Ethnomedicinal study of medicinal plants used for treatment of urinary tract infections in Mara region, Tanzania

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Research

Abstract

Background: Medicinal plants (MPs) are a valuable inheritance for humanity, especially in most rural communities that rely on them for their primary healthcare needs. This study aims to document MPs used by Kuria Traditional Healers (KTH) in managing Urinary Tract Infections (UTIs) in Mara region, Tanzania.

Methods: This study was conducted in Tarime and Serengeti districts in Mara Region, Tanzania. Ethnobotanical information were collected using semi-structured interviews and field walks with 20 KTH from July 2021 to February 2022. The study focused on MPs’ names, parts used, preparation, and administration of remedies. Descriptive statistics and inferential indices were performed to analyze the data, and conservation statuses of the recorded MPs were retrieved from IUCN RedList online database.

Results: A total of twenty MPs belonging to 8 families were documented. The families with the higher number of MPs were Asteraceae (31.6%), followed by Lamiaceae (26.3%) and Fabaceae (15.8%). Most plants were shrubs (53%) and herbs (37%). Leaves (53%) and roots (29%) were the most preferred MPs parts for remedy formulation. Decoction (55%) and oral route (100%) were the most cited preparation and application of remedies, respectively. Among the recorded MPs, 35% fall within the least concern category in the IUCN database. Gender, age, education level, and experience significantly (p < 0.05) affected traditional medicinal knowledge.

Conclusion: The study discloses that the KTHs have rich knowledge of MPs used to treat UTIs. Their expertise on MPs should be validated with phytochemical and pharmacological studies, and their knowledge and practices must be conserved for future generations.

Keywords: Ethnomedicine, indigenous healers, infectious diseases, remedies, traditional medicines, UTIs
Background
Globally, urinary tract infections (UTIs) are one of the common bacterial infections affecting different parts of the urinary system of both men and women. Urinary Tract Infections (UTIs) are the most common casualty infections, with 50 - 60% prevalence in adult women (Medina & Castillo-Pino 2019), the leading cause of morbidity in the general population and the second most common infectious disease after respiratory infections (Addis et al. 2021). In Africa, the prevalence of UTIs is significantly high for women than men; for instance, in Nigeria, the prevalence of UTIs for women is 42.8%, while for men is 10.2% (Oladideinde et al. 2011). In Tanzania, the prevalence of UTI for women is 58.5% (Sekharan et al. 2017). Women are more pretentious than men due to their anatomical structures, sexual activities, use of some birth control measures, and menopause (Dougnon et al. 2020). Moreover, pregnant women, the elderly, or patients with spinal cord injuries, catheters, and diabetes are at high risk (Magliano et al. 2012, Shaikh et al. 2008).

Escherichia coli is the predominant pathogen responsible for UTIs. It is commonly found in the gastrointestinal tract and constitutes up to 80 - 85% (Kostakioti et al. 2012, Ronald 2002), followed by Staphylococcus saprophyticus, which accounts for 5 - 10% (Fazly Bazzaz et al. 2021). Other pathogens, such as Klebsiella pneumoniae, Proteus mirabilis, and Enterococcus faecalis, also cause UTIs (Flores-Mireles et al. 2015, Ronald 2002). The occurrence of infections due to viral or fungal agents is a rare phenomenon. Prolonged illness of UTIs may result in severe consequences such as frequent recurrences, pyelonephritis with sepsis, and birth to an immature baby, for the case of children, can result in renal damage and complications caused by regular antimicrobial use (Flores-Mireles et al. 2015).

Urinary Tract Infections (UTIs) are effectively treated through several antibiotics, including trimethoprim, ciprofloxacin, co-amoxiclav, or cephalaxin. In cases of severe infections, broad-spectrum parenteral antibiotics and admission for intravenous fluids are necessary (Fazly Bazzaz et al. 2021). Although antibiotics seemed effective and efficient in treating UTIs, the current evolution of resistance of microbial infectious developed resistance to the antibiotic, which made the antibiotic drugs lose their efficiency and effectiveness in treating contagious diseases, including UTIs (Khameneh et al. 2019, Loubet et al. 2020). These have caused a reliance on alternative medications to overcome drug resistance against microbial infectious diseases.

