The Ethnobotany and Chemistry of South African Meliaceae: A Review

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Abstract: Meliaceae are widely distributed across the world in tropical or subtropical climates and are of considerable ethnobotanical importance as sources of traditional medicine and cosmetics. This comprehensive review summarizes the ethnobotanical uses and chemistry of 12 South African species, belonging to six genera: Ekebergia, Nymania, Entandrophragma, Pseudobersama, Trichilia, and Turraea. Eight of the species have ethnomedicinal records, classified into 17 major disease categories. The ethnomedicinal uses comprise 85 ailments dominated by gastrointestinal complaints, followed by gynaecological and obstetrics related problems. Chemical records were found for 10 species, which describe nine classes of compounds. In nearly all South African Meliaceae, limonoids are the predominant constituents while triterpenes, sterols, and coumarins are also common. The widest range of use-records and medicinal applications are found with the two most chemically diverse species, Ekebergia capensis and Trichilia emetica. Of the chemical compounds identified in the various plant organs of the 10 species of South African Meliaceae for which data are available, 42% was found in bark and 17% in seeds. Roots represent 35% and bark 33% of the organs that are used medicinally, and they are typically prepared as decoctions or infusions. Root and bark harvesting are destructive so that it may be important to examine the chemistry of plant parts such as wild-crafted leaves and fruits.

Keywords: South African Meliaceae; ethnomedicinal importance; functional uses; chemistry; limonoids

1. Introduction

Ethnobotany is the cultural study of the practical uses of a region’s plants by the local people. It is interdisciplinary and can often progress into a lab-based collaborative project with the vision of benefiting modern society in the form of wild food crops, pharmaceuticals, nutraceuticals, or cosmetics [1]. Furthermore, by recording traditional plant use, indigenous knowledge and belief systems are conserved [2] and incentives for biodiversity conservation are realized. Unfortunately, the floras that are used traditionally are the most likely to be destroyed or threatened by over-exploitation. The management of plants that are utilised by local people or small grass-roots level industries may be facilitated by a more complete understanding of the dynamics of people–plant interactions [2–4].

The culture of plant-based subsistence is rapidly becoming a rarity in the modern world. Hence, the cultures of the African people represent a minority that have continued practicing holistic environmentalism that utilises raw plant-based materials for food, medicines, as pesticides or tools and in spiritual pursuits including rituals [5]. In the modern day, most South Africans rely on traditional medicine as a first line of treatment. This is chiefly due to its affordability, accessibility, and the high level of knowledge by local traditional healers [6,7]. In this regard, about 3000 out of over 20,000 species of higher plants in South Africa are used in traditional medicine [8]. The botanical prescriptions made by the archetypical traditional healers in South Africa are collectively called ‘muthi’ and are generally distributed out of informal markets.
Since the turn of the 21st century, there has been a renewal of interest in the use of medicinal plants and herbal remedies for the treatment of health afflictions or in nutritional support [9,10]. While traditional healing systems in Africa have become a rich source of information on plant-based health, there are minimal written records to draw upon to guide the integration of natural products into developed societies. This is due to the fact that medicinal plant-use knowledge of traditional healers is passed on from generation to generation via word of mouth [6]. Hence, the importance of creating written records of traditional knowledge cannot be over emphasized, particularly in South Africa [2] or in highly remote locations such as Ethiopia [5]. Pappe [11] published the first synthesis of South African medicinal plants, then nearly a century later, Watt and Breyer-Brandwijk [12] provided a more comprehensive report on medicinal plants used in the same country. Hutchings et al. [13] created a focused account of medicinal plants commonly used in the Zulu nation, which was further elaborated by Van Wyk et al. [6] and especially by Mhlongo and Van Wyk [14].

The chemistry of taxa from South African Meliaceae is highly diverse. Many sesquiterpenes, sterols, coumarins, flavonoids, and other phenolics have been reported. Species in Meliaceae are well known for their bitter and biologically active nortriterpenoids, known as limonoids or meliacins [15,16]. Over 300 limonoids have been isolated from the world’s flora and their production is confined to the order Rutales, of which they are more diverse and abundant in Meliaceae than in any other family [15–17]. They are derivatives of 4,4,8-trimethyl-17-furanylsteroid. These compounds have aroused considerable commercial interest due to their molluscicidal, antifungal, bactericidal, insect-antifeedant, insect-repellent, insecticidal, and plant antiviral activities, as well as their numerous medicinal effects in humans and animals [16,18–20]. Hence, limonoids have attracted significant interest within biological and chemical research disciplines.

Several researchers have reported the chemistry, biosynthesis, and biological activities of meliaceous limonoids [21–25]. *Azadirachta indica* L. is known as a famous limonoid producing plant as well as a source of environmentally friendly biopesticide of commercial importance in the agricultural sector. Products of *A. indica* (such as align, azitin, margosan-O, and turplex) were recognized and approved as pest control agents in the United States [26]. In China, three commercial limonoid products (from *A. indica*, *Melia azedarach* L., and *Melia toosendan* Siebold & Zucc.) were granted approval for insect controls on organic vegetable plantings.

The ethnobotanical uses of taxa in South African Meliaceae are well documented [6,12,13,27–30]. Several limonoids and other secondary metabolites with appreciable biological activities have also been reported in South African species of Meliaceae [31–35]. Hence, the aim of this study is to present a detailed and comprehensive review of the ethnobotanical uses and compounds that have been previously isolated from South African indigenous Meliaceae, which can be used for comparisons at a continental and global level. Additionally, to identify knowledge gaps in terms of the ethnobotany and chemistry that can be used as a guide for future research work.

2. The Ethnobotany and Chemistry of South African Meliaceae

2.1. Ethnobotanical Uses

Although there are many uses in woodwork, staining, and construction [36], the traditional and contemporary uses as medicines are also well documented [6,12,13,29,30,37–39]. Furthermore, the plants find a place in horticulture for ornamental purposes and shade, as food, as anti-feedants, and for ritual purposes [36]. The most frequently cited medicinal uses of species in Meliaceae are as anthelmintics and antimicrobials. However, they are included in a wide range of applications including as therapeutic interventions in cardiovascular function, and respiratory, urinary, gastrointestinal, dermatological, and oral infections [12,30].
Ethnobotanical uses and prescriptions of South African Meliaceae are reported in Table 1. Although six genera and twelve species are recognised in South Africa, only eight species from five genera have recorded ethnomedicinal uses, giving a total of 85 different ethnomedical uses summarised from published records. Out of the functional uses, Trichilia emetica Vahl demonstrated the highest utility, followed by Ekebergia capensis Sparrm (Figure 1). Both were frequently cited as being used as shade trees and for ornamental purposes, as well as for furniture, timber, and cosmetics (Section 2.1.5).

In the context of strictly therapeutic applications, E. capensis represents an important complement to South African materia medica [6]. The parts of E. capensis used traditionally vary according to end-use, but range from bark, leaf, fruit, root, wood to twig. Such applications include the treatment of epilepsy, malaria, pain, skin ailments, and gastrointestinal, respiratory, cardiovascular, and reproductive problems (Table 1).

The most commonly used organs are the bark or root bark, administered as a decoction that is boiled in about 2 L of water and taken as an emetic for coughs, heartburn, and respiratory chest complaints [6]. When a poultice is made from the crushed bark, it is combined with flour and water as a caking agent and applied as a skin scrub for use as a topical blood purifying agent for abscesses, boils, and in hot water infusions for pimples [13]. Different parts of the plant could either be used alone or in combination with other species. The bark powder and leaf decoctions are used in the treatment of intestinal worms and epilepsy [13,30,40]. In this regard, approximately 200 mL of the aqueous leaf
infusion is drunk as a purgative parasiticide. Furthermore, the bark and root are combined to treat gastritis, dysentery, heartburn, and as an expectorant [6,8,12]. The bark is also used in rituals to guard tribal chiefs against witchcraft and taken orally as a love charm emetic [13].

Table 1. The traditional uses of South African Meliaceae. The categories are according to Moffett’s (2010) classification. *NR: Not recorded; A: Afrikaans; E: English; N: Ndebele; NS: Northern Sotho; S: Sotho; Sh: Shona; T: Tsonga; Ts: Tswana; V: Vhavenda; X: Xhoza; Z: Zulu.

| Taxa                  | Local Names                                | Traditional Use             | Preparation and Administration | References |
|-----------------------|--------------------------------------------|------------------------------|--------------------------------|------------|
| Ekebergia capensis    | Esseboom, essenhout (A); dogplum, cape ash (E); munyonga, mmidibidi (NS); umNyamatsi (S); mumbafwe (T); nyamaru (Ts); mudouma, mutobvuma, muzhouzhou (V); umgwwenyezinja (X); imanaya, isimanaye, mahlunzidintaba, ronyamati, simanaya, umathunzi wentaba, umathunzini, umgwwenyana wezinja, umnyamathi, umthoma, usimanaye, uvungu, (Z) | Analgesic                     |                                |            |
|                       |                                            | Headache                    | Powdered, charred pulverized roots are sniffed | [12,41,42] |
|                       |                                            | Malaria                     | Extracts from maceration of crushed roots and leaves are drunk | [44] |
|                       |                                            | Anthelmintic                | Bark inner bark is boiled and drunk | [45] |
|                       |                                            | Antimicrobial               | Crushed leaf is boiled and drunk | [47,48] |
|                       |                                            | Venereal diseases           | Freshly collected bark and roots are boiled in water and the extract is drunk three times daily | [49] |
|                       |                                            | Cardio-vascular             | Leaf or inner bark is boiled and drunk | [13,45,47] |
|                       |                                            | Cytological                 | Bark NR | [13] |
|                       |                                            | Dermatological              | Fruits are crushed, sieved, and drunk | [50] |
|                       |                                            | Gastro-Intestinal           | Infusion or maceration of the bark powder is applied | [6,39,51,52] |
|                       |                                            | Abscess, scabies, and acne  | Bark | Infusion or maceration of the bark powder is applied | [6,39,51,52] |
|                       |                                            | Scabies                     | Root and leaf | NR | [12,41] |
|                       |                                            | Abscess and boil            | Bark | Crushed bark added to flour and water poultices is applied | [13,51] |
|                       |                                            | Pimples                     | Bark | Crushed bark in hot water infusion is drunk and used as a wash | [13,51] |
|                       |                                            | Skin ailments               | Leaf | NR | [37] |
|                       |                                            | Bloody stool                | Bark | Bark is macerated with bark of Diospyros lycioides Desf. and extract is drunk | [53] |
|                       |                                            | Emetic and heartburn        | Bark and root | Bark or root decoctions are taken as emetics | [6,43,54] |
Table 1. Cont.

