Ethnobotanical survey of anti-constipation medicinal plants used in Sikonge District, Tanzania

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Research

Abstract

Background: Constipation is a common gastrointestinal disorder in most low-and middle-income countries, including Tanzania. The disorder causes economic burdens to many societies in the country. Most of the locals in Tanzania depend on medicinal plants (MPs) to treat various ailments, including constipation. This study aimed to document MPs used by Nyamwezi traditional health practitioners (NTHPs) to manage constipation in Sikonge district, Tanzania.

Methods: This study was conducted between August and October 2020 in Sikonge district. The ethnobotanical data on MPs used to treat constipation, plant part(s) used, mode of preparation, and route administration of remedies were collected from twenty-three (23) NTHPs using a semi-structured questionnaire. The aim of the study was communicated to all NTHPs, and their consent was requested before interviewing them.

Results: The study documented 15 MPs belonging to 12 families and 14 genera. Euphorbiaceae was the wealthiest family with three MPs. Tree (40%) was the dominant life form utilised for herbal remedies preparations, and most MPs (67%) were collected from the wild areas. Roots (44%) were the most utilized plant part, decoction (73%) was the preferred remedy preparation method, and oral administration (93%) was the most used route in administering remedies. *Euphorbia hirta* Oliv. (81%), *Ricinus communis* L. (76%), *Euphorbia candelabrum* Welw. (67%), and *Clerodendrum capitatum* (Willd.) Schumach. (62%) were frequently mentioned by the NTHPs as the most widely used anti-constipation MPs in the area.

Conclusion: The study discloses that MPs are vital for primary health care needs in most rural areas in Tanzania. Moreover, it offers evidence for forthcoming pharmacological studies to discover effective and affordable novel drugs against constipation.

Keywords: Ethnobotany, ethnomedicine, constipation, digestive disorders, gastrointestinal, herbal remedies, Nyamwezi healers, Tabora region

Background

Constipation is a symptom-based disorder that occurs when bowel movements become less recurrent, and stools become difficult to pass, usually lasting two or more weeks (Forootan *et al.* 2018). Its diagnosis depends on the steadiness of the stool, the frequency of bowel movements, and difficulty in passing stools. Worldwide, constipation is a common gastrointestinal problem that causes significant economic burdens to societies (Liem *et al.* 2009). The prevalence of the disorder varies among countries and children and adults. For instance, studies conducted in European and Asian countries revealed a 10 - 20% prevalence in adults and 0.7 - 29.6% in children (Ip *et al.* 2005, Loening-Baucke 2005). The disorder accounts for 3 - 5% of the referral cases to pediatricians, and the records show that about one-third of kids aged 6 to 12 years get constipation at least once per annum (Farnam *et al.* 2009). In Africa, data on the prevalence of the disorder is limited and poorly quantified, but studies in urban health facilities report high frequency (Sehonou *et al.* 2018).

The disorder is mainly due to low-intake or lack of fibre diet, dehydration or taking inadequate amounts of fluids, especially water, during physical activity or in hot areas, delaying the impulse to have a bowel movement and causing a gradual decrease in colonic motility (Saad *et al.* 2010), travel or changes in routine (Wald *et al.* 2007), pregnancy, aging especially those with greater than 60 years (Sehonou *et al.* 2018), and consumption of some medications including certain antacids, painkillers, diuretics and some treatments for Parkinson's disease (Everhart & Ruhl 2009). The management of constipation includes the use of osmotic and stimulant laxatives, fibrous drugs, fibre-rich diets, stool softeners, and behavioral modification, including diet and lifestyle (Liu 2011). Though using over-the-counter laxatives is typical for urban dwellers in managing constipation, the drugs are expensive and sometimes inaccessible to most rural inhabitants due to limited modern health facilities in those areas (Wintola & Afolayan 2010). Hence, many people in rural settings rely on MPs for treatment.
Since time immemorial, people have used MPs to manage various health ailments, including stimulating the digestive system and reducing constipation. The MPs subsidise primary healthcare delivery in many rural settings in many African countries, and herbal remedies are gaining a reputation among global citizens as they have insignificant or no side effects if administered appropriately (Semenya *et al.* 2013). Constipation is among the public problems for which people are in quest of a plant-based absolute treatment (Forootan *et al.* 2018). However, the laxative potential of various MPs has been reported in many studies, and several are known to have anthraquinones, which absorb fluids in the intestine and increase bowel movement, which in turn helps the stool pass out of the body (Akram *et al.* 2022).

