrift für Lebensmittel Untersuchung und Forschung 180:394-397.

Idstein, H., C. Bauer, and P. Schreier 1985.

Volatile constituents from guava *Psidium guajava* L. fruit.

Journal of Agricultural and Food Chemistry 33: 138-143.

Imperato, P. J. 1966.

Witchcraft and traditional medicine among the Luos of Tanzania, Tanzania

Notes and Records 66: 193-201.

Kokwaro, J. O. 1976.

Medicinal plants of East Africa.

East African Literature Bureau, Kampala, Nairobi, Dar es Salaam.

Krishnamurty, H. G., L. Krishnaswami, and N. S. Rangaswamy. 1975.

Hydroquinone diacetate from *Rhynchosia minima*.

Phytochemistry 14:2518- 2519.

Lin, L.-L., c.v. Wu, H.-C. Hsiu, M.-T. Wang, and H. Chuang. 1967.

Diabetes mellitus. 1. The hypoglycemic activity of phytosterin on alloxan-diabetic rats. T'ai-wan 1 Hsueh Hui Tsa Chih 66:58-66.
In Chemical Abstracts 68:20822b.

MacLeod, A. J., and N. Gonzalez de Troconis. 1982.

Volatile flavour components of guava.
Phytochemistry 21:1339-1342.

Mair, A. G. R., M. Pandiyan, and H. Venkatasubramanian. 1987.

Polyphenolic compounds from flowers of *Psidium guajava*.
Fitoterapia 58:204--205.

Maruyama, Y., H. Matsuda, R. Matsuda, M. Kubo, T. Hatano, and T. Okuda. 1985.

Study on *Psidium guajava* L. (1). Antidiabetic effect and effective components of the leaf of *Psidium guajava* L. Shoyakugaku Zasshi 39:261-269.
In Chemical Abstracts 105:18202p.

Miller, C. D., and R. C. Robbins. 1934.

Vitamin C in fresh pineapple juice and in guavas.
Hawaii Agricultural Experiment Station, Research Report 1934:25.

Mirvish, S. S., E. F. Rose, and D. M. Sutherland. 1979.

Studies on the esophagus. II. Enhancement of (³H)-thymidine incorporation in the rat esophagus by *Bidens pilosa* (a plant eaten in South Africa) and by croton oil.
Cancer Letters (Shannon, Ireland) 6:159-165.

Mirvish, S. S., S. Sulmasi, T. A. Lawson, P. Pour, and D. Sutherland. 1985.

Test of catechol, tannic acid, *Bidens pilosa*, croton oil, and phorbol for cocarcinogenesis of esophageal tumors induced in rats by methyl-n-arylnitrosamine.
Journal of the National Cancer Institute 74: 1283-1290.

Mishra, C. S. and K. Misra. 1981.

Chemical constituents of *Psidium guajava* heartwood.
Journal of the Indian Chemical Society 58:201-202.

Misra, K., and T. R. Seshadri. 1968.

Chemical components of the fruits of *Psidium guajava*.
Phytochemistry 7:641-645.

Nadkarni, K. M. 1976.

In A. K. Nadkarni, ed. Indian Materia Medica. Vol 1.
Popular Prakashan Pvt. Ltd., Bombay.

N'Dounga, M., G. Balansard, A. Babadjamian, P. T. David, and M. Gasquet. 1983.

Study on *Bidens pilosa* L. Identification and antiparasitic activity of l-phenyl-1,3,5-heptatriyne. *Plantes Medicinales et Phytotherapie* 17:64-75.

Okuda, T., T. Hatano, and K. Yazaki. 1984.

Guavin B, an ellagitannin of novel type.
Pharmaceutical Bulletin 32:3787-3788.

Okuda, T., T. Yoshida, T. Hatano, K. Yazaki, and M. Ashida. 1982.

Ellagitannins of the Casuarinaceae, Stachyuraceae, and Myrtaceae.
Phytochemistry 21: 2871-2874.

Okuda, T., T. Yoshida, T. Hatano, K. Yazaki, Y. Ikegami, and T. Shingu. 1987.

Guavin A, C and D, complex tannins from *Psidium guajava*. *Chemical & Pharmaceutical Bulletin* 35:443-446.

Oliveros-Belardo, L., R. M. Smith, J. M. Robinson, and V. Albano. 1986.

A chemical study of the essential oil from the fruit peeling of *Psidium guajava* L.
Philippine Journal of Science IIS: 1-21.

Osman, A. M., Y. M. El-Garby, and A. E. Sheta. 1974.

Chemical examination of local plants. VI. Triterpenoids of the leaves of *Psidium guajava*.
Phytochemistry 13:2015-2016.