| Taxa | Local Names | Traditional Use | Preparation and Administration | References |
|------|-------------|------------------|---------------------------------|------------|
| **Medicinal Use** | Part Use | | | |
| Gastritis, dysentery, and heartburn | Bark and root | One teaspoon of bark and root powder in a half cup of hot water is taken as tea | [6,12,41,44,55] |
| Purgative | Leaf | A cup of leaf infusion is drunk | [13] |
| Stomachache | Fruits | Fruits are masticated and swallowed | [50] |
| **Gynaecological and Obstetrics; Genital system** | | | | |
| Dystocia | Leaf and twig | Leafy twigs mixed with Indigofera ouabanguensis Tisser. are taken orally and used as a wash to treat dystocia | [30,56] |
| Infertility | Bark | NR | [13] |
| **Nervous system** | | | | |
| Epilepsy | Bark | Bark infusion is drunk | [57] |
| Stress relief | NR | NR | [14] |
| **Respiratory system** | | | | |
| Chest complaints and coughs | Bark and root | Bark or root decoctions are taken orally | [54] |
| Chronic cough | Leaf | NR | [43] |
| Cough and respiratory complaints | Bark | Bark decoction with root of Euclea natalensis A.DC. is drunk | [54] |
| **Trauma** | | | | |
| Snakebite | Root and leaf | Extracts from maceration of crushed roots and leaves are drunk | [44] |
| **Ethnoveterinary** | | | | |
| Tuberculosis | Bark | Crushed bark is boiled and administered orally | [48,58] |
| Abortion | Galls | Galls on plant are boiled and administered orally | [59] |
| **Magic** | | | | |
| Protection | Bark | Bark is used to protect chiefs against witchcraft | [13,60] |
| Love | Bark | Bark decoction is drunk as love charm emetics | [13,60] |
| **Analgesic** | | | | |
| Malaria | Bark | NR | [61] |
| **Antimicrobial** | | | | |
| Gonorrhoea | Root | Root decoction is drunk | [62] |
| Genital warts | Fruit | Burnt fruit peels mixed with Vaseline are applied topically | [62] |

Ekebergia pterophylla (C.DC.) Hofmeyr
Entandrophragma caudatum (Sprague) Sprague

Rotsessenhout (A); rock ash (E); maGwedla (S)

Bergmahonie (A); mountain mahogany, wooden-banana (E); mophumêna (Ts); munzhounzhou (V)
| Taxa | Local Names | Traditional Use | Preparation and Administration | References |
|------|-------------|-----------------|---------------------------------|------------|
| *Nymania capensis* (Thunb.) Lindb. | Kankerbos, kiepkiepies, klapperbos, klapperbossie, lanternbos, oumeidbos, oumeidebos, stuipbos, stuipbossie, stinkbossie, ystervarkbos (A); chinese lantern tree, kipkippers, klapper (E) | **Ear, Nose, and Throat**<br>Ear, Nose, and Throat | Leaf infusion is taken | [63] |
| | | **Influenza**<br>Influenza | Leaf | |
| | | **Gastro-Intestinal**<br>Gastro-Intestinal | | |
| | | **Stomach complaints and nausea**<br>Stomach complaints and nausea | Root decoction is taken | [64] |
| | | **Nervous system**<br>Nervous system | Leaf | Leaf decoction | [12,53,63] |
| | | **Convulsion**<br>Convulsion | | |
| | | **Trauma**<br>Trauma | | |
| | | | | Roasted, pulverized roots are sprinkled on the affected part and can also be mixed with fat into an ointment and applied as a salve | |
| | | **Urinary system**<br>Urinary system | Root | Root decoction is taken | [64] |
| | | **Kidney problem**<br>Kidney problem | Root | Root decoction is taken | |
| *Pseudobersama mossam bicensis* (Sim) Verdc. | Valswitessenhout (A); umpho (Z) | | No Ethnomedicinal Records | |
| *Trichilia dregeana* Sond. | Bos Rooi-essenhout, bosrooiessenhout (A); cape mahogany, forest mahogany, forest natal mahogany, white mahogany (E); mutshikili, mutuhu, muuhu (V); umhlakele, umkhuhlu, umkhuhluwa (X), isolo, umathunzi, umathunzini, umkhuhlu (Z) | **Analgesic**<br>Analgesic | A teaspoon of pulverised bark boiled in a cup of milk is allowed to cool and strained, then half a cup of the extract is taken as an enema in the early morning | [12,13] |
| | | **Back pain**<br>Back pain | Bark | | |
| | | **Fever**<br>Fever | Root | Root decoction is taken orally | [12,65] |
| | | **Toothache**<br>Toothache | NR | NR | [14] |
| | | | | Handful of leaves is boiled with a handful of *Albizia adianthifolia* leaves in 2 L water and half a cup of the decoction is taken daily | [27,43,53,66] |
| | | | | Leprosy NR NR | [65] |
| | | | | **Cardio-Vascular**<br>Cardio-Vascular | Blood purifier Bark | Bark is taken as an enema for men | [43] |
| | | | | **Dermatological**<br>Dermatological | Bruises and eczema<br>Bruises and eczema | Leaf or fruit poultice is applied topically | [65] |
| | | | | **Gastro-Intestinal**<br>Gastro-Intestinal | Bloody diarrhoea<br>Bloody diarrhoea | Bark decoction is taken daily | [53,65] |
| | | | | Purgative and stomach complaints<br>Purgative and stomach complaints | Bark or root | Bark infusion is taken as an enema or root decoction is taken orally | [13,65,67] |
| | | | | **Gynaecological and Obstetrics; Genital system**<br>Abortifacient<br>Abortifacient | Bark | Bark infusion or decoction is taken orally or used as an enema | [65,67] |
Table 1. Cont.