Although various ethnobotanical studies (Augustino *et al.* 2011, Kacholi & Amir 2022a, Kacholi & Amir 2022b, 2022b) on MPs have been conducted in Tanzania, particularly in the Tabora region, there is limited information on MPs used to manage constipation in the area. Therefore, this study aimed to document the anti-constipation MPs used by the Nyamwezi traditional health practitioners (NTHPs), their habits, plant parts used, and modes of preparation and administration. The present study is the first to focus exclusively on ethnomedicinal knowledge and practices of anti-constipation MPs in the country. Hence, the presented information provides baseline data for future pharmacological studies in formulating contemporary drugs against constipation and helps conserve MPs' knowledge of the recorded MPs.

Materials and Methods

Study area

Sikonge District is located in the southern part of the Tabora Region within latitudes 05°15' to 06°45'S and longitudes 32°15' to 33°45' E (Figure 1). The District covers 36.6% of the region's area and constitutes 10.2% of the region's population, with an annual population growth of 3.9% (URT 2022). The District borders Manyoni District to the east, Uyui District to the north, Urambo District to the northwest, Mlele District to the southwest, and Chunya District to the South. The altitude is nearly 1300 m above sea level and is dominated by the Miombo vegetation type. The climate of the study area is bimodal. The wet season lasts for five months, from November to March, and is characterised by humid and overcast conditions, while the dry season lasts for seven months, from April to October, and is characterized by windy and partly cloudy. The annual average low and high temperatures vary from 16°C to 33°C, for cool and hot seasons, respectively. The average rainfall of the study area is 165 mm. The main ethnic group in the District is Nyamwezi, who practice agriculture as their primary occupation. The rural population's socio-economic status in the community shows that most people in the District use herbal prescriptions to treat numerous health disorders (Masanja 2013, Kacholi & Mvungi 2022).

Research clearance and ethical procedures

The research clearance to undertake this study was obtained from the Office of the Vice-Chancellor of the University of Dar es Salaam, approval reference AB3/12(B) of March 5, 2020. The aim of the study was communicated to all NTHPs, and their consent was requested before engaging them.

Ethnobotanical data collection

This study adopted the standard ethnobotanical methodology (Martin 2010). The ethnobotanical information was collected from 23 NTHPs using a semi-structured questionnaire between August and October 2020. The NTHPs were obtained through snowballing sampling. The questionnaire focused on the local names of the plants, plant parts used, habits, modes of preparation, and administration of the treatments to the patients. The MPs used to treat constipation were obtained directly from the NTHPs, while others were collected during field walks through the forest. MPs were identified primarily by their local names and later authenticated at the Herbarium of the Department of Biological Sciences of the Dar es Salaam University College of Education (DUCE). All scientific names were verified using the Global Plants database (https://plants.jstor.org/) and Useful Tropical Plants (https://tropical.theferns.info/) database.