Medicinal plants (MPs) are the common alternative medicines to treat microbial infections in most rural African settings with limited health facilities. In developing countries, including Tanzania, documentation of indigenous knowledge and associated cultural practices on MPs and their applications is vital because it is a vehicle for preserving cultural heritage, the ethnopharmacological base of drug research, and the preservation of biological diversity.

Mara region is the ancestral home of the Kuria tribe in Tanzania, and MPs’ applications are popular among its residents. Unfortunately, there are limited records of in-depth ethno-botanical research in the Mara region (Charwi et al. 2023). The autochthonous knowledge can vanish because of the immigration of locals to urban areas for employment, loss of natural habitats, industrialization, and extreme change in local ecology (Usman et al. 2022). This study, therefore, aims to document and compile the MPs used by the KTHs in treating UTIs in the region. The obtained data will help as a baseline for forthcoming phytochemical and pharmacological studies and for preserving the Mara region’s cultural practices.

Material and Methods
Description of the study area
This study was conducted in Tarime and Serengeti districts in Mara Region, Tanzania (Figure 1). Geographically, the region is located at 01° 46’ South latitude and 34° 09’ East longitude at about 1317 meters above sea level and covers a total area of 30,150 km². The region has a tropical wet and dry or savanna climate and receives biannual rainfall, with an annual average of 227 mm. Mara region is located along the East African Rift Valley, which is naturally endowed with a wide range of biodiversity resources given biannual rainfall seasons. Tarime and Serengeti districts were purposely selected due to the experiences of one author of this article. The literature review in this study has realized that ethno-botanical studies in the region are limited, and hence more studies on traditional medicinal plants are paramount. Four villages were investigated in the two districts: Rosana and Nyamwigura in Tarime; and Bhonchugu and Kebohosongo in Serengeti. The map below (Figure 1) depicts the setting of the villages in the region, and the study was carried out as per the schematic flowchart Figure 2.

Ethnobotanical data collection
The study was conducted between July 2021 and February 2022 using a semi-structured questionnaire (Martin 2010), and the interviews were performed using the local language so that KTH could adequately express themselves. A total of 20 KTH were selected, 13 from Tarime and 7 from Serengeti districts. Before interviewing, each KTH was informed about the study’s goal, and their consent to participate was requested. All plants mentioned were collected and identified with the help of
informants on separate field walks and a trained botanist. Voucher specimens were adequately prepared and deposited at the Herbarium of the Dar es Salaam University College of Education in Dar es Salaam. The scientific names were verified using the Plants of the World Online database (https://powo.science.kew.org/). The global conservation status of all the plants mentioned was then surveyed using the IUCN online database (2023).

Figure 1. Map showing locations of the study sites in Mara region and placement of the region in Tanzania.

Figure 2. Figure Schematic flowchart of the study plan.
Data analysis
The collected ethnobotanical information was organized and analyzed for descriptive statistics such as frequencies and percentages using Microsoft Excel 2013 version, while the Independent t-test and Analysis of Variance (ANOVA) were analyzed using QED statistic software. The conservation status of the collected MPs was derived from the International Union for Conservation of Nature RedList (IUCN RedList) threatened species database.

Results and Discussion
Kuria traditional healers' demographic profile
The KTHs are essential in providing primary health care in the Kuria community in the Mara region. In this study, women constituted 65% of the total KTHs in the two districts, while men represented 35% (Table 1). Unlike in Urambo District in Tanzania (Kacholi & Amir 2022a), Katsina State, Nigeria (Kankara et al. 2018), and Livingstone, Southern Province, Zambia (Chinsembu 2016), where male healers are highly trusted and dominate the traditional healing sector, for Kuria tribe is different. In many households, Kuria women are the central authority in home-based herbal therapeutics (Charwi et al. 2023). Similar supremacy is also reported among the Bambara in Mali (Imperato 1981).