| Taxa                          | Local Names                                                                 | Traditional Use | Preparation and Administration | References |
|-------------------------------|-----------------------------------------------------------------------------|-----------------|---------------------------------|------------|
|                               |                                                                             | Medicinal Use   | Part Use                        | References |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Musculo-Skeletal| Lumbago NR                      | [65]       |
|                               |                                                                             |                 | NR                              |            |
|                               |                                                                             | Rheumatism      | Seed Oil from seed is used for massage | [65]       |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Trauma          | Seed Oil from seed is rubbed into scarifications made on fractured limb | [65]       |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Urinary system  | Kidney problem Bark Bark maceration is taken as an enema | [13,43,53] |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Ethnoveterinary | Fishing poison Bark NR           | [8,65,67]  |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Analgesic       | Back pain Bark or leaf Bark or leaf maceration is taken as an enema Twig, trunk, wood or root is chewed and the crushed flowers is used as a toothpaste | [12,13,68] |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Dental care     | Twig, trunk, wood, root or flower Leaf infusion is used to wash the head Leaf decoction mixed with lemon is drunk or used as a bath for 3–7 days. Bark decoction mixed with honey is also taken orally. Root, stem, and leaf decoction is taken 2–3 times daily for 3 days. Root maceration of T. emetica, Pseudocedrala kotschii (Schweinf.) Harms and Nauclea latifolia Sm. mixed with honey can also be drunk for 10 days | [69]       |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Headache        | Leaf Leaf infusion is used to wash the head Leaf decoction mixed with lemon is drunk or used as a bath for 3–7 days. Bark decoction mixed with honey is also taken orally. Root, stem, and leaf decoction is taken 2–3 times daily for 3 days. Root maceration of T. emetica, Pseudocedrala kotschii (Schweinf.) Harms and Nauclea latifolia Sm. mixed with honey can also be drunk for 10 days | [69]       |
|                               |                                                                             |                 |                                  | [38]       |
|                               |                                                                             | Malaria         | Leaf, bark, and root Leaf decoction mixed with lemon is drunk or used as a bath for 3–7 days. Bark decoction mixed with honey is also taken orally. Root, stem, and leaf decoction is taken 2–3 times daily for 3 days. Root maceration of T. emetica, Pseudocedrala kotschii (Schweinf.) Harms and Nauclea latifolia Sm. mixed with honey can also be drunk for 10 days | [38]       |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Antihelmintic   | Crushed bark mixed with root of Securidaca longependonculata Fresen. is taken orally for 3 days | [38]       |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Teniasis        | Bark Bark or leaf maceration is taken as an enema | [38]       |
|                               |                                                                             |                 |                                  | [38]       |
|                               |                                                                             | Worm            | Bark or root Bark or root decoction is taken daily for 3 days | [53,70]    |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Antimicrobial   | Dysentery Bark or leaf Bark or leaf maceration is taken as an enema | [12,13,71] |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Gonorrhoea      | Bark and leaf Bark and leaf decoction is drunk | [43,62]    |
|                               |                                                                             | and syphilis    |                                                                      |            |
|                               |                                                                             | Leprosy         | Root Root maceration is drunk or used as a bath | [38,42,71] |
|                               |                                                                             |                 |                                  |            |
|                               |                                                                             | Cardio-vascular | Blood and digestive tract cleanser Bark Infusion is applied as an enema | [13,43]    |
|                               |                                                                             |                 |                                  |            |
| Taxa | Local Names | Traditional Use | Preparation and Administration | References |
|------|-------------|-----------------|-------------------------------|------------|
| **Blood pressure** | Leaf | A teaspoon of 1 h decoction of *T. emetica* leaf, *Aloe marlothii* leaf, and *Hyphaene coriacea* root is taken orally three times daily | [27] |
| **Dermatological** | Burns and bruises | Leaf | Hot leaf infusion is applied to the affected part | [69] |
| | | | Leaf decoction is used in a steam bath or crushed leaves are applied on the affected part while the powdered bark can also be used for cleansing | [38,72] |
| | Dermatitis | Leaf and bark | Leaf decoction is used in a steam bath or crushed leaves are applied on the affected part while the powdered bark can also be used for cleansing | [38,72] |
| | Eczema | Fruit or leaf | Fruit or leaf poultice is applied topically | [12,13,73,74] |
| **Ear, Nose, and Throat** | Colds and bronchial inflammation | Root | Root decoction is taken orally | [37] |
| **Gastro-Intestinal** | Abdominal pain | Leaf or root | Crushed leaf or root decoction is used as a bath and taken orally with salt and lemon twice daily 50 g of chopped bark is boiled with 50 g of chopped bark of *Spirostachys africana* Sond. in 5 L of water and taken orally | [38] |
| | Constipation | Bark | Bark infusion is administered anally twice a day | [68] |
| | Diarrhoea | Bark | Root decoction mixed with coffee is taken orally for 3 days or decoction mixed with *Cassia sieberiana* DC. root and honey drunk in the morning for 5 days | [38] |
| | Digestive infections | Root | Root decoction mixed with coffee is taken orally for 3 days or decoction mixed with *Cassia sieberiana* DC. root and honey drunk in the morning for 5 days | [38] |
| | Emetic | Bark or root | Pulverized bark in hot water is taken, root extract can also be taken orally Powdered root infusion added to *Acacia nilotica* seed powder is taken Crushed root bark mixed with black pepper and crushed fruit of *Xylopia aethiopica* (Dunal) A. Rich. is taken daily, while the powdered root in salt water is used as an enema | [12,13,37,46,72,75–77] |
| | Flatulence | Root | Powdered root infusion added to *Acacia nilotica* seed powder is taken Crushed root bark mixed with black pepper and crushed fruit of *Xylopia aethiopica* (Dunal) A. Rich. is taken daily, while the powdered root in salt water is used as an enema | [38] |
| | Hemorrhoids | Root | | [38] |
| Taxa                        | Local Names                  | Traditional Use                                      | Preparation and Administration       | References  |
|-----------------------------|------------------------------|------------------------------------------------------|---------------------------------------|-------------|
| **Medicinal Use**           |                              |                                                      |                                       |             |
| Gastric ulcer               | Bark                         | Crushed bark mixed with salt and ginger is added to  | Crushed bark mixed to porridge and    | [38]        |
|                            |                              | porridge and taken twice daily                      | twice daily                           |             |
| Hernia                      | Root                         | Crushed root is added to porridge and taken orally  |                                       | [38]        |
| Inflamed anus               | Bark                         | Pulverized bark puffed into the anus                |                                       | [30]        |
| Jaundice                    | Root                         | Root decoction is taken daily for 3 days, chopped   |                                       | [38,70]     |
|                            |                              | roots are also mixed with honey and used as a bath  |                                       |             |
| Laxative                    | Bark                         | Bark is mixed with eggs and taken orally to clean   |                                       | [78]        |
|                            |                              | the stomach                                         |                                       |             |
| Purgative                   | Bark                         | Bark infusion or decoction is used as an enema or    |                                       | [53,67,76]  |
|                            |                              | taken orally                                         |                                       |             |
| Stomach complaints          | Bark                         | Bark infusion or decoction is taken orally or       |                                       | [43,53,54,67]|
|                            |                              | administered as an enema                             |                                       |             |
| **Gynaecological and Obstetrics; Genital system** |                              |                                                      |                                       |             |
| Abortifacient               | Bark                         | Bark infusion is taken                               |                                       | [67,71]     |
|                            | Bark and root                | One handful of crushed bark and root in a litre of   |                                       |             |
|                            |                              | milk and Coca Cola mixture is boiled for 15 min and  |                                       |             |
|                            |                              | taken orally                                         |                                       |             |
| Breast pain                 | Leaf                         | Leaf decoction is used to bath                       |                                       | [38]        |
| Dysmenorrhoea               | Leaf                         | Leaf decoction added to Tamarindus indica L. or      |                                       | [38,79]     |
|                            |                              | lemon is taken orally for 7 days                    |                                       |             |
| Fertility                   | Leaf                         | Leaf decoction with Combretum molle R. Br. ex G.    |                                       | [38]        |
|                            |                              | Don is taken orally                                  |                                       |             |
|                            |                              | Crushed bark mixed with the same amount of         |                                       |             |
|                            |                              | Gymnosporia senegalensis root is boiled and decoction|                                       | [27]        |
|                            |                              | is used as an enema                                  |                                       |             |
| Labour pain                 | Leaf                         | Hot leaf decoction is used to massage the belly of   |                                       | [27]        |
| Sterility                   | Root                         | and salt is taken as a porridge                     |                                       | [38]        |
| **Musculo-Skeletal**        |                              |                                                      |                                       |             |
| Lumbago                     | Bark or leaf                 | Bark or leaf maceration is taken as an enema        |                                       | [12,30]     |
| Paralyses                   | Root                         | Crushed root is mixed with porridge and taken orally|                                       | [38]        |
| Taxa                        | Local Names                                                                 | Traditional Use                  | Preparation and Administration                                                                 | References |
|-----------------------------|-----------------------------------------------------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------|------------|
| **Rheumatism**              |                                                                             | Oil from boiled seeds is taken   | Topically                                                                                        | [8,12,13,46,75] |
| **Ophthalmic**              |                                                                             |                                  |                                                                                                |            |
| Eye infection               | Leaf and bark                                                               | Leaf and bark decoction is used  | for eye cleansing for 2 days                                                                     | [38]       |
| **Respiratory system**      |                                                                             |                                  |                                                                                                |            |
| Cardiac problems            | Leaf                                                                        | Leaf decoction is taken orally   |                                                                                                | [80]       |
| Chest pain                  | Leaf                                                                        | Leaf decoction is used in a steam bath or rubbed on the chest | [38]       |
| Cough                       | Bark and root                                                               | Bark and root decoction is drunk |                                                                                                | [81]       |
| Pneumonia                   | Root or leaf                                                                | Root or leaf decoction is taken  | orally or used as a bath for 12 days                                                            | [37,38]    |
| **Trauma**                  |                                                                             |                                  |                                                                                                |            |
| Fracture                    | Seed                                                                        | Oil from the seed is rubbed into incisions on broken limbs and baked pulverized root of *Sideroxylon inerme* L. is applied | [8,12,13,82] |
| Stiffness or sprains        | Bark                                                                        | Bark extract is applied topically |                                                                                                | [69]       |
| Wound                       | Seed                                                                        | Oil from the seed is applied to prevent infection from maggots | [37]       |
| **Urinary system**          |                                                                             |                                  |                                                                                                |            |
| Kidney problem              | Bark                                                                        | Bark decoction is administered as an enema |                                                                                                | [43]       |
| Renal ailments              | Bark                                                                        | Bark decoction is taken orally   |                                                                                                | [13]       |
| **Ethnoveterinary**         |                                                                             |                                  |                                                                                                |            |
| Fishing poison              |                                                                             |                                  |                                                                                                |            |
| Magic                       |                                                                             |                                  |                                                                                                |            |
| Burial rituals              | Leaf                                                                        | Leaves are worn during burial rituals |                                                                                                | [54]       |
| **Dermatological**          |                                                                             |                                  |                                                                                                |            |
| Abscesses                   | Root                                                                        | Root decoction is taken orally   |                                                                                                | [30]       |
| **Gastro-Intestinal**       |                                                                             |                                  |                                                                                                |            |
| Ascites                     | Root                                                                        | Root maceration is taken orally  |                                                                                                | [12,13]    |
| Emetic                      | Bark                                                                        | Bark extract is taken orally     |                                                                                                | [8,37]     |
| Purgative                   | Bark and root                                                               | Bark and root decoction are taken orally |                                                                                                | [37]       |
| **Musculo-Skeletal**        |                                                                             |                                  |                                                                                                |            |
| Rheumatism                  | Root                                                                        | Root maceration is taken orally  |                                                                                                | [8,12,13,75,76] |
| **Respiratory system**      |                                                                             |                                  |                                                                                                |            |
| Cardiac problems            | Root                                                                        | Root maceration is taken orally  |                                                                                                | [12,13,47,75,76] |
## Table 1. Cont.