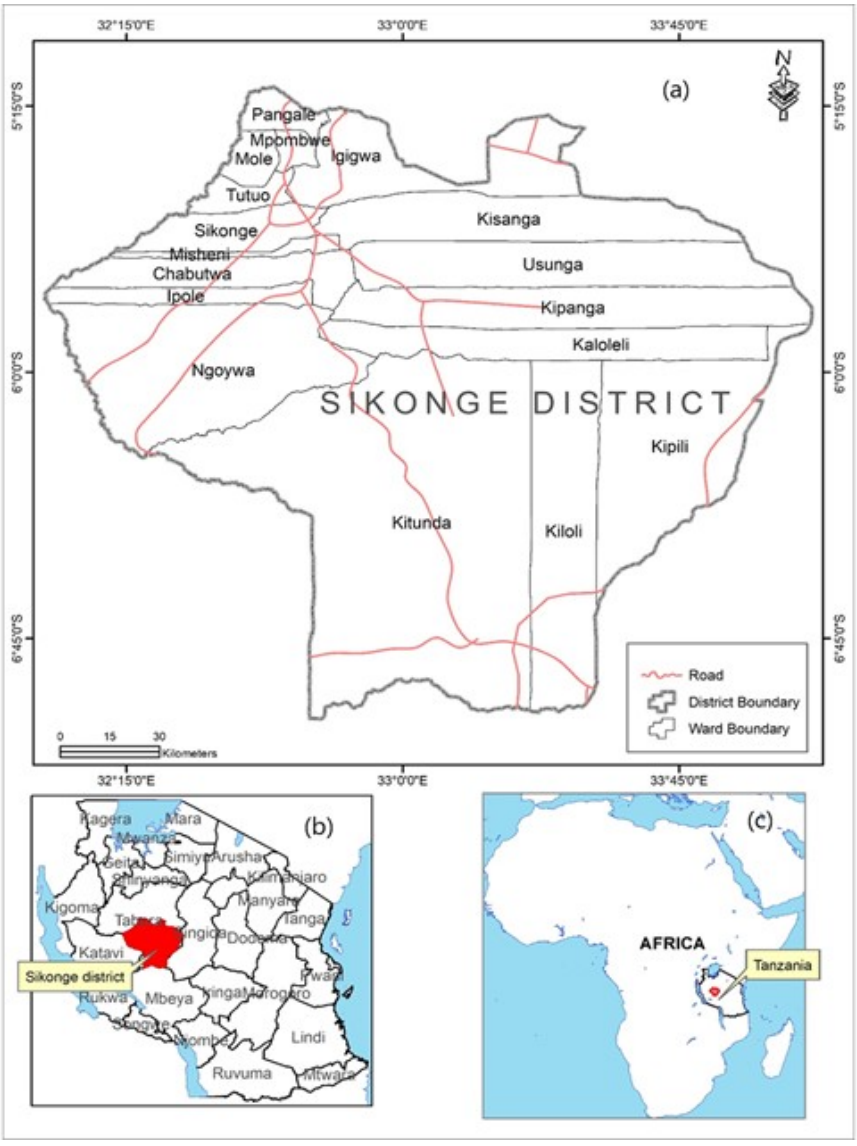

Figure 1. Map of Sikonge District and its location in Tanzania and Africa (Source: Kacholi & Mvungi 2022)

Data analysis

Data were organized using MS Excel software, and descriptive statistics such as frequencies and percentages were used to analyze the collected ethnobotanical data (plant parts, life forms, preparation methods, and routes of administration). The findings were then presented in figures and tables. The independent t-test confirmed differences in MPs' knowledge between genders. The one-way analysis of variance (single factor ANOVA) followed by the Tukey posthoc test ($p < 0.05$) was used to examine differences in MPs' knowledge within age groups, educational levels, and experiences. The correlation between age and experience in MPs' knowledge was evaluated using the Pearson correlation coefficient. The frequency index (FI) for each medicinal plant was computed to determine the number of NTHPs that considered a plant an anti-

constipation. The FI values range between 0% and 100%, whereby FI of 100% proposes the highest NTHP consensus on using a specific plant against constipation. The FI was computed as shown below:

$$FI = \frac{FC}{N}\ x\ 100$$

Where FC is the number of NTHPs who named the use of a specific species, and N is the total number of NTHPs who participated in the study (n = 23).

Results

Demographic characteristics of informants

In this study, male NTHPs were dominant, accounting for 74% of the total NTHPs. Regarding age group distribution, the highest number of NTHPs was in the 41 - 50 years (57%) age group, followed by the age group above 50 (22 %). The lowest and highest ages were 22 and 71 years, respectively. Regarding education, 48% of the NTHPs had a primary education level, 35% had no opportunity to attend formal education, and 17% had secondary education (Table 1).