Furthermore, the study revealed that most KTHs are older, as shown in Table 1. The data informs us of the traditional healing knowledge gap between the old and younger generation, as reported in Tabora (Kacholi & Amir 2022a) and Kagera (Kisangau et al. 2007) regions in Tanzania. Hence, the trend jeopardizes the existence of indigenous knowledge as it may get lost after the demise of the older generation and if not well documented for the future generation. Regarding education level, Most KTHs (65%) had primary education. A similar observation was also reported in Nsenda ward in Tabora region, Tanzania (Kacholi & Mvungi 2022). Also, most THs (52%) reported having acquired their healing practice from family members, while others gained knowledge from herbalists (19%), friends (14%), ancestor spirits (10%), and 5% trained themselves.

Table 1. Socio-demographic profile of Kuria traditional healers

<table>
<thead>
<tr>
<th>Biodata</th>
<th>Category</th>
<th>No. of KTHs</th>
<th>% of KTHs</th>
<th>Mean No. of MPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>7</td>
<td>35</td>
<td>5.6 ± 1.6a</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>13</td>
<td>65</td>
<td>7.7 ± 2.3b</td>
</tr>
<tr>
<td>Age (year)</td>
<td>30 - 45</td>
<td>4</td>
<td>20</td>
<td>3.7 ± 0.9a</td>
</tr>
<tr>
<td></td>
<td>46 - 65</td>
<td>8</td>
<td>40</td>
<td>6.6 ± 1.9b</td>
</tr>
<tr>
<td></td>
<td>&gt; 65</td>
<td>8</td>
<td>40</td>
<td>7.2 ± 2.1b</td>
</tr>
<tr>
<td>Education level</td>
<td>None</td>
<td>7</td>
<td>35</td>
<td>8.1 ± 1.9a</td>
</tr>
<tr>
<td></td>
<td>Primary</td>
<td>13</td>
<td>65</td>
<td>5.9 ± 1.2b</td>
</tr>
<tr>
<td>Experience (year)</td>
<td>&lt; 5</td>
<td>2</td>
<td>10</td>
<td>2.5 ± 0.7a</td>
</tr>
<tr>
<td></td>
<td>5-10</td>
<td>5</td>
<td>25</td>
<td>3.6 ± 1.5a</td>
</tr>
<tr>
<td></td>
<td>11 - 15</td>
<td>7</td>
<td>35</td>
<td>4.8 ± 1.5a</td>
</tr>
<tr>
<td></td>
<td>&gt; 15</td>
<td>6</td>
<td>30</td>
<td>8.3 ± 1.6b</td>
</tr>
</tbody>
</table>

Note: Differences in the superscript letters indicate significant differences between the two means at a 5% significant level.

Traditional Medicine Knowledge
The findings revealed that the average number of cited MPs within gender, age groups, education level, and experience categories differed appreciably. Female KTH cited a significantly higher number of MPs than men (t = -2.38, df = 17, p = 0.02). Reporting more MPs by women indicates a relatively better knowledge of women in traditional medicine. The transfer of knowledge on traditional medicine is conventionally transferred to daughters than sons in many parts of the Mara region through oral communication. The KTH with greater than 65 years (F(2,17) = 4.98, p = 0.01) and those with experience of greater than 15 years (F(3,16) = 12.19, p = 0.0002) had noticeably higher knowledge of MPs than the rest within respective categories (Table 2). Older people’s high level of medicinal knowledge could be due to the accumulated knowledge obtained through their long years of interaction with their environments (Usman et al. 2022). Other ethnobotanical studies such as (Abebe and Chane Teferi 2021, Girma et al. 2022, Kacholi & Mvungi 2022, Kassa et al. 2020) support our findings. The lower medicinal knowledge of younger KTH suggests the possible deterioration of information flow, which can be considered a risk to indigenous knowledge. Thus, the older KTH generation should communicate their knowledge to the youth as early as possible before they depart. Moreover, the knowledge of traditional medicine was also significantly varied between educational levels of the KTH (t = 2.74, df = 8, p = 0.02). The number of cited MPs declined with increasing education levels. The negative correlation between formal education and MPs knowledge has been reported elsewhere (Charwi et al. 2023, Girma et al. 2022, Kacholi & Mvungi 2022, Kassa et al. 2020). Most of the KTH informed to have learned the practices from their family members or close friends.
Medicinal plant diversity