| Taxa                          | Local Names                                                                 | Traditional Use                  | Preparation and Administration                                                                 | References |
|-------------------------------|----------------------------------------------------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------|------------|
| **Plants**                    |                                                                            |                                  |                                                                                                |            |
| **Cough**                     |                                                                            | Root                             | Root decoction is taken orally                                                                  | [37]       |
| **Urinary system**            |                                                                            |                                  |                                                                                                |            |
| Urethral infection            |                                                                            | Bark                             | Bark decoction is taken orally 1–3 times daily                                                  | [83]       |
| Magic                         |                                                                            | Bark                             | Bark infusion is taken orally                                                                  | [30,75,76] |
| To induce a state of trance   |                                                                            | Bark                             |                                                                                                 |            |
| Protection from               |                                                                            |                                  |                                                                                                | [76]       |
| **Turraea nilotica**          | Kotschy and Peyr.                                                         |                                  |                                                                                                |            |
| Analgesic                     | Bushveld honeysuckle-tree, lowveld honeysuckle-tree, miombo honeysuckle-tree, small mahogany (E) isidlamvundala (N); chipindura, chirambagavakava, chitsvimbovarisa, chitunguru, mudyakuwe, mukondanyoka, muzaramhanga (Sh) | Headache                         | Root decoction or leaf infusion is taken orally                                                  | [46,67]    |
|                               |                                                                            | Toothache                        | Root decoction is used as a mouthwash                                                           | [76,84]    |
| **Anthelmintic**              |                                                                            |                                  |                                                                                                | [30]       |
| Ascariasis                    |                                                                            | Root                             | Root decoction is taken orally                                                                  |            |
| **Antimicrobial**             |                                                                            |                                  |                                                                                                | [81]       |
| Gonorrhoea                    |                                                                            | Root                             | Root decoction is taken orally                                                                  |            |
| Venereal diseases             |                                                                            | Root                             | Root infusion is taken orally                                                                   | [8,67]     |
| **Dermatological**            |                                                                            |                                  |                                                                                                |            |
| Abscesses                     |                                                                            | Root                             | Root decoction is taken orally and applied as a compress                                        | [30]       |
| **Gastro-Intestinal**         |                                                                            |                                  |                                                                                                |            |
| Abdominal pain                | Leaf or root                                                               | Leaf decoction or root infusion is taken orally                                                | [8,67,85]  |
| Constipation                  | Root                                                                       | Root bark decoction is taken orally                                                        | [8,81]     |
| Diarrhoea                     | Leaf or root                                                               | Leaf or root decoction is taken orally                                                        | [8,67,85]  |
| Indigestion                   | Root                                                                       | Root bark decoction is taken orally                                                        | [37]       |
| Schistosomiasis or hernia     | Root                                                                       | Root infusion mixed with honey is taken orally                                                | [81]       |
| **Gynaecological and Obstetrics; Genital system** |                                                                            |                                  |                                                                                                |            |
| Aphrodisiac                   | Root                                                                       | Powdered root mixed with beer or porridge is taken                                            | [67]       |
| Dysmenorrhoea                 | Root                                                                       | Powdered root mixed with porridge is taken                                                   | [8,67]     |
| Prevent abortion              | Root                                                                       | Root infusion is taken orally                                                            | [67]       |
| Sterility                     | Root                                                                       | Root decoction is taken orally                                                           | [81]       |
| Nervous system                |                                            |                                  |                                                                                                |            |
| Dizziness                     | Leaf                                                                        | Leaf infusion is taken orally                                                            | [67]       |
| Epilepsy                      | Root                                                                       | Powdered root mixed with porridge is taken                                                    | [8,67]     |
Table 1. Cont.

| Taxa                              | Local Names                                                                 | Traditional Use       | Preparation and Administration                          | References |
|-----------------------------------|-----------------------------------------------------------------------------|-----------------------|---------------------------------------------------------|------------|
| *Opthalmic*                       |                                                                             |                       |                                                         |            |
| Eye problems                      | Leaf                                                                         | Leaf paste is applied to the eyelids                           | [67]       |
| *Respiratory system*              |                                                                             |                       |                                                         |            |
| Dyspnea                           | Root                                                                         | Powdered root mixed with porridge is taken orally              | [67]       |
| Pneumonia                         | Root                                                                         | Powdered root is rubbed into scarification on the painful area, root infusion is taken orally, and smoke from the burnt roots is inhaled | [8,67]    |
| *Trauma*                          |                                                                             |                       |                                                         |            |
| Snakebite antidote                | Root                                                                         | Burnt root ashes are applied to the bite                        | [67]       |
| Wound                             | Root                                                                         | Root scrapings are applied topically                            | [30]       |
| *Urinary system*                  |                                                                             |                       |                                                         |            |
| Dysuria or rectal prolapse        | Root                                                                         | Root bark decoction is taken orally                             | [67]       |
| *Ethnoveterinary*                 |                                                                             |                       |                                                         |            |
| Anthelmintic for dogs             | Root                                                                         | Root infusion is administered orally                            | [67]       |
| Magic                             |                                                                             |                       |                                                         |            |
| To calm the insane                | Leaf                                                                         | Leaf infusion is administered orally and smoke from burnt leaves is inhaled | [67]       |
| *Turraea obtusifolia*             | Kleinkanferfoelieboom (A); small honeysuckle tree, lesser honeysuckle tree, (E); amzulu, ikhambi-lomsinga, i kunzi, inkunzi, inkunzi-embomvanya, umhlatholana, uswazi (Z) |                       |                                                         |            |
| *Gastro-Intestinal*              |                                                                             |                       |                                                         |            |
| Stomach and intestinal complaints | Leaf, bark and root                                                          | Hot water maceration of leaf, bark or root is given as an enema and also mixed with porridge to be taken orally | [13,54,75,76,86] |
| *Ethnoveterinary*                 |                                                                             |                       |                                                         |            |
| Wounds in livestock               | Leaf                                                                         | Crushed leaves are applied topically on the affected part      | [87]       |
| *Turraea pulchella*               | (Harms)                                                                      |                       |                                                         |            |
|                                   | T.D.Penn.                                                                    |                       |                                                         |            |
| *Turraea streyi* F. White and Styles |                                                                             |                       |                                                         |            |

2.1.1. Categories of Medicinal Uses

Remedies made from the South African Meliaceae are used to treat a wide variety of medical conditions in humans, as well as for ritual purposes. They are also used in ethnoveterinary treatments. Most of the species had more than one therapeutic use, with *T. emetica* having the highest number of uses and categories (50 and 15, respectively), followed by *E. capensis* (29 and 13, respectively). The lowest number of uses and categories was recorded against *T. obtusifolia* (Figure 1). The highest number of citations for ethnomedical uses was recorded against *T. emetica* (31) followed by *E. capensis* (30), *T. dregeana* (12), *T. nilotica* (9), *T. obtusifolia* (6), *N. capensis* (5), and *E. caudatum* (2) (Figure 1). Eighty-seven
different ailments grouped into 17 major categories which are gastro-intestinal; gynaecological and obstetrics; dermatological; analgesic; antimicrobial; respiratory system; magic; trauma; urinary system; nervous system; anthelmintic; ethnoveterinary; cardio-vascular; ear, nose and throat; ophthalmic; and cytological were recorded in this study (Figure 2). Most of the species of South African Meliaceae are mostly used in the treatment of gastro-intestinal ailments followed by gynaecological and obstetrics related ailments (Figure 2). However, there was no ethnomedicinal record found for four of the species (E. pterophylla, P. mossambicensis, T. pulchella, and T. streyi).

Figure 2. Number of ailments in each category, species used in the treatment of each category of ailment, and references for South African Meliaceae.

An example of the use of E. capensis in multi-therapeutic combinations with other species is the decoction that is made from a combination of E. capensis leafy twigs and I. oubanguiensis, which is taken orally and used as a was to treat dystocia [30]. Bryant [54], also described how the bark decoction of E. capensis is mixed with roots of E. natalensis, to be taken orally to treat respiratory problems. More examples of species combinations in multi-therapeutics with E. capensis are provided in Table 1. Preparation of herbal remedies
using more than one plant species can be attributed to the synergistic or additive effects that could occur during the treatment [88].

In contrast to *E. capensis*, *E. caudatum* has minimal presence in South African *materia medica*. The root decoction is being used as a remedy for gonorrhoea, while the burnt fruit is mixed with Vaseline and applied topically to treat genital warts [62]. This is not the only record of dry heating/burning as a *materia medica* modality.

In some applications, *N. capensis* processing involves a roasting step, i.e., according to Von Koenen [64] the root is roasted, pulverized, and applied topically to treat wounds and relieve knee pain. However, medical uses of *N. capensis* broaden to include a root decoction taken orally to treat kidney and stomach complaints, as well as nausea. The leaf decoction is also taken orally as a herbal remedy for convulsion [63,89].

*Trichilia dregeana* is an important medicinal plant with all of the parts used traditionally [55]. It is used as a herbal remedy for the treatment of syphilis, bloody diarrhoea, skin diseases, rheumatism, as an abortifacient, blood cleanser, and as fish poison (Table 1). The bark infusion or maceration is used as an enema for the treatment of kidney problems, bronchial inflammation, skin diseases, as well as general cleaning [13,43,52]. The bark is eaten as a purgative or for procuring abortion and also as a fish poison [67]. The leaf decoction is taken orally as a herbal remedy for syphilis [13,66].

