Original Research Article

Ethnobotanical Study on Awareness of Medicinal Plants Used to Treat Urinary Tract Infection and Microbial Infections in BiharamuloDistrict

Abstract

Medicinal plants had been interested by many researchers for overcoming a catastrophic disaster of antimicrobial resistance. This study aimed to identify medicinal plants for treating UTI through ethnobotanical survey, conducted in Biharamulo district at Kagera region in Tanzania. Semi structured questionnaires were used to assess awareness of the society on UTI and its medicinal plants. UTI herbs were collected and identified. The ethnobotanical data were analysed by using Chi-square test in SPSS version 16. Awareness of participants were justified at the statistical significance difference of p-values < 0.05. The study found most participants to have awareness on UTI and its herbs, because they identified clinical signs (85.2%), mode of transmission and aetiology (41%), UTI herbs (99.5%) and used herbs to treat UTI by (92.8%). Out of the 42 medicinal plants identified for treating UTI, 29 (69%) had pharmacological supports for antimicrobial activities which were attributed to their phytochemicals and ethnomedical literature support for treating UTI and other related microbial infections, they belonged in 20 families where by the dominant were Lamiaceae 17.2 %, and legumesae (10.3 %). This agreed with other studies that the society had awareness on UTI and its medicinal plants. This study was supported by ethnomedical literatures. The study results were significantly justified and supported the uses of identified medicinal plants for treating UTI with antimicrobial efficacies as claimed by traditional healers and herbalists, hence this study may provide a direction and scope for further discovery of new UTI drugs.

Key words: Antimicrobial resistance, awareness, medicinal plants and Urinary Tract Infection.

1.0 Introduction

Comment [RMSS1]: Long paragraphs make reading boring. The aim of the study was not more explicit.

Medicinal plants possesstherapeutic potentials with more significances compared to orthodox medications by having a wide range of efficiencies with sophisticated mechanisms for curing a variety of illnesses while some may become sources of nutrients, all of which enhances peoples' health. The holy bible depicted at least 30 medicinal plants while Hippocrates gave more than 400 herbs [1]. An ethnobotanical survey is useful for gathering information about herbs from local residents who belongs to their own traditions and belief [2]. Through ethnobotanical survey, manyhiddeninformation on medicinal plants can be obtained and become useful for treating various diseases which slow down development of the community. In order to effectively tackle antimicrobial illnesses, WHO associated folk and western medicines in contemporary and alternative medications [3]

Urinary tract infection happens when microbes like bacteria and fungi colonize and infect parts of the urinary system [3]. Previous studies showed that prevalence of UTI to be 30.9% among pregnant women at Bugando in MwanzaTanzania[4]. Bacteria and fungi are what cause UTIs, with *E. coli* being the main leading microbe accounting for more than 80% of the aetiology [5]. The rest UTI causative agents are countered by *P. mirabilis*, *K. pneumonia*, *S. aureus*, *E. faecalis*, and fungi [6]. When UTI is accompanied by illnesses that deteriorate host immunity, it is regarded as complicated UTI [3]. The disease is transmitted through genital organs to contact with infected agents like water from toilets and bathrooms, poor personal hygiene, crossing of *E. coli* from alimental canal to urinary system and sexual intercourse.Urinalysis and media-based microbial culture are the diagnostic tests for UTI. [7] and [3] gave clinical indications of UTI to be pains during urination, high rate of urination, fever, shivering, vomiting, aches in the lower abdomen, and back. Its side effects are associated with discomfort, deterioration of reproductive system, body impairment, and promotes miscarriage in females. UTI is treated by using antibiotics, probiotics, medicinal plants and equipping self and public person hygiene [8]

Biharamulo district has medicinal plants found in sub-equatorial climatic conditions. Within the district civilization, there are herbalists with extensive awareness gained via battling illnesses in daily life and from oral dissemination of traditional herbal knowledge and skills from nearby nations [9]. Herbal remedies were undermined and discredited throughout the colonial era in Africa, as inferior medical interventions, but later on,

research into their phytochemicals had revealed that they possess pharmacological significance [2]. Research is a crucial tool for taking what hearsays into consideration when putting theories into perspective in order to support what traditional healers have claimed and believed on herbal remedies for long time. The majority of herb knowledge is passed down orally through informal education, which has resulted in the concealment of some critical details about folk therapies among the communities and resulted into prohibition of their accessibility of such information to the younger generation [10].