A total of 20 MPs belonging to eight families and 20 genera were documented from the two studied Districts to be used by KTHs for managing UTI (Table 2). Asteraceae was observed to be the dominant family with 31.6% of the documented MPs, followed by Lamiaceae (26.3%) and Fabaceae (15.8%), while the remaining five families were represented by one species each (5% each) (Figure 3). Asteraceae and Lamiaceae were also commonly used as UTI therapies in Burkina Faso (Kam et al. 2018) and South Africa (Cock et al. 2021). Among the reported MPs, such as *Abras precatorius* L. is also used in Nigerians (Prenner 2013) and Benineses (Dougnon et al. 2020) pharmacopoeia to treat UTI. Also, *Bidens pilosa* L. is used by Indians (Pattanayak et al. 2017) and the people of Trinidad and Tobago (Lans 2006) for treating UTIs.

Life form analysis of the documented MPs revealed shrubs (53%) to be dominant, followed by herbs (37%). The other two life forms (trees and climbers) accounted for 5% each (Figure 4). The finding agrees with similar works conducted in Burkina Faso (Kam et al. 2018) and India (Pattanayak et al. 2017), which reported that shrubs and herbs are dominant MPs for treating UTIs. Moreover, the present result is in line with studies conducted in Uganda (Tugume and Nyakoojo 2019), Tanzania (Kacholi & Amir 2022b), and Ethiopia (Tuasha et al. 2018), which reported shrubs and herbs to manage various human ailments. The exploitation of shrubs and herbs indicates that KTHs are more knowledgeable about using the two forms. Most (60%) of the MPs were obtained from wild habitats, including forests, grasslands, roadsides, and around rivers, while the rest (40%) were cultivated in farmlands or home gardens (Table 1). This finding agrees with studies conducted in different parts of the country (Augustino and Gillah 2005, Kacholi and Amir 2022b, Kacholi & Mvungi 2022, Kingo & Maregesi 2020, Mahonge et al. 2006).
<table>
<thead>
<tr>
<th>Voucher No.</th>
<th>Scientific Names1</th>
<th>English name</th>
<th>Kuria Plant Name2</th>
<th>Family</th>
<th>Life form</th>
<th>HB</th>
<th>Plant part used</th>
<th>Preparation and administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC083</td>
<td>Abrus precatorius L.</td>
<td>Rosary pea</td>
<td>umri ghwi irighena</td>
<td>Fabaceae</td>
<td>Climber</td>
<td>W</td>
<td>Whole plant</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC067</td>
<td>Alnus rhombifolia Nutt.</td>
<td>White alder</td>
<td>omokéndé/</td>
<td>Betulaceae</td>
<td>Shrub</td>
<td>W</td>
<td>Leaves</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC062</td>
<td>Asystasia gangetica (L.) T.Anderson</td>
<td>Chinese violet or foxglove</td>
<td>mokéraoghetángó</td>
<td>Acanthaceae</td>
<td>Herb</td>
<td>W</td>
<td>Leaves</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC060</td>
<td>Bidens pilosa L.</td>
<td>Blackjack</td>
<td>iritótónimaisó/</td>
<td>Asteraceae</td>
<td>Herb</td>
<td>W</td>
<td>Leaves, Fruits</td>
<td>Decoction drunk (powdered mix with water and drink)</td>
</tr>
<tr>
<td>MC044</td>
<td>Chromolaena odorata (L.) R. King &amp; H. Rob,</td>
<td>Siam weed</td>
<td>irihémbúhémúbú/</td>
<td>Asteraceae</td>
<td>Herb</td>
<td>W</td>
<td>Leaves</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC030</td>
<td>Conyza bonariensis (L.) Cronq.</td>
<td>Hairy fleabane, Asthma weed</td>
<td>ibhibiúyátoróra/</td>
<td>Asteraceae</td>
<td>Herb</td>
<td>W</td>
<td>Leaves</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC006</td>
<td>Indigofera suffruticosa Mill</td>
<td>True indigo</td>
<td>eghesángúchi/</td>
<td>Fabaceae</td>
<td>Shrub</td>
<td>Cu</td>
<td>Roots</td>
<td>Chewing and gulping the liquid from the roots or pound, soak in water for 3 hours, and drink the infusion</td>
</tr>
<tr>
<td>MC094</td>
<td>Juglans regia L.</td>
<td>Walnut tree</td>
<td>umurííbha/</td>
<td>Juglandaceae</td>
<td>Tree</td>
<td>W</td>
<td>Bark, Leaves</td>
<td>Decoction drunk (pound seeds, mix with water, and drink the infusion) Infusion is drunk</td>
</tr>
<tr>
<td>MC003</td>
<td>Kalanchoe pinnata (Lam.) Pers.</td>
<td>Cathedral Bell, Miracle leaf motherwort,</td>
<td>eghekénékéné/</td>
<td>Crassulaceae</td>
<td>Herb</td>
<td>W</td>
<td>Seeds</td>
<td>Infusion drunk</td>
</tr>
<tr>
<td>MC047</td>
<td>Leonurus cardiaca L.</td>
<td></td>
<td>ibhibiukénékéné/</td>
<td>Lamiales</td>
<td>Herb</td>
<td>W</td>
<td>Leaves</td>
<td>Infusion drunk</td>
</tr>
<tr>
<td>MC034</td>
<td>Leucas urticifolia (Vahl) R.Br. ex Sm.</td>
<td>Horse mint</td>
<td>irinyabhoghághá/</td>
<td>Lamiales</td>
<td>Herb</td>
<td>Cu</td>
<td>Leaves</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC027</td>
<td>Ocimum gratissimum L.</td>
<td>African basil, clove basil</td>
<td>ikiií/</td>
<td>Lamiales</td>
<td>Shrub</td>
<td>Cu</td>
<td>Leaves</td>
<td>Chewing and gulping the liquid and Decoction drunk (for kids)</td>
</tr>
</tbody>
</table>