Similar to *E. capensis*, species in *Trichilia* are also strongly represented in the ethnombotanical tradition of South African people. *Trichilia emetica* is a multipurpose tree that is widely distributed throughout Africa, meaning it is not exclusively a South African medicine [38]. All plant parts, the leaf, twig, bark, flower, wood, root, and fruit of *T. emetica* are used (Table 1). It is used as a purgative, an antipyretic, antiepileptic, and antimalarial agent [72]. The twig, trunk, wood, and root are chewed as herbal remedy for dental care [30]. The powdered bark is taken orally as a remedy for infertility and also to ease labour pain [27,38]. The bark decoction or infusion is also used to treat various ailments including dysentery, gastrointestinal problems, breast pains, back pains fever, malaria, and as a purgative (Table 1). The bark decoction is used by the Xhosa tribe as an enema to treat kidney problems [12].

In other applications, a hot leaf infusion of *T. emetica* is rubbed on the affected part to treat burns while the leaf decoction is taken orally as a remedy for dysmenorrhoea and syphilis [13,38]. The leaves are also used as a poultice for wound healing, skin problems, and contusions [29,52]. The leaves can also induce drowsiness or sleep at night when placed in the bed [38]. The root decoction is used as a herbal remedy for colds and bronchial inflammation, chest pain, fever, pneumonia, jaundice, gastrointestinal infections, and sexually transmitted diseases (Table 1). The fruit is used as a herbal remedy for eczema [13,82]. Pulverized seeds of *T. emetica* are boiled and the oil is rubbed on the affected part to treat rheumatism and leprosy [46]. However, the combination of two or more organs of *T. emetica* can also be used as a herbal remedy (Table 1) that is allegedly more potent than the individual parts. The decoction of stem, root, and bark is taken orally as a herbal remedy for whooping cough and ulcers [38,81]. The leaf and bark decoction of *T. emetica* is rubbed on the eye to treat an eye infection [38].

Similar to other taxa in Meliaceae, the bark and root of *T. floribunda* is used as a remedy for a broad range of ailments (Table 1). It is boiled in water and taken orally as an emetic and herbal remedy for urethral infection [37,54,83]. A bark infusion of *T. floribunda* is also taken orally to induce a state of trance prior to rituals [75]. The root decoction is taken orally as a remedy for cough and hardened abscess [37], while the root maceration is taken orally to treat rheumatism, cardiac problems, ascites, and dropsy [8,13]. The root and bark decoction are taken orally as a purgative [12,37].

The root decoction of *T. nilotica* is taken orally as a remedy for headaches, hardened abscess, indigestion, gonorrhoea, sterility, dysuria, jaundice, as a poison antidote, and against intestinal worms [30,67,70,81]. The root decoction is used as a mouth wash for toothache and the ash of the burnt root is applied topically as a snakebite antidote [30,84]. The root infusion is taken orally to treat venereal diseases, abdominal pain, constipation,
inflammation of navel cord, and to prevent abortion [8,30,67]. The root infusion is taken orally with honey to treat schistosomiasis, hernia, and bilharziasis, while in ethnoveterinary medicine, the root infusion is used as an anthelmintic for dogs [8,81]. The root powder is taken orally in beer or porridge as an aphrodisiac, it could also be used as a remedy for dysmenorrhea, epilepsy, and dyspnoea [67]. The leaf decoction is taken orally as a remedy for abdominal pain and diarrhoea, while the leaf infusion is taken orally as a remedy for dizziness [30,37,85]. The leaf infusion of *T. nilotica* is taken orally and the smoke from burnt leaves is inhaled to calm an ‘insane person’, while the leaf paste is applied to the eyelid to treat eye problems [67].

The leaves, bark, and root bark of *T. obtusifolia* are macerated together in hot water and taken with porridge as a remedy for stomach and intestinal complaints [86]. Due to the diverse use of *E. capensis*, *T. dregeana*, *T. emetica*, *T. floribunda*, and *T. obtusifolia* as herbal remedies, the bark is sold in informal herbal medicine markets as traditional medicines in Gauteng and KwaZulu-Natal provinces in South Africa [90].

2.1.2. Categories of Uses

Remedies made from South African Meliaceae are used to treat a wide variety of medical conditions in humans as well as for ritual purposes. They are also used in ethnoveterinary treatments. All of the species had more than one therapeutic use, with *T. emetica* having the highest number of uses and categories (50 and 15, respectively), followed by *E. capensis* (29 and 13, respectively) and the lowest number of uses and categories was recorded against *T. obtusifolia* (Figure 1). The highest number of citations for ethnomedicinal uses was recorded against *T. emetica* (31) followed by *E. capensis* (30), *T. dregeana* (12), *T. nilotica* (9), *T. obtusifolia* (6), *N. capensis* (5), and *E. caudatum* (2) (Figure 1). Eighty-seven different ailments were grouped into 17 major categories including gastrointestinal; gynaecological and obstetrics; dermatological; analgesic; antimicrobial; respiratory system; magic; trauma; urinary system; nervous system; anthelmintic; ethnoveterinary; cardio-vascular; ear, nose, and throat; ophthalmic; and cytological were recorded in this study (Figure 2). South African Meliaceae are mostly used in the treatment of gastrointestinal ailments followed by gynaecological and obstetrics related ailments (Figure 2). However, there was no ethnomedicinal record found for four of the species (*E. pterophylla*, *P. mossambicensis*, *T. pulchella*, and *T. streyi*).

2.1.3. Plant Parts Used

The plant parts of South African Meliaceae used in making herbal remedies were the root, bark, leaf, fruit, seed, twig, and trunk. Roots (35%), followed by barks (33%) and leaves (25%), were the most frequently used plant parts in preparation of the recorded herbal remedies (Figure 3a). Several studies reported roots to be more effective than other herbal plant parts. Hence, these were most frequently sourced [5,91–93]. This practice can also be linked to the scientific reasoning that roots and other underground parts contain high concentrations of bioactive compounds [94]. However, harvesting of roots for medicinal purposes is not sustainable as it threatens the existence of many medicinal plants which could lead to depletion of the plants. It is well documented by conservationists that medicinal plants mostly sourced for their root parts and bark are likely to be the most threatened by over-exploitation [95].

2.1.4. Mode of Herbal Preparation

Decoction (47%) was the most common mode of preparation recorded followed by infusion (16%), direct use as herbal powder (14%), poultice (12%), and maceration (11%) (Figure 3b). Decoction (boiling of the plant material) has been reported to be the most commonly used method of preparation in herbal medicine as it is believed that boiling extracts all of the potential bioactive compounds from the plant [96–100]. Moreover, decoction was reported to be the most common method of herbal preparations in South
Africa [6]. Most of the remedies were administered orally followed by topically in the case of wound and skin infections, while some are sniffed into the nose (Table 1).

![Diagram showing the percentage of different plant parts of South African Meliaceae reported to be used in ethnomedicine.](image)

**Figure 3.** (a) Percentage of different plant parts of South African Meliaceae reported to be used in ethnomedicine; (b) different dosage forms of herbal remedies of South African Meliaceae reported in the literature; (c) plant parts of South African Meliaceae from which compounds were reported to be extracted.

2.1.5. Other Uses

South African Meliaceae have also been reported to be useful for other purposes apart from medicinal uses. *Ekebergia capensis, E. pterophylla, Entandrophragma caudatum, T. dregeana, T. emetica, T. floribunda,* and *T. obtusifolia* are used as ornamental plants in gardens and on roadsides to create shade, wind breaks, and soil conservation (Table 2). The timber of *E. capensis, E. caudatum, P. mossambicensis,* and *T. dregeana* are mostly sought after by the furniture industry since they are soft, easy to work with, and durable (Table 2).

**Table 2.** The functional uses of South African Meliaceae.

| Taxa               | Functional Use                      | Traditional Use     | Method of Use                      | References |
|--------------------|-------------------------------------|---------------------|------------------------------------|------------|
| *Ekebergia capensis* | Tanning, furniture, brush, broom heads and handle, beams, planks, wagon, ship and boat building, light construction, poles and tool handles, light flooring, joinery, interior trim, vehicle bodies, sporting goods, toys, novelties Firewood and charcoal production | Wood               | Wood is used in furniture industry | [12,40]    |
|                    |                                     | Wood                | Wood is used in cooking            | [12,40]    |
|                    | Animal feed                         | Fruit and leaf      | Birds feed on fleshy parts of the fruit, while the leaf is used as a fodder It serves as an ornamental tree planted in gardens and roadsides for shades, as well as for wind break and soil conservation | [12,40]    |
|                    | Shades and wind break               | Whole plant         | Caterpillars are gathered from the plant and prepared as food | [40,43]    |
|                    | Edible caterpillar                  | Whole plant         |                                    | [43,101]    |
Table 2. Cont.