Table 1. Demographic characteristics of NTHPs and mean (±SD) number of species

Variable	Category	No. of NTHPs	% NTHPs	No. of MPs
Gender	Male	17	74	8.8 ± 1.6[a]
	Female	6	26	6.3 ± 2.1[b]
Age (years)	21-30	3	13	5.3 ± 0.6[a]
	31-40	2	8	5.5 ± 0.7a
	41-50	13	57	9.5 ± 1.8b[b]
	> 50	5	22	10.4 ± 1.3[b]
Education levels	None	8	35	8.4 ± 2.1
	Primary	11	48	9.1 ± 2.6
	Secondary	4	17	7.3 ± 0.6
Experience (years)	< 5	2	8	4.5 ± 0.7
	5 - 10	6	26	6.2 ± 2.1
	11 - 15	12	52	9.3 ± 2.0
	> 15	3	13	10.3 ± 1.5

Note: The different superscript letters along a column indicate differences between the two values (p < 5%)

Medicinal plants knowledge

Men NTHPs enumerated more MPs than women (Table 1). The independent t-test revealed that men NTHPs had considerably higher knowledge of the traditional use of MPs than women (t = 2.69, df = 21, p = 0.031). The one-way ANOVA followed by the Tukey *posthoc* test revealed a significant difference in MPs' knowledge within the age groups (F = 10.34, p = 0.0002) and experience (F = 7.13, p = 0.002). In contrast, the MPs' knowledge among education levels (F = 0.86, p = 0.438) did not differ appreciably. The MPs' knowledge by age and experience showed a positive correlation (r = 0.85, n = 23) (Figure 2). Most NTHPs (39%) verbally acquired their ethnomedicinal knowledge from family members (parents, grandparents, or other relatives). Others gained knowledge through ancestor spirits (22%), friends (17%), dreams (13%), and self-trained (9%).

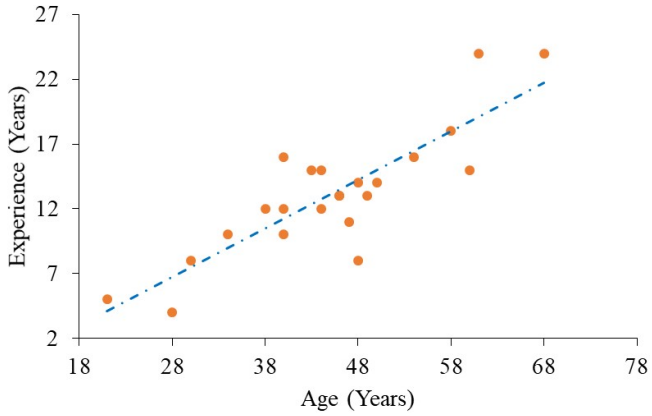

Figure 2. Relationship between the age of NTHPs and their experience in traditional medicinal practice

Table 2. List of medicinal plants used by Nyamwezi traditional health practitioners (NTHPs) for the treatment of constipation

Family Name	Scientific Name	Local name	Source	Habit	Part used	MoP & RoA	FI (%)
Anacardiaceae	*Sclerocarya birrea* (A.Rich.) Hochst.	Mng'ongwa	Wild	Shrub	Stem bark	Decoction; Oral	38
Annonaceae	*Monanthotaxis obovata* (Benth.) P.H.Hoekstra	Msalalasi	Wild	Shrub	Root	Decoction; Oral	23
	Hexalobus monopetalus (A.Rich.) Engl. & Diels	Mkuwa	Wild	Tree	Leaves	Decoction; Oral	52
Apocynaceae	*Strophanthus eminii* Asch. ex Pax	Msungululu	Wild	Climber	Root	Decoction; Oral	57
Euphorbiaceae	*Euphorbia candelabrum* Welw.	Mulangali	Wild	Tree	Twigs	Cooked mixed with Chicken/ goat or cow meat; Oral	67
	Euphorbia hirta L.	Vakikulu	Wild	Herb	Whole plant	Powdering, then mix with porridge; Oral	81
	Ricinus communis L.	Mnyonyo	Cultivated	Shrub	Seed	Chewing; Oral	76
Fabaceae	*Tamarindus indica* L.	Mkwaju	Cultivated	Tree	Leaves	Decoction; Oral	33
Loganiaceae	*Strychnos nitida* G.Don	Mwangajini	Wild	Climber	Root, Stem bark	Decoction; Oral	52
Myrtaceae	*Psidium guajava* L.	Mpera	Cultivated	Tree	Fruit	Chewing; Oral	23
Phylanthaceae	*Securidaca longependunculata* Fresen.	Muteyu	Wild	Tree	Root	Decoction; Oral	14
Rutaceae	*Zanthoxylum chalybeum* Engl.	Mulungulungu	Wild	Shrub	Root, Stem bark	Decoction; Oral	48
Sapotaceae	*Chysophyllum bangweolense* R.E.Fr. & Pelegr.	Museveye	Cultivated	Tree	Root	Decoction; Enema	57
Solanaceae	*Solanum incanum* L.	Ntalantu	Cultivated	Herb	Root	Decoction; Oral	28
Verbenaceae	*Clerodendrum capitatum* (Willd.) Schumach.	Kapolo	Wild	Climber	Root, Leaves	Decoction; Oral	62