1 The Latin and English names were confirmed using the Plants of the World Online database (https://powo.science.kew.org/).

2 Kuria is a tonal language, which means that the tone pattern of a word can be the only phonological feature distinguishing it from other words. Kuria has two basic tones, i.e. high and low. Only high tones are noted with an acute accent mark on the vowel, e.g. á. Unmarked vowels are low-toned. Kuria plant names are inventoried in both their singular and plural forms, which are separated by a slash. Plant names with only one form are non-count nouns. Some of medicinal plants have two names, others have more than one noun class. All these possibilities have been shown in the column of Kuria plant names.
<table>
<thead>
<tr>
<th>Voucher No.</th>
<th>Scientific Names¹</th>
<th>English name</th>
<th>Kuria Plant Name²</th>
<th>Family</th>
<th>Life form</th>
<th>HB</th>
<th>Plant part used</th>
<th>Preparation and administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC055</td>
<td>Plectranthus amboinicus (Lour) Spreng.</td>
<td>Mexican mint</td>
<td>iririlebhána irikuria/ amarighabhána amakuria</td>
<td>Lamiaceae</td>
<td>Herb</td>
<td>Cu</td>
<td>Leaves</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC051</td>
<td>Ricinus communis L.</td>
<td>Castor oil plant</td>
<td>iriransanyi amaransanyi iritághará/ amatághará umubhíbhí/ imibhibhi</td>
<td>Euphorbiaceae</td>
<td>Shrub</td>
<td>Cu</td>
<td>Roots</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC058</td>
<td>Senecio mannii (Hook.f.) C. Jeffrey</td>
<td>Groundsel/ Ragwort</td>
<td>iriransanyi amaransanyi iritághará/ amatághará umubhíbhí/ imibhibhi</td>
<td>Asteraceae</td>
<td>Shrub</td>
<td>W</td>
<td>Leaves</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC084</td>
<td>Senecio mannii (Hook.f.) C. Jeffrey</td>
<td>Senna occidentalis (L.) Link</td>
<td>iritághará/ amatághará umubhíbhí/ imibhibhi</td>
<td>Fabaceae</td>
<td>Shrub</td>
<td>Cu</td>
<td>Roots</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC090</td>
<td>Solanum incanum L.</td>
<td>Nightshade or Thorn apple</td>
<td>iritá/ amatá/ amitá</td>
<td>Solanaceae</td>
<td>Shrub</td>
<td>Cu</td>
<td>Bark, Roots, Fruits</td>
<td>Chewing and gulping the liquid Cut the fruits, mix with lemon, then boil in water and drink the Decoction</td>
</tr>
<tr>
<td>MC049</td>
<td>Tetradenia riparia (Hochst.) Codd.</td>
<td>Ginger bush, Misty plume bush</td>
<td>irirákwá/ amarakwá</td>
<td>Lamiaceae</td>
<td>Shrub</td>
<td>W</td>
<td>Leaves</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC041</td>
<td>Tithonia diversifolia (HemsL.) A. Gray,</td>
<td>Mexican sunflower or tree marigold</td>
<td>iriichonkíná/ amachónkíná/ inchokíná/ ichinichokíná/ iirimárárwé/ amatárárwé</td>
<td>Asteraceae</td>
<td>Herb</td>
<td>Cu</td>
<td>Leaves</td>
<td>Decoction drunk</td>
</tr>
<tr>
<td>MC052</td>
<td>Vernonia gigantea (Walter) Trel.</td>
<td>Giant ironweed</td>
<td>iirimárárwé/ amatárárwé</td>
<td>Asteraceae</td>
<td>Shrub</td>
<td>W</td>
<td>Leaves, Roots</td>
<td>Infusion drunk</td>
</tr>
</tbody>
</table>
Plant parts used
The study observed that leaves (53%) followed by roots (29%) are the most preferred plant parts in remedy formulation (Figure 5). Other used plant parts include fruits, bark (7% each), and seeds (4%). Similarly, leaves are the most common plant part used in Iran (Bahmani et al. 2016), Burkina Faso (Kam et al. 2018), and Indonesia (Nisa et al. 2021) to treat UTIs. The use of leaves in herbal remedies is mainly due to easy accessibility and because they are the seat of photosynthesis and preferential sites for accumulating active ingredients (Mukaila et al. 2023). Moreover, compared to using plant roots or stem bark, which endangers MPs’ survival, the harvest of leaves presents a diminutive risk to MPs’ survival and encourages recurrent and sustainable utilization of MPs for herbal preparations (Omara 2020, Reimers et al. 2019, Sadeghi et al. 2014). Thus, applying leaves in herbal remedy formulations should be emphasized as a more sustainable practice due to less adverse impacts on the parent plant and renewability.