| Taxa                      | Functional Use               | Part Use            | Method of Use                                                                 | References |
|---------------------------|------------------------------|---------------------|-------------------------------------------------------------------------------|------------|
| Ekebergia pterophylla     | Garden tree                  | Whole plant         | Whole plant is used as an ornamental garden tree as well as a bonsai          | [76]       |
| Entandrophragma caudatum  | Furniture, cabinet making,   | Wood                | Wood is light and durable, hence high demand by the furniture industry       | [8]        |
|                           | carving canoes               |                     | Wood sap is used for tanning                                                 | [43]       |
|                           | Tanning                      | Wood                | Fruit pericarp is used to make ‘zwilwilili’ with which children like to play | [43,101]  |
|                           | Toy                           | Fruit               | Whole plant is favoured for shade                                            | [43]       |
| Nymania capensis          | Toy                           | Fruit pericarp       | Whole plant is used to create shady avenue and as an ornamental tree         | [65,75]    |
|                           | Animal feed                  | Leaf                | Whole plant is used to create shady avenue and as an ornamental tree         | [65]       |
| Pseudobersa mamossam bicensis | Buildings and charcoal       | Wood                | Wood is used in making poles in local house buildings, as well as firewood and making charcoal | [102] |
|                            | Food condiments              | Fruit               | Wood is used for carving, repair of ships, and for making household furniture | [8,55,75] |
| Trichilia dregeana        | Furniture and carving        | Wood                | Fruit content is cooked with vegetables, fruit pulp is eaten as sour milk, while the oil made from the fruit pulp is used in cooking vegetables and other relishes | [43,65] |
|                           | Craftwork                    | Wood                | Oil made from seed and fruit pulp is used to polish women’s clothes made from leather, furniture, and other household implements made from wood | [43] |
|                           | Polish                       | Fruit and seed      | Oil from seeds is used to make soap, cosmetics, and candles                   | [43,75,103]|
|                           | Soap and cosmetics           | Seed                | Residue from seeds after oil extraction is used as a fertilizer or animal feed | [65]       |
|                           | Forage or fertilizer         | Seed                | Fruits are eaten by birds and bats                                           | [75]       |
|                           | Drink                        | Seed aril           | Seed aril is pounded and made into a sauce or sweet drink                    | [65]       |
| Fishing                   | Seed aril                    |                     | Whole plant is used to create shady avenue and as an ornamental tree         | [65,75]    |
Table 2. Cont.

| Taxa                          | Functional Use | Traditional Use References | Part Use               | Method of Use                          | References |
|-------------------------------|----------------|-----------------------------|------------------------|----------------------------------------|------------|
| *Trichilia emetica*           | Shade          | Whole plant                 | Whole plant is used for shade | Oil from seed is used to make soap, body ointment, and candle | [43,75]    |
|                               |                |                            |                        |                                        | [8,71,76,103,104] |            |
|                               | Soap and cosmetics | Seed                      |                        | Residue from seed after oil extraction is used as a fertilizer | [71]       |
|                               | Fertilizer     | Seed                        | Seed aril is eaten as a substitute for kola |                       | [71]       |
|                               | Kola           | Leaf                        | Leaf is eaten by cattle and goats |                        | [71]       |
|                               | Forage         | Fruit                       | Fruit is eaten by baboons, antelopes, and monkeys |                     | [75]       |
|                               |                | Seed                        | Seed is eaten by birds |                        | [75,76]    |
|                               | Carvings       | Wood                        |                        | Wood is used in carving furniture, household implements, musical instruments, canoes, and as chew-stick | [8,71,75,76,105] |
|                               | Dyeing         | Bark                        | Pinkish or light red-brown dye is obtained from the beaten boiled bark |                     | [4,71,75] |
|                               | Cooking        | Seed aril                   | Seed aril is soaked and cooked together with squash or sweet potatoes | Juice is made from the seeds and other edible plants to control malnutrition | [8,75,101] |
|                               |                | Seed                        |                        |                                        | [106]      |
|                               | Beverage       | Fruit                       | NR                     |                                          | [101]      |
| *Turraea floribunda*          | Traps          | Wood                        |                        | Tree is used as an ornamental plant in humid, frost-free subtropical and tropical gardens, and as a greenhouse plant in temperate countries | [107]      |
|                               |                |                            |                        | Stems/branches are used for handicrafts and domestics purposes | [76,82]    |
|                               |                |                            |                        | Branches are sorted for firewood | [107]      |
| *Turraea nilotica*            | Handicrafts    | Stem/branches               |                        | Plant is used as an ornamental container plant in landscape designs, as well as an attractive garden plant | [107]      |
|                               | Firewood       | Branches                    |                        |                                         |            |
| *Turraea obtusifolia*         | Ornamental     | Whole plant                 |                        |                                          |            |
|                               | Insect repellent | Leaf                      |                        | Insect repellent | [87,101] |

The wood of *E. capensis*, *P. mossambicensis*, and *T. nilotica* are used for charcoal and firewood for cooking (Table 2). Birds feed on the fleshy part of the fruit of *E. capensis* and the leaves are used as a fodder for domestic stock and game [12,40]. Edible caterpillars gathered from *E. capensis* are eaten as food by the Vhavenda [43,101]. *Nymania capensis* is used as a garden plant and also as a source of forage for goats [89]. The seeds of *T. dregeana*...
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and T. emetica are known for their high fat content, hence the fat is used in soap making, as a body ointment, as polish, hair oil, and in cooking [43,75,103]. The seed arils of T. dregeana and T. emetica are cooked as vegetables or crushed for the milky juice which is taken with side dishes or as a drink [8,101]. In northern KwaZulu-Natal, the wood of T. dregeana is used to carve birds and animals which are sold along roadsides [8].

The wood of T. emetica is used to carve meat dishes, bowls, spoons, head rests, and animal carvings in Maputaland [4]. The leaves of T. emetica are eaten by wild animals and also worn in burial rituals by the Zulu [13,82]. The VaVhenda people in South Africa use the wood to construct the frame of an African traditional musical instrument (‘mbila’), while oil from T. emetica is applied on the instrument to soften the animal skin used for the instrument [82]. Saka and Msonthi [106] reported the juice from T. emetica seeds mixed with other edible plants to be used as multivitamins in cases of malnutrition.

The wood of T. floribunda is used for making traps, while stems of T. nilotica are used for handcrafts [107]. Turraea obtusifolia can also be used as a container plant in landscape design [76].

2.2. Reported Active Compounds

Several limonoids and other secondary metabolites of appreciable biological activities have been reported in South African species of the Meliaceae. The extracted compounds and parts extracted are represented in Table 3. Chemical studies for 10 out of the 12 South African Meliaceae were found. The two species that had no records are T. streyi and T. pulchella.

The compounds are classified according to nine categories of chemical class which are: (1) Limonoids, (2) triterpene, (3) coumarin, (4) glycoflavonoid (glycoside), (5) phenolic aglycone, (6) sterol (phytosterol), (7) pregnane, (8) protolimonoid, and (9) sesquiterpene. The highest reported chemical classes were limonoids followed by triterpenes and sterols. However, sterols are common in higher plants. On the other hand, a significant number of triterpenes, coumarins, and limonoids are described in South African species for the first time and their naming is etymologically related to the genus or species. Unsurprisingly, the richest diversity of new metabolites include a heterocyclic moiety in the form of a lactone, coumarin or furan.

Novel types of limonoid of the ekebergolactone class were first described from a species of Ekebergia and received the name capensolactones, which were isolated among others (Table 3) from the leaves, seeds, and stem bark of E. capensis [31,33,108,109]. From E. pterophylla, more new limonoids were described and given initials taken from the genus and species name (EP1-EP6), which are closely related to methyl angolensate and similar to those of other Ekebergia species [110,111]. Furthermore, complex limonoids referred to as Nymania 1-4 were isolated from the bark of N. capensis [112], reiterating the etymological genesis.

All of the species in the current study, except one, were rich sources of new limonoids, often described nowhere else in the world. While no limonoids were reported from P. mossambicensis, the nine other species investigated so far constitute valuable sources of these compounds [113–115]. The limonoids of E. caudatum were named phragmalins after the genus [116]. From seeds of T. dregeana, the limonoids include dregeana 1–4 [117]. Several limonoids from other South African Meliaceae were assigned in the stem bark of T. emetica, and previously undescribed compounds including trichirokin and trichilins A-G [24,118]. Then, in the genus Turraea several limonoids were also reported, such as turraflorins A–I and the floribundins A–F (names assigned in the current review, Table 3) from the root of T. floribunda, nilotin from the root and stem bark of T. nilotica [119,120] or prieurianins from seeds of T. obtusifolia [121–123].

The limonoid class, per se, was first isolated from citrus, typically from leaves, fruit, and peel of lemons, limes, oranges, pomelos, grapefruits, bergamots, and mandarins (Manners 2007; Hamdan 2011; Wang 2016). Citrus limonoids represent the traditional limonoid that is known as limonin or its derivatives, which occur in aglycone and glycoside
forms [124]. They are distinctly different from the ekebergolactone class of limonoid (that is a pentaneotriterpenoid) represented strongly in South African Meliaceae. These include Nymania limonoids and capensolactones. Therefore, it is expected that a functional overlap is minimal in the context of biology.

A third category of limonoids, ekebergins 1–10 from E. capensis are triterpenes and have demonstrated anti-plasmodial activity in an in vivo mouse model, giving moderate parasitemia suppression [33]. However, the ekebergins have a structural feature that classifies them as nortriterpenes, but conveys a structure that is between the traditional limonoid and a triterpene. In this regard, some researchers classify them as limonoids, whilst others call them nortriterpenes [125].

The protolimonoids are also of triterpenoid origin but are classed as steroids. Protolimonoids were isolated and assigned as new compounds from the root and stem bark of T. nilotica and named according to the species as nilotin and dihydroniloticin [119,120]. Melianone type protolimonoids were isolated and identified from E. caudatum [113–115] and T. obtusifolia, which also had turraeanthin [121–123].