NB: MoP represents the Method of preparation; RoA is the route of administration; FI is the familiarity index

Medicinal plants diversity

A total of 15 MPs belonging to 12 families and 14 genera were recorded as being used by NTHPs to treat constipation in the District (Table 2). Regarding MPs family distribution, Euphorbiaceae was the wealthiest family, represented by three species (20% of all species) and followed by Annonaceae (2 species, 13%). The remaining ten families were represented by one species each.

Frequency index

The eight MPs, namely *Euphorbia hirta* Oliv. (Euphorbiaceae) (81%), *Ricinus communis* L. (Euphorbiaceae) (76%), *Euphorbia candelabrum* Welw. (Euphorbiaceae) (67%), *Clerodendrum capitatum* (Willd.) Schumach. (Verbenaceae) (62%), *Chysophyllum bangweolense* R.E.Fr. & Pelegr. (Sapotaceae) and *Strophanthus eminii* Asch. ex Pax (Apocynaceae) (each with 57%), *Strychnos nitida* G.Don (Loganiaceae) and *Hexlalobus monopetalus* (A.Rich.) Engl. & Diels (Annonaceae) (each with 52%) had high-frequency indices of greater than 50% (Table 1), connoting that the MPs were frequently mentioned and highly recommended by NTHPs for managing constipation in Sikonge District.

Life forms, sources, and used plant parts

Among the recorded medicinal plants, trees (40%) and shrubs (27%) formed the highest life forms used for herbal remedies preparations in the District. Other reported life forms include climbers (13%), Liana (7%), and herbs (13%) (Figure 3). Most documented MPs (67%) are primarily sourced from wild environments, while 33% of the species are from cultivated ecosystems. Roots (44%) were the most utilised plant organ for preparing herbal remedies, followed by the leaves and bark (with 17% each), twigs and seeds (with 6% each), and fruits and whole plants, with 5% each (Figure 4).