Padula, M., and D. B. Rodriguez-Amaya. 1986.

Characterization of the carotenoids and assessment of the vitamin A value of Brazilian guavas *Psidium guajava* L.
Food Chemistry 20: 11-19.

Petard, P. 1952.

Tanniferous plants of Oceania.
Medicina Tropical 21: 181-186.

Prakash, D., and P. S. Misra. 1988.

Protein content and amino acid profile of some wild leguminous seeds.
Plant Foods for Human Nutrition (Dordrecht, Netherlands) 38:61-65.

Primo, B. L. 1945.

Tannin content of certain Brazilian vegetable products.
Anais da Associacao Quimica do Brasil 4: 117-120.

Rangaswamy, N. S., H. G. Krishnamurty, and M. S. Rawat. 1974.

Proanthocyanidins in seeds of the leguminous weed, *Rhynchosia minima*.
Current Science 43:792-793.

Sasaki, S., H. C. Chiang, K. Habaguchi, T. Yamada, K. Nakanishi, S. Matsueda, H.-Y. Hsu, and W.-N. Wu. 1966.

The constituents of medicinal plants in Taiwan.
Yakugaku Zasshi 86:869-870.

Seshadri, T. R., and K. Vasishtha. 1963.

Polyphenols of *Psidium guajava* plant.
Current Science (India) 32A99-500.

Seshadri, T. R., and K. Vasishtha 1964.

Polyphenolic components of guava fruit.
Current Science (India) 33:334-335.

Seshadri, T. R., and K. Vasishtha 1965.

Polyphenols of the stem- bark of *Psidium guajava* a new ellagic acid glycoside (amritoside).
Phytochemistry 4:317-326.

Shiota, H. 1978.

Review and study on guava fruits
Ilavor. Koryo 121:23-30.

Smith, R. M., and S. Siwatibau. 1975.

Sesquiterpene hydrocarbons of Fijian guavas.
Phytochemistry 14: 2013-2015.

Soliman, G., and M. K. Farid. 1952.

Constituents of the leaves of *Psidium guajava*. L Psidiolic acid.
Journal of the Chemical Society 1952:2782-2784.

Spencer, G. F., R. Kleiman, R. W. Miller, and F. R. Earle. 1971.

Occurrence of cis-6-hexadecenoic acid as the major component of *Thunbergia alata* seed oil.
Lipids 6:712-714

Stevens, K. L., J. E. Brekke, and D. J. Stern. 1972.

Volatile constituents in guava.
Journal of Agricultural and Food Chemistry 18:598-599.

Towers, G. H. N., J. T. Arnason, C. K. Wat, and J. D. H. Lambert. 1984.

Cercaricidal compositions containing a naturally occurring conjugated poly-acetylene and method for controlling cercariae using it.
Canada. 1,169,767. Jun 26.

Trivedi, K. K., and K. Misra. 1984.

Chemical investigation of *Psidium guajava* roots.
Current Science 53:746-747.

Varshney, I. P., and K. M. Shamsuddin. 1964.

Saponins and sapogenins XXIV. Sapogenins of the leaves of *Psidium guajava*.
Indian Journal of Chemistry 2:377-378.

Verdcourt, B. 1954.

Notes from the East African Herbarium.
II. Kew Bulletin 1954:35-43.

Wat, C.-K., R. K. Biswas, E. A. Graham, L. Bohm, G. H. N. Towers, and E. R. Waygood. 1979.

Ultra-violet-mediated cytotoxic activity of phenylheptatriene from *Bidens pilosa* L.
Journal of Natural Products 42:103-111.

Watt, J. M., and M. G. Breyer-Brandwijk. 1962.

Medicinal and poisonous plants of Southern and Eastern Africa.
2nd ed. E. & S. Livingstone Ltd. Edinburgh, London.

Weiss, E. A. 1973.

Some indigenous trees and shrubs used by local fisherman on the East African Coast.
Economic Botany 27: 174-192.

Weiss, E. A. 1979.

Some indigenous plants used domestically by East African Coast fisherman.
Economic Botany 33:35-51.

Wilson, C. W., and P. E. Shaw. 1978.

Terpene hydrocarbons from *Psidium guajava*.
Phytochemistry 7:1435-1436.

Wilson, C. W., P. E. Shaw, and C. W. Campbell. 1982.

Determination of organic acids and sugars in guava *Psidium guajava* L. cultivars by high-performance liquid chromatography.
Journal of the Science of Food and Agriculture 33:777-780.

Zheng, Y., Y. Sun, Z. Wu, and M. Liu. 1987.

Natural flavor components of *Psidium guajava* L. fruit.
Zhiwu Xuebao 29:643-648.
In Chemical Abstracts 108: 183681p.