The species that expressed the highest steroid composition was T. emetica, which produced an extract comprising C21 steroids known as 17β-ethylandrostan derivatives or simply pregnanes. Nine pregnanes are known thus far from T. emetica [126] and one from E. capensis [33]. The pregnanes are agonists of the nuclear pregnane x receptor, which controls the elimination of toxins from the body by xenobiotic monooxygenase metabolism (cytochrome P450 3A) [127]. Activation can cause a variety of effects that include promotion of elimination of toxins that have similar structures. However, drug-drug interactions can also result, preventing co-administered therapies from being metabolised. The net outcome is an increase in drug half-life for some types of xenobiotics, which can be positive in terms of prolonging efficacy effects, but negative by augmenting the risk of toxicity [128].

South African Meliaceae also express several common triterpenes of the oleanane type and common sterols such as β-sitosterol. For example, the type, as well as common triterpenes β-amyrin, β-amyrone, oleanonic acid, lupeol, and other common sterols were reported from the wood and bark of E. pterophylla [108]. Ergosterols were isolated from twigs and leaves of P. mossambicensis [129], cycloarten-diol triterpenes from the leaves of T. dregeana [130], and sterols from the stem bark of E. emetica [24]. The common triterpene oleanolic acid and its derivatives from E. capensis demonstrated cytotoxicity against cancer cell lines and moderate antiplasmodial activity that may be related to the cytotoxic activity [31]. However, novel acyclic triterpene derivatives of costatetraene or squalene are also reported in E. capensis. These hydroxylated structures are atypical in that they are tail-to-tail sesquiterpenes that demonstrate noteworthy antiplasmodial activity comparable to the ekebergin limonoid mentioned previously [33]. Some sesquiterpenes have also demonstrated these biological effects. Kurubasch aldehyde is another antiplasmodial terpene isolated from T. emetica, which is a hydroxylated humulene that is a potent inhibitor (IC₅₀ 7.4 µM) of the S180 cancer cell line and demonstrates a modest anti-protozoal effect [131].

South African Meliaceae are also a reservoir of rare coumarins. The pterophyllin 1–5 series was isolated from the wood and bark of E. pterophylla [132]. These chemical species belong to the group of furocoumarins. The pterophyllins are moderate antifungal compounds which are active against fruit pathogens [133]. Coumarins were also reported in E. capensis, one of which is ekersenin. This compound was first described in E. senegalensis but is now known to be widespread in African Meliaceae. Several derivatives of ekersenin were isolated from the stem bark, wood, and root of E. capensis [31–35]. While the cytotoxic effects against cancer cell lines have not yet been tested, it will be a worthy undertaking since a related limonoid demonstrated potent inhibition (IC₅₀ 6.8 µM) against the A2780 cell line [134], although the authors did not specify the mechanism nor did they screen against healthy cells, hence toxicity was not determined.
Table 3. Isolated compounds extracted from various parts of South African Meliaceae.

| Plant                  | Compound                  | Part Extracted     | References |
|-----------------------|---------------------------|--------------------|------------|
| **Ekebergia capensis**| **Limonoids**             |                    |            |
|                       | Capensolactones 1-3      | Seed [108]         |            |
|                       | Methyl 3α-hydroxy-3-deoxy angolensate | Seed [108]      |            |
|                       | Ekebergin                 | Seed [109]         |            |
|                       | Ekebergins C1-C3          | Bark [33]          |            |
|                       | 7-Deacetoxyl-7-oxogedunin | Bark [33]          |            |
|                       | Methylangolensate         | Bark [33]          |            |
|                       | Mexicanolide              | Bark [33]          |            |
|                       | Proceranolide             | Leaf and bark [31,33]|            |
|                       | Swietenolide              | Bark [33]          |            |
|                       | **Triterpenes**           |                    |            |
|                       | 3,11-Dioxooolean-12-en-28-oic acid | Bark [33]|            |
|                       | Ekebergin A               | Bark and root [31,33]|        |
|                       | Ekebergins D1-D5          | Bark [33]          |            |
|                       | Melliferone               | Bark [33]          |            |
|                       | 7-Acetyleneoctichilenone  | Bark [33]          |            |
|                       | Lupeol                    | Bark [32]          |            |
|                       | 2-hydroxymethyl-2,3,22,23-tetrahydroxy-6,10,15,19,23-penta methyl-6,10,14,18-tetra decatetraene | Bark [31,33,34]|            |
|                       | 3-Epi-ooleanolic acid     | Bark and wood [31,33–35]|        |
|                       | 3-Oxo-12β-hydroxy-oleanan-28,13β-oxide | Bark and root [31–35]|       |
|                       | Oleoic acid               | Bark, root, and wood [31–35]|       |
|                       | **Coumarins**             |                    |            |
|                       | Ekersenin                 | Bark [33,135]      |            |
|                       | 4,6-Dimethoxy-5-methylcoumarin | Bark [33]         |            |
|                       | 7-Hydroxy-6-methoxy coumarin | Wood [35]    |            |
|                       | **Glycoflavonoids**       |                    |            |
|                       | kaempferol-3-O-β-D-glucopyranoside; quercetin-3-O-β-D-glucopyranoside | Leaf [31]|            |
|                       | **Phenolics**             |                    |            |
|                       | Atraric acid              | Bark [32]          |            |
|                       | **Sterols**               |                    |            |
|                       | β-sitosterol              | Bark and wood [32,35]|        |
|                       | β-sitosterol oleate; β-sitosterol palmate | Bark [32]|            |
|                       | **Protolimonoids**        |                    |            |
|                       | Ekebergin B               | Bark [33]          |            |
|                       | Pregnanate                |                    |            |
|                       | (Z)-volkendousin          | Bark [33]          |            |
|                       | **Limonoids**             |                    |            |
|                       | Ekebergin                 | Seed [110]         |            |
|                       | Ekebergolaactones and prieurianin | Seed [110]|        |
|                       | EP1-EP6                   | Seed [111]         |            |
|                       | **Coumarins**             |                    |            |
|                       | Pterophyllins 1 and 2     | Bark [108]         |            |
|                       | Pterophyllins 3-5         | Wood [108]         |            |
|                       | **Triterpenes**           |                    |            |
|                       | Lupeol                    | Leaf [108]         |            |
|                       | Oleanonic acid; β-amyrin; and β-amyrone | Bark [108]|            |
|                       | **Sterols**               |                    |            |
|                       | β-sitosterol              | Bark [108]         |            |
|                       | β-sitosteryl acetate      | Bark [108]         |            |
|                       | **Phenolics**             |                    |            |
|                       | Atraric acid              | Bark [108]         |            |
|                       | **Limonoids**             |                    |            |

**Entandrophragma caudatum**
| Plant.                    | Compound                                                                 | Part Extracted | References |
|--------------------------|--------------------------------------------------------------------------|----------------|------------|
| Phragmalin; phragmalin 3,30-diisobutyrate; phragmalin 3-isobutyrate-30-propionate; Entandrophragmin B; (12α-acetoxyphragmalin 3-nicotinate-30-isobutyrate) Bussein A and B; entandrophragmin Protolimonoids 3α–turreanthin; melanone | Seed           | [116]       |
| Nymania capensis         | Limonoids Nymania 1-4; Prieurianin                                        | Bark and Wood  | [112]      |
| Pseudobersama mossambicensis | Sterols Ergosta-5,24(28)-diene-3β, 7α-diol; 24,28-epoxyergost-5-ene-3β, 7α-diol; and ergost-5-ene-3β,7 α,24,28-tetraol | Twig and leaf  | [129]      |
| Trichilia dregeana       | Limonoids Dregeana-5; dregeanin; and 12-(2′-deacetyl)-dregeanin | Stem           | [136]      |
|                          | D. 1-4; hispidin C                                                       | Seed           | [117]      |
|                          | Sterol Cycloart-23-ene-3β,25-diol                                        | Leaf           | [130]      |
| Trichilia emetica        | Limonoids Trichirokin                                                    | Stem           | [24]       |
|                          | Rohituka                                                                | Stem           | [24,118]   |
|                          | Trichilin A; trichilin B; and 7-acetyltrichilin A                        | Stem           | [137]      |
|                          | Trichilin C; trichilin D; and trichilin G                               | Stem           | [138]      |
|                          | Trichilin F and trichilin G                                             | Stem           | [139]      |
|                          | 1-acetyltrichilin; Tr-A; Tr-B; Tr-C                                     | Stem           | [140]      |
|                          | Dregeana-4; rohituca-3; rohituca-5; rohituca-7; and Nymania-1            | Stem           | [118]      |
|                          | Sesquiterpenes Kurubasch aldehyde                                     | Leaf           | [131]      |
|                          | Triterpenes Methyl-1(S),23(R)-diacetoxy-7(R),24,25-trihydroxy-20(S)-21,24-epoxy-3,4-seco-apotirucall-4(28), 14(15)-dien-3-oate | Stem           | [118]      |
|                          | Pregnane 1-methoxy-pregnan-17(R)-1,4-dien-3,16-dione; 1-methoxy-pregnan-17(S)-1,4-dien-3,16-dione; 2,3-seco-pregnan-17(S)-2,3-dioic acid-16-oxo-dimethyl ester; 2,3,16-tri hydroxy-5-pregnan-17(R)-20-yl acetate; 1-methoxy-androstan-1,4-dien-3,16-dione; 2,3-seco-androstan-2,3-dioic acid-16-oxo-dimethyl ester; 3-methoxy carbonyl-2,3-seco-androstan-3-oic acid-16-oxo-2,19-lactone; 2,3,16,20-tetrahydroxy-5-pregnan; 2,3-dihydroxypregnan-16-one | Root           | [126]      |
|                          | Phenolics Benzoic acid; protocatechuic acid                            | Stem           | [24]       |
|                          | Coumarin Scopoletin                                                     | Stem           | [24]       |
|                          | Sterols                                                                 |                |            |
Table 3. Cont.