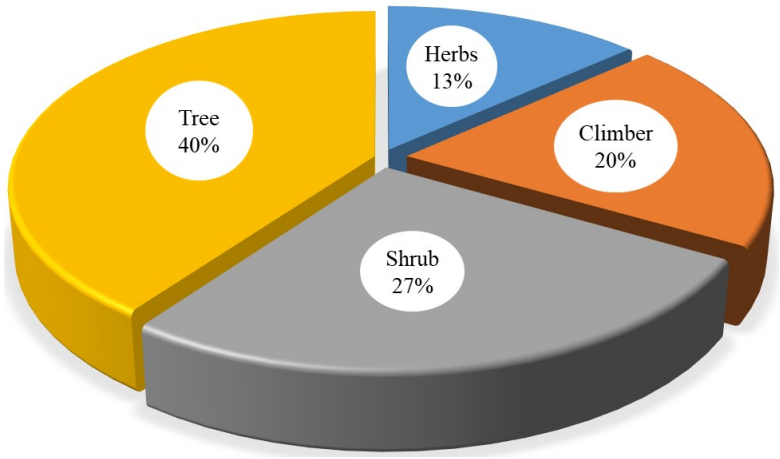

Figure 3. Plant life forms used in herbal remedies preparations

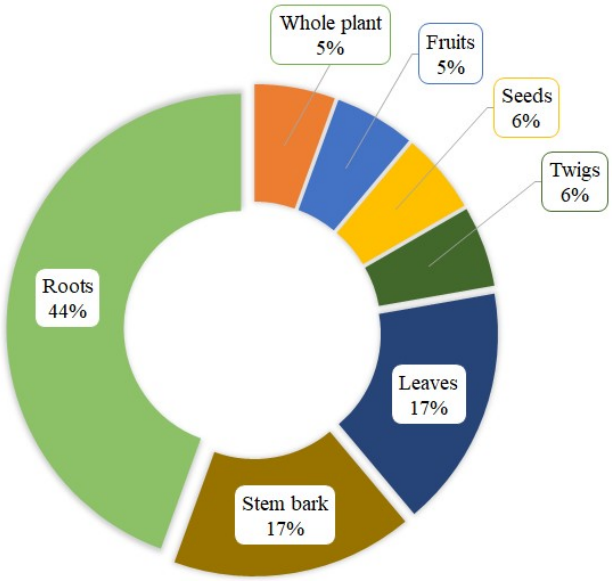

Figure 4. Plant parts used for herbal remedy formulation

Preparation and administration of remedies

About 57% of the plant parts are freshly harvested, 26% are used both dry and fresh parts, and 17% of the remedies are prepared from dry parts. Decoction (73%) was the most typical method of preparation of herbal remedies (Figure 5), and oral intake (93%) was the frequently used administration route. Of the listed medicinal plants, the decoction of roots of *C. bangweolense* was the only herbal remedy administered through an enema technique.

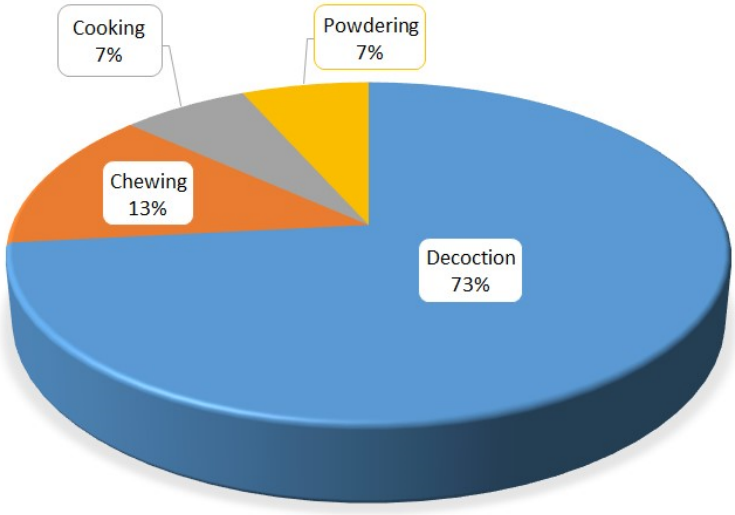

Figure 5. Methods of preparing herbal remedies

Discussion

Medicinal plants' knowledge

The findings exposed the supremacy of male NTHPs in the sector, which is similar to other ethnobotanical studies from Katsina State, Nigeria (Kankara *et al.* 2018), Nansebo District, Ethiopia (Girma *et al.* 2022), Bengkulu, Indonesia (Wiryono *et al.* 2019b) and Urambo District, Tanzania (Kacholi & Amir 2022a), males had more ethnomedicinal knowledge than females as they spend much time in the gardens and wild environment. However, some ethnobotanical studies reported the opposite finding: females or women knew more medicinal plants than males. For instance, in Nigeria (Olanipekun 2023) and Indonesia (Wiryono *et al.* 2019a), females had more medicinal knowledge than males because they were in charge of food and medicine at the household level. Moreover, the observed significant gender inequality might be expounded by the fact that male traditional health practitioners are more trustworthy in African traditional therapeutic practices than females, who face numerous cultural barricades (Kacholi & Amir 2022b).