Roots are known to be rich in bioactive compounds (Alebie et al. 2017), but their frequent exploitation in herbal remedy preparations may threaten the existence of used MPs. Therefore, suitable harvesting approaches, including using alternative plant parts like leaves and conservation measures, are inevitable if sustainable consumption of MPs is to be realized (Kacholi and Amir 2022b, Omara 2020). Other used plant parts, such as seeds, bark, and fruits, which are known for accruing phytochemicals, are seldom utilized, similar to other reports from Zimbabwe (Ngarivhume et al. 2015), Ethiopia (Alebie et al. 2017) and Uganda (Okello & Kang 2019).

Preparation and administration of remedies
Most herbal remedies are prepared through the decoction technique (55%) followed by infusion (26%) and chewing (11%), while the remaining methods (powdering and burning) contribute 4% each (Figure 6). The decoctions and infusions were made by boiling from fresh plant materials and taken orally. Similar to this study finding, ethnobotanical studies conducted in the Blouberg area, South Africa (Mathibela et al. 2019), Burkina Faso (Kam et al. 2018), and Shiraz City in Iran (Bahmani et al. 2016) reported Decoction as the most dominant technique in preparing remedies for urinary tract ailments. Besides, other studies conducted in the Tabora region, Tanzania (Kacholi & Amir 2022b), Ejisu-Juaben Municipality, Ghana (Appiah et al. 2018), Rukungiri District, Uganda (Tugume & Nyakoojo 2019) and Guangxi, China (Hu et al. 2020) reported Decoction as the preferred method of preparing herbal remedies for treating various ailments. Decoctions are simple to prepare and allow high flexibility of recipes. The technique also speeds up the extraction of active compounds from plant materials, disinfects the materials, and clears poisonous compounds (Sheridan et al. 2012). The routes of administration of remedies were mainly oral (100%) because most KTHs established that oral administration was the most convenient for treating UTIs. Likewise, studies conducted elsewhere (Kam et al. 2018, Nisa et al. 2021) have reported the same route as the most dominant in treating urinary infections.
Pharmacological activities of some medicinal plants