| Plant          | Compound                                                                 | Part Extracted | References |
|----------------|--------------------------------------------------------------------------|----------------|------------|
| *Turraea floribunda* | **Limonoids** Floruburdin A (1β-acetoxy-3,7-diacetyl-4α-carbomethoxy-12α-isobutyrylyoxy-28-nor-1-tigloyl-havanensin); Floruburdin B (28-nor-4α-carbomethoxy-11β-acetoxy-12α-(2-methylbutanoyl oxy)-14,15-deoxyhavanensin-1,7-diacetate); Floruburdin C (28-nor-4α-carbomethoxy-11β-hydroxy-12α-(2-methylbutanoyl oxy)-14,15-deoxyhavanensin-1,7-diacetate); Floruburdin D (2218-nor-4α-carbomethoxy-11β-acetoxy-12α-(2-methylbutanoyl oxy)-14,15-deoxyhavanensin-1-acetate); Floruburdin E (28-nor-4α-carbomethoxy-7-deoxy-7-oxo-11β-acetoxy-12α-(2-methylbutanoyl oxy)-14,15-deoxyhavanensin-1-acetate) | Stem | [24] |
|                | Havanensinoids 2-4                                                       | Root           | [143]      |
|                | Floruburdin F (1α,7α-12α-triacetoxy-4α-carbomethoxy-11β-(2-methylpropanoyl oxy)-14β,15β-epoxyhavanensin) | Bark           | [121]      |
|                | Turraflorins A, B, and C                                                 | Seed           | [144]      |
|                | Turraflorins A and B; turraflorins D-I                                   | Seed           | [112]      |
|                | Toonafolin A and B                                                       | Seed           | [145]      |
|                | **Sterols**                                                              |                |            |
|                | Stigmasterol and sitosterol                                              | Wood           | [146]      |
| *Turraea nilotica* | **Limonoids** Nilotin                                                   | Root           | [119]      |
|                | Mzikonone; azadirone; 12α-acetoxy-7-deacetylazadirone; 1α,3α-diacyt-7α-tigloyvilasinin | Root           | [147]      |
|                | **Protolimonoids** Niloticin; hispidol B; piscidinol A; toonapubesin F    | Bark           | [147]      |
|                | Niloticin; dihydroniloticin; and piscidinol                              | Bark           | [120]      |
|                | **Sterols**                                                              |                |            |
|                | Sitosterol-3-O-β-D-glucopyranoside acetate; stigmasterol-3-O-β-D-glucopyranoside acetate; and sitosterol-3-O-β-D-glucopyranoside | Leaf           | [147]      |
| *Turraea obtusifolia* | **Limonoids** Nymania-1                                                  | Seed           | [122,148] |
|                | Prieurianin and rohitukin                                                | Seed           | [123]      |
|                | Prieurianin                                                             | Whole plant    | [121]      |
|                | **Protolimonoids** 7-deacetylglabretal-3-acetate Melianone; *Turraeanthin* | Wood           | [149]      |
|                | Melianodi; melianotriol; and 7,8-dihydro* *Turraeanthin* 3-acetate       | Seed           | [148]      |
|                | Melianone; sepalin-F                                                    | Leaf           | [146]      |
2.2.1. Class of Isolated Compounds and Parts Extracted

The isolated compounds are categorised into limonoids, triterpenes, sterols, protolimonoids, coumarins, pregnanes, phenolics, glycoflavonoids, and sesquiterpenes. The highest number of compounds reported in the studied species are limonoids (89 compounds) followed by triterpenes (20 compounds) (Figure 4). Limonoids were identified in all of the species except *P. mossambicensis* where only sterols have been reported until now (Table 3). Out of the various compounds isolated from South African Meliaceae, the highest number were from *E. capensis* (37) followed by *T. emetica* (36), *T. floribunda* (23), *E. pterophylla* (21), *T. nilotica* (15), *E. caudatum* (9), *T. dregeana* (9), *N. capensis* (5), and *P. mossambicensis* (3) (Figure 5). Most of the compounds were isolated from the bark (42%), followed by seed (17%), wood (16%), root (13%), leaf (11%), and twig (1%) of the plants (Figure 3c).

![Figure 4. Number of compounds (chemical diversity), classes of compounds, and references for each species of South African Meliaceae.](image-url)

2.2.2. Structures of Some of the Isolated Compounds

Most of the reported limonoids are summarised into series according to their structure (Table 4 and Figures 6–16) or with common structural themes. Floribundin naming is used here for the first time.

![Figure 5. Structures of some isolated compounds.](image-url)
Figure 5. Number of compounds, classes of compounds and references for each species of South African Meliaceae.

Table 4. Reported limonoids according to series.

| Series                        | Limonoids                                                                                      |
|-------------------------------|------------------------------------------------------------------------------------------------|
| Ketone and Azadirone           | Mzikonone; Azadirone; Toonafoi; Ekebergin C1; 12α-Acetoxy-7-deacetylazadirone; 7-deoxy-7-oxogedunin; 7-deacetoxy-7-oxogedunin |
| Capensolactones and Nymania   | Capensolactone 1-3; Nymania 1-4                                                                |
| Dregeanin EP *                 | Dregeanin; Dregeana 1-5; 12-(2'-deacetyl)-dregeanin                                             |
| Floribundin ** and Havanen    | EPI-6; Ekebergin; Methyl,3-hydroxy,3-deoxy-angolensate; Methlyangolensate Floribundin A-F       |
| Orphan                        | Havanensinoid 2-4                                                                              |
| Phragmalin and Phragmin        | 1α,3α-diacetyl-7α-tigloylvilasin; 14,15-deoxytoonacin; Nilotin; Prieurianin Entandrophragmin B; Phragmalin 3-isobutyrate-30-propionate; Entandrophragmin; Phragmalin 3,30-diisobutyrate; Phragmalin; Bussein A and B |
| Rohituka                      | Rohituc 3, 5 and 7; Hispidin C; Trichirokin                                                    |
| Swietenolide/Ekebergin        | Swietenolide; Proceranolide; Ekebergin C2-C3; Mexicanolide                                    |
| Trichilin                     | Trichilin A-G; 7-Acetyltrichilin A; 1-Acetyltrichilin                                         |
| Turraflorin                   | Turraflorin A-I                                                                                |

* EP is an abbreviation of Ekebergia pterophylla (Taylor and Taylor 1984; Kehrli et al., 1990; Mulholland et al., 1998; Murata et al., 2008)  
** Floribundin A–F was named by the authors since the authors did not provide a shorter name.
Figure 6. Ketone series of limonoids reported from South African Meliaceae [33,146,147].
Figure 7. Capensolactones and Nymania series of limonoids reported from South African Meliaceae [108,112].
Figure 8. Dregeanin series of limonoids reported from South African Meliaceae [117,136].
Figure 9. EP series of limonoids reported from South African Meliaceae [33,108,110,111].
Figure 10. Floribundin and Havanen series of limonoids reported from South African Meliaceae [121,141–143].
Figure 11. Orphan series of limonoids reported from South African Meliaceae [108,119,121,147].
Figure 12. Phragmalin, phragmin, and bussein series of limonoids reported from South African Meliaceae [113,116].
Figure 13. Rohituka series of limonoids reported from South African Meliaceae [24,117,118].
Figure 14. Swietenolide and Ekebergin series of limonoids reported from South African Meliaceae [31,33].
Figure 15. Trichilin series of limonoids reported from South African Meliaceae [137–139].
Figure 16. Turraflorin series of limonoids reported from South African Meliaceae [112,144].

3. Materials and Methods

The recorded ethnobotanical uses and isolated compounds were based on a search of scopus and science-direct electronic databases, pubMed, reference libraries, conference
papers, ethnobotanical books, dissertations, theses, and scientific articles. All of the relevant papers were included in this study except those that were not peer reviewed and those containing species that are not indigenous to South Africa. The ethnomedicinal uses are classified into 17 major categories, based on Moffett’s [150] classification, while the compounds were categorised into nine main chemical classes and the structures drawn using ACD/ChemSketch Freeware (Windows platform).

4. Conclusions

The species of South African Meliaceae have been reportedly used for a diversity of purposes from medicinal (including human and animal), to rituals, to functional uses (making of implements, furniture, oils, and dyes). A total of 85 different medicinal uses were recorded, and T. emetica is the most frequently used, followed by E. capensis. Several compounds have been isolated from South African Meliaceae. A total of 188 compounds belonging to nine classes were recorded from various plant parts. The highest number of compounds belonged to the limonoids class, followed by sterols. There was no record found for the chemistry of T. streyi and T. pulchella.

The high chemical diversity of these species may be related to the high diversity of therapeutic uses recorded. South African Meliaceae are mostly used in the treatment of gastro-intestinal ailments followed by gynaecological and obstetrics related ailments. The most common mode of herbal preparation was decoction followed by infusion. The roots followed by bark are mostly commonly used in the preparation of the remedies, whereas most of the compound isolation work focused on the bark followed by seeds – this may be a consequence of logistical difficulty in obtaining roots for chemical study.

The ethnomedicinal uses recorded in this study are of value for bioprospectors or synthetic chemists looking for chemical scaffolds as precursors to biologically enhanced derivatives. However, the current review also strengthens the call for increased conservation practice, which is due to the fact that root and bark harvesting are destructive. Hence, it may be important to examine the chemistry of plant parts such as leaves and fruits.

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