Most old NTHPs were more knowledgeable than young ones as they have accumulated experiences and knowledge in the sector over time compared to younger ones. A similar result was also reported in Ethiopia (Girma *et al.* 2022), Nigeria (Olanipekun 2023), and Mexico (Beltrán-Rodríguez *et al.* 2014). The lack of traditional knowledge of the younger NTHPs could be associated with various factors, such as cultural changes resulting from modernization (Kacholi & Amir 2022a), disbelief, and lack of conventional healing interest (Ayantunde *et al.* 2008, Olanipekun 2023). The decline of ethnobotanical knowledge among young generations has been reported in other ethnobotanical studies in Mato Grosso, Brazil (Miguéis *et al.* 2019), Bengkulu, Indonesia (Wiryono *et al.* 2019b) and Tabora, Tanzania (Kacholi & Amir 2022a). This finding informs us of an ethnomedicinal knowledge gap between the younger and the older generation. The trend endangers the existence of medicinal plant knowledge if not well documented, as it may get lost after the departure of the elders.

In terms of education level, though there was no significant difference in MPs' knowledge, a study conducted in Nothern Kenya has reported that formal education contributes to the degradation of traditional knowledge (Bruyere *et al.* 2016). Thus, if emphasized, documentation of MPs and their utilization in various communities will ensure the smooth transfer of knowledge across generations.

Medicinal plants diversity

MPs continue to be the cheapest and most valuable source of cure in the primary healthcare systems for most African rural people (Kigen *et al.* 2017, Semenya *et al.* 2013, Ssenku *et al.* 2022). In Sikonge District, 15 MPs were mentioned by NTHPs as anti-constipation. Similar to other ethnobotanical studies conducted in sub-Saharan Africa, this study recorded a more

significant number of MPs used as anti-constipation. For instance, in South Africa (Wintola and Afolayan 2010) and Zimbabwe (Maroyi 2013), 10 and 5 MPs were reported as anti-constipation, respectively. A significant number of MPs used as anti-constipation in the present study indicates ethnomedicinal fortune in the Sikonge District. The study findings revealed that Euphorbiaceae was dominant in treating constipation. Similarly, in Korea, members of this family are reported to possess anti-constipation properties, hence used in herbal formulations (Wiart 2013). Moreover, the members of the family Euphorbiaceae are widely used in South Africa (De Wet *et al.* 2012) and Zimbabwe (Maroyi 2013), which reported the family to be dominant in managing various ailments.

Similar medicinal plant use elsewhere

The literature review of other ethnomedicinal studies revealed that some of the reported MPs in this study were also reported in other countries to be used for managing constipation. For instance, R. communis (Vakili *et al.* 2018) and Psidium guajava L. (Myrtaceae) (Kigen *et al.* 2017) are used by the indigenous people of Iran and Kenya for treating constipation, respectively. Other MPs used as anti-constipation in other countries include Tamarindus indica L. (Fabaceae) used in Nigeria (Lockett & Grivetti 2000), India (Bhadoriya *et al.* 2011), and Madagascar (Norscia & Borgognini-Tarli 2006), *Zanthoxylum chalybeum* Engl. (Rutaceae) in Nigeria (Okagu *et al.* 2021) and *Solanum incunum* L. (Solanaceae) in Kenya (Mathiu *et al.* 2005). Similarly, *E. hirta* is reported in Punjab, Pakistan (Ali *et al.* 2020) to manage constipation. This kind of consensus in utilizing MPs offers opportunities for future research to emphasize categorizing herbal laxatives and develop novel and effective drugs for poor communities.

Life forms, sources, and used plant parts

As reported in other ethnobotanical studies (Girma *et al.* 2022, Kankara *et al.* 2018, Mogha *et al.* 2022), the two dominant life forms (trees and shrubs) were used most in various human ailments. The wide utilization of the two life forms indicates that the NTHPs are knowledgeable about using these forms in prescriptions. They are also preferred as they are not affected by seasonality; hence, they are available and accessible throughout the year (Kacholi & Amir 2022a). Moreover, using life forms accessible throughout the year guarantees sustainable disease management. Comparable to many other ethnobotanical studies conducted elsewhere, most plant materials used for preparations of herbal remedies are sourced from the wild (Mogha *et al.* 2022, Semenya *et al.* 2013).