Various studies conducted elsewhere have shown that some of the reported MPs possess essential compounds that can be used to treat UTIs. For instance, a study conducted in Kenya showed that the leaves extract of *Tetradenia riparia* (Hochst.) Codd can inhibit the growth of *Serratia liquefaciens*, indicating that the plant can be crucial in treating the infections caused by the bacteria, which cause nosocomial urinary tract infections (Ndiku & Ngule 2014). The mature leaves crude extracts of *Ricinus communis* L. (Anthony et al. 2022) and *Plectranthus amboinicus* (Lour) Spreng. (Yadav et al. 2021) indicated the significant potential to inhibit the growth of pathogenic fungal and bacterial strains and are medicinally safe. The aqueous extract of leves of *Indigo suffruticosa* Mill showed potent inhibitory activity against the Gram-positive bacteria *Staphylococcus aureus* and *Bacillus subtilis* (Leite et al. 2006). Moreover, the extracts of leaves of *Kalanchoe pinnata* (Lam.) Pers. showed good antibacterial activity against resistant UTIs isolates (Dholaria & Desai 2014). Nevertheless, investigating the MP's toxicity is vital as prolonged use of the remedies can jeopardize patient safety. For instance, the 70% ethanol extract of the aerial parts of *Tithonia diversifolia* (Hems.) A. Gray was reported to cause kidney and liver toxicity at the lowest dose tested (Elufioye et al. 2009). Thus, its use for treating UTIs raises alarms over its safety.

ICUN conservation status for the medicinal plants

The KTH sourced most of the MPs from wild environments near the villages. Most of the KTH are mindful of the importance of MPs in the local's livelihoods but do not recognise the likelihood of extinction due to overharvesting and lack of conservation of the MPs. Therefore, the IUCN RedList online database (https://www.iucnredlist.org/) was used to survey the conservation status of the recorded plants. The findings revealed information for only 35% (7 species) of the recorded MPs, emphasising that most plant species lack conservation information. All seven MPs (*Alnus rhombifolia* Nutt., *Juglans regia* L., *Leonurus cardiaca* L., *Senecio manni* (Hook.f.) C. Jeffrey, *Senna occidentalis* (L.) Link, *Solanum incanum* L., and *Tetradenia riparia* (Hochst.) Codd.) have a Least Concern (LC) conservation status, which ratifies a sufficiently stable population for the MPs worldwide. Although these are international conservation standings, the findings are an overall combination of the individual local exploitation of the world's flora. Thus, studies on the conservation of the recorded MPs are encouraged. Also, it is essential to assess the conservation status of the MPs that have not been evaluated too.

Conclusion

The study exposed that the KTH are rich in ethnomedicinal knowledge. Along with contemporary medications, people of the two districts still depend on herbal plant-based remedies for their primary health care needs. The socio-demographic statuses such as gender, age, education level, and experience were found to affect the traditional medicine knowledge of the local healers on conventional medicine. Since traditional knowledge is diminishing among the younger generations, knowledge transfer from older adults should be promoted and emphasized. The study suggests that the reported MPs should be subjected to pharmacological investigations to validate their efficacy and safety for extensive usage.
Declarations

Conflict of Interest: Authors have no conflict of interest.

List of abbreviations: MPs - Medicinal plants; UTIs - Urinary Transmitted Infections; KTHs - Kuria Traditional Healers; IUCN - International Union for Conservation of Nature.

Ethical approval and consent to participate: All the involved KTHs provided prior informed consent before the interviews.

Consent for publication: Oral permission from KTHs and local authorities has been taken.

Data and material availability: Voucher specimens were deposited in the herbarium of the Department of Biological Sciences, Dar es Salaam University College of Education. The rest of the details are available in this article.

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Author's contributions: MZC, NGM, and DSK conceptualized and designed the overall strategy of the study. MZC and NGM conducted fieldwork and collected plant materials for identification. DSK, MZC, and NGM processed, interpreted the surveyed data, drafted the manuscript, and All authors read, reviewed, and approved the final manuscript for publication consideration.

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