To address the issue, an ethnobotanical survey was required to verify the information narrated by key informants and traditional healers regarding the use of specific medicinal plants to treat UTI. Finally, to document what is revealed for the future health prosperity of the society. Therefore, medicinal plants used to treat UTI and other related microbial infections were identified and documented in this study.

2.0 Materials and methods

2.1 Description of the study area

The research was conducted in Biharamulo district in Kagera region which is allocated North Western part of Tanzania. The area is characterized by tropical-equatorial climatic conditions with bimodal rainfall. Peasant agriculture is the economic backbone of the society. Its dominant tribes are Subi, Ha and Haya who belong to Christians, Muslims and paganism. Out of 17 wards, the 5 namely Biharamulo town, Kabindi, Kalenge, Nyarubungo and Nyakahurawards were selected for the study. Below is a map of Biharamulo district indicating the study area (Figure 1).

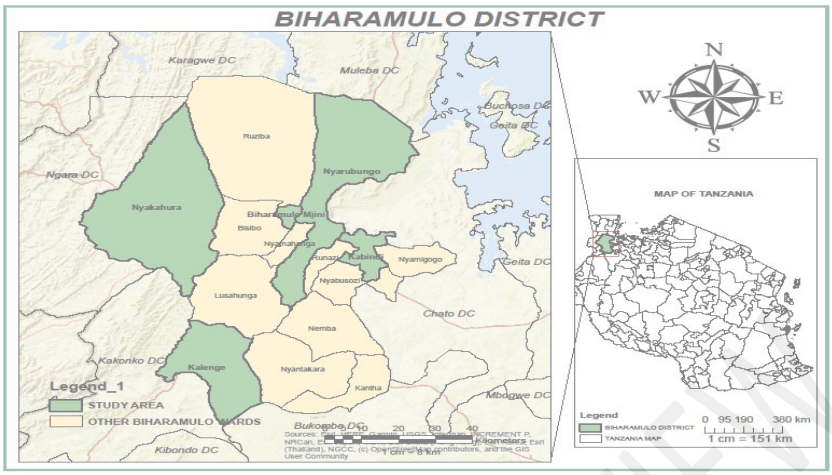

Figure 1: A map of Biharamulo district in Kagera.

Source: Created by GIS program (2021).

The map is unnecessary, as the study area has already been characterized in the text.

2.2 Study designs

It employed cross-sectional study design. Cross-sectional study design involved to conduct an interview during ethnobotanical survey among 5 wards of Biharamulo district.

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2.3 Sample size and sampling techniques

Snowball sampling technique was used to recruit 400 participants in interview by using semi structured questionnaires during ethnobotanical survey in Biharamulo district, it involved 5 wards, namely Biharamulo town, Kabindi, Kalenge, Nyarubungo and Nyakahura. According to [11] sample size was calculated from Yamane's formula: -

$$n=N/ (1+Ne2)$$

$$n=124\ 368/ (1+124\ 368*0.052)$$

Where n = desired sample size, e= acceptable error (5%), N=124 368 people as known population from the census 2012 in 5 wards of Biharamulo district. Therefore, the sample size was 399 participants.

2.4 Ethnobotanical survey and identification of medicinal plants

In ethnobotanical survey, villagers,traditional healers and key informants in 5 wards of Biharamulodistrict were interviewed by using semi structured questionnaires with open

and closed ended questions. Information on medicinal plants' vernacular name or morphology helped to identify the plants by matching their pictures with those in plant net identification software and confirmed through the literature.

2.5 Method of data analysis

The ethnobotanical survey data were compiled by using Microsoft Excel in Window 2016. Version 16 of the Statistical Package for Social Sciences (SPSS) software was used to analyse the data using the Chi-square test. Statistically significant differences between interviews' awareness on UTI and their medicinal plants were determined from Chi-square test at the p-values < 0.05.

3.0 Results

3.1 Demographic characteristics of participants in wards of Biharamulo district, Kagera

The ethnobotanical survey on medicinal plants for treating UTI was conducted in Biharamulo district, where by 400respondents were interviewed by using semi-structured questionnaires on assessment of effects of medicinal plants used for treatment of urinary tract infections in humans. Female respondents were many (65%) than males. In age, most respondents were youth (60.5%) followed by adulthood (28%) and elders (11.5%). In the occupations participated, most of them were non dominant occupations (45.2%) like teachers, medical service providers,housewives, and motorcycle riders, followed by farmers (34.8%), businessmen (11.8%), and traditional healers (8.2%). Most participants attained secondary and primary educations by 43.5% and 41.8% respectively. In tribals, Ha participated with high frequencies (39.2%), followed by Subi (26.2%), other less dominant tribes (19.5%), Haya (11%) and finally Hangaza (4%) (Table1).