The study showed that the roots were the most utilized plant part in the district in managing the disorder, as reported in South Africa (Wintola & Afolayan 2010). Roots are highly preferred because they possess bioactive compounds with higher therapeutic potential compared to other plant parts (Pandey *et al.* 2021). However, the unsustainable harvest of roots can harm the plants and endanger their survival (Chen *et al.* 2016). Thus, educating NTHPs and other lay people who collect plant roots for medicinal drives is vital to the sustainability of the MPs. Also, the use of substitute plant parts, such as leaves, can be a good alternative strategy, as they have no detrimental effects on the plants' survival.

Preparation and administration of remedies

The decoction method was the dominant technique for preparing herbal remedies in the study area. Similar to this study's findings, a survey conducted in Nkonkobe Municipality in South Africa (Wintola & Afolayan 2010) and China (Lyu *et al.* 2022) reported decoction as the principal method of preparing remedies for constipation. The technique involves extracting functional bioactive ingredients by boiling plant materials (Huang *et al.* 2019). The NTHPs informed that most parts of plants used to prepare remedies were either fresh or dried materials, though the fresh materials were supposedly more effective and preferred to the dry ones. The preference for freshly plant materials could be due to the possession of more bioactive ingredients compared to dry specimens, which may have reduced or volatilized bioactive ingredients due to exposure to sun and during air drying (Jima & Megersa 2018, Regassa *et al.* 2017).

Regarding the route of administration, the findings showed that oral was the preferred route for 93% of the herbal remedies. Similarly, ethnobotanical studies conducted in China (Liu 2011) and South Africa (Wintola & Afolayan 2010) reported oral as the most utilized administration route for treating constipation disorder. The NTHPs reported that the remedies are habitually administered twice to thrice a day for a short period of not more than two weeks and sometimes as soon as the condition disappears.

Evidence of laxative activities of some of the reported medicinal plants

Laxatives are substances that can loosen stools and increase bowel movements. Usually, they are used for treating or managing chronic and acute constipation (Akram *et al.* 2022). However, due to the adverse effects of contemporary laxatives, herbal remedies are preferred alternative therapies for managing constipation (Cirillo & Capasso 2015). The literature review

of five reported MPs in this study has scientifically proven that they possess laxative activities. The fruit extract of *T. indica* extracts is traditionally used as a laxative due to a significant amount of malic, tartaric, and potassium acid (Bhadoriya *et al.* 2011). The extract of fruits and leaves of *P. guajava* contains sufficient dietary fibre that forms the base for treating constipation. At the same time, the extracts from *P. guajava* seeds (Kafle *et al.* 2018) and leaves (Vakili *et al.* 2018) are potent laxatives that help in chronic constipation and cleansing of the bowel.

Conclusion

The Sikonge flora is one of the most diverse, rich, and unique in Tanzania. The high number of anti-constipation MPs recorded in the present study indicates the diversity as well as their indigenous uses. The study has also exposed that MPs continue to play a crucial role in the primary health care of the people of the Sikonge District in Tanzania. The data presented reinforces the Tanzanian ethnopharmacological databank, and the study provides a starting point for future phytochemical characterisation and pharmacological investigations to examine the efficacy and toxicity of the recorded MPs. Moreover, it offers opportunities for future studies to focus on classifying herbal laxatives based on their treatment mechanisms and discovering new drugs.

Declarations

List of abbreviations: MP - Medicinal plants; NTHPs - Nyamwezi traditional health practitioners; MoP - Method of preparation; RoA - Route of Administration; FI - Familiarity Index

Ethical approval and consent to participate*:* All the participants provided prior informed consent before the interviews.

Data and material availability: Voucher specimens have been deposited at the Department of Biological Sciences Herbarium, Dar es Salaam University College of Education.

Disclosure statement: The author reports there are no competing interests to declare.

Author's contribution: DSK and HMA did conceptualization, data collection and analysis, and manuscript writing.

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