Table 1: Demographic characteristics of respondents

	N = 400 interviews	
Characteristics	**Frequencies**	**Percentage (%)**
Sex		
Male	140	35
Female	260	65
Age		
Youth age: 18 - 35 years old	242	60.5
Middle age: 36 - 55 years old	112	28
Old age: 56 years and above	46	11.5
Occupations		
Farmer	139	34.8
Businessmen	47	11.8
Traditional healer	33	8.2

Others	181	45.2
Education level		
Informal education	20	5
Primary education (std 1 - 7)	167	41.8
Secondary education (std 9 - 12)	174	43.5
Tertiary education (above std 12)	39	9.8
Tribes		
Subi	105	26.2
Ha	157	39.2
Haya	44	11
Hangaza	16	4
Sukuma	43	10.8
Others	35	8.8

Source: Field data (2022).

3.2 Correct responses on awareness of UTI and its medicinal pants

Awareness of UTI among 400 interviews indicated that people already diagnosed or heard patients with UTI (98.2%), those able to give causes and mode of transmission (41%), those said UTI can be treated by using medicinal plants (53.5%). For awareness of UTI medicinal plants, those mentioned at least one medicinal plant (99.5%), those used the herbs (92.8%), who know herbs locations (93.5%), understanding herbs safety (85%), people sold medicinal plants (13.8%), those able to mentioned medicinal plants for treating other related microbial infections like typhoid, gonorrhoea and syphilis (15%) and participants appreciated medicinal plants for treating UTI (68.8%) (Table 2).

Table 2: Correct responses on awareness of UTI and its medicinal pants

Characteristics	N=400	
	Frequencies	**Percentage**
People diagnosed or heard UTI patients in the society	393	98.2
Awareness of UTI clinical signs	341	85.2
Understanding UTI mode of transmission	167	41.8
Understanding UTI aetiology	164	41.0
People said UTI can be treated by using medicinal plants	214	53.5
People able to mention medicinal plants for treating UTI	398	99.5
People treated UTI by using medicinal plants	371	92.8
People said UTI medicinal plants to be available	374	93.5
People said UTI medicinal plants are safe to health	340	85
People selling medicinal plants	55	13.8
Knowing herbs to treat related microbial infections	60	15
People appreciated medicinal plants to cure UTI	275	68.8

Source: Field data (2022)

3.3 Awareness of UTI and its medicinal plants according to sexes of participants

In assessing awareness of UTI and its medicinal plants, females had good understanding by (72.3%) compared to male (66.6%). On other hand females were

more knowledgeable in using medicinal plant than males as most of them agreed for UTI to be treated by medicinal plants, used their surrounding medicinal plants to treat UTI in daily life and have positive attitude toward medicinal plants by appreciating them than male respondents at a significant difference p-value < 0.05 (Table 3).

Table 3: Awareness of UTI and its medicinal plants according to sexes of participants

Awareness in:	Sexes' answer frequencies (%)		
	Male n = 140 (35)	Female n = 260 (65)	P-value
People diagnosed or heard UTI patients	138 (34.5)	255 (63.8)	0.532
Mentioning UTI clinical signs	116 (29.0)	225 (56.2)	0.199
Understanding of UTI mode of transmission	56 (14.0)	111 (27.8)	0.34
Understanding of UTI aetiology	59 (14.8)	105 (26.2)	0.407
Treatment of UTI by medicinal plants	62 (15.5)	152 (38.0)	**0.001**
Identification of UTI medicinal plants	139 (34.8)	259 (64.8)	0.578
Use of medicinal plants to treat UTI	121 (30.2)	250 (62.5)	**0.002**
Selling UTI medicinal plants	17 (4.2)	43 (10.8)	0.152
Availability of UTI medicinal plants	127 (31.8)	247 (61.8)	0.221
Safety of UTI medicinal plants	112 (28.0)	228 (57.0)	0.120
Knowing Herbs to treat other related microbes	86 (21.5)	162 (40.5)	0.473
Appreciation for UTI medicinal plants	85 (21.2)	190 (47.5)	**0.053**
Total percentages of items (%)	**(66.6)**	**(72.3)**	

Significant p-values (<0.05) according to Chi-square test

Source: Field data (2022).

3.4 Awareness of UTI and its medicinal plants according to age groups of participants

In assessing awareness of UTI and its medicinal plants old and middle-aged people had good understanding by (76%) compared to youth age (68.7%). On the other hand, old and middle-aged people were more knowledgeable for treating UTI and other related microbial infections by using medicinal plants, sold experienced safety or nontoxic medicinal plants including traditional healers than youth age respondents at a significant difference p-value of < 0.05 (Table 4).

Table 4: Awareness of UTI and its medicinal plants according to age groups of participants

Characteristics	Age groups in years			Chi-square
	Youth (18-35) n = 242 (60.5)	Adulthood (36-55) n = 112 (28)	Old age (55 +) n = 46 (11.5)	P-value
People diagnosed or heard UTI patients	237 (59.2)	110 (27.5)	46 (11.5)	0.619

Mentioning UTI clinical signs	204 (51.0)	99 (24.8)	38 (9.5)	0.520
Understand UTI transmission	101 (25.2)	49 (12.2)	17 (4.2)	0.734
Understanding of UTI aetiology	101 (25.2)	47 (11.8)	16 (4.0)	0.660
Treatment of UTI by medicinal plants	108 (27.0)	74 (18.5)	32 (8.0)	**0.000**
Identification of UTI medicinal plants	240 (60)	112 (28.0)	46 (11.5)	0.519
Use of medicinal plants to treat UTI	218 (54.5)	107 (26.8)	46 (11.5)	0.114
Selling UTI medicinal plants	28 (7.0)	18 (4.5)	14 (3.5)	**0.004**
Availability of UTI medicinal plants	220 (55)	108 (27.0)	46 (11.5)	0.52
Safety of UTI medicinal plants	191 (47.8)	104 (26.0)	45 (11.2)	**0.000**
Knowing Herbs to treat other microbes	76 (19.0)	54 (13.5)	22 (5.5)	**0.003**
Appreciation for UTI medicinal plants	155 (38.8)	88 (22)	32 (8.0)	0.209
Knowing UTI expertise with evidence	117 (29.2)	60 (15.0)	24 (6.0)	0.634
Total percentages of items (%)	**68.7**	**76.6**	**76.8**	

Significant p-values (<0.05) according to Chi-square test

Source: Field data (2022)

3.5 Awareness of UTI and its medicinal plants according to wards of respondents

Awareness in UTI and its medicinal plants indicated that Biharamulo town ward had good awareness (77.71%, followed by, Nyakahura (72.19%), Nyarubungo (68.85%), Kabindi (63.13%) and finally Kalenge ward (60.10%). Participants from Biharamulo town were awared in knowing UTI patients, clinical signs, use of medicinal plants, knowing availability of herbs, ensurance of s safety to users, understanding medicinal plants treated UTI and other microbial infections and they appreciated medicinal plants compared to other wards at a significant difference p-value of < 0.05 (Table 5).

Table 5: Awareness of UTI and its medicinal plants according to wards

	Wards' answer frequencies and (%)					
	Biharamulo	**Kabindi**	**Kalenge**	**Nyakahura**	**Nyarubungo**	**P-value**
UTI awareness in:	**n = 80 (20)**	**n = 80**	**n =80**	**n = 80**	**n = 80**	
Diagnosed or heard UTI patients	80 (20.0)	77 (19.2)	79 (19.8)	78 (19.5)	79 (19.8)	0.437
UTI clinical signs	73 (18.2)	68 (17.0)	59 (14.8)	73 (18.2)	68 (17.0)	**0.011**
Understanding spread	43 (10.8)	31 (7.8)	27 (6.8)	36 (9.0)	30 (7.5)	**0.089**
Understanding etiology	40 (10.0)	29 (7.2)	32 (8.0)	34 (8.5)	29 (7.2)	0.370
Treatment by herbs	52 (13.0)	29 (7.2)	28 (7.0)	48 (12.0)	57 (14.2)	**0.000**
Identification of herbs	80 (20.0)	80 (20.0)	79 (19.8)	79 (19.8	80 (20.0)	0.555
Use of UTI herbs	80 (20)	70 (17.5	66 (16.5)	77 (19.2)	78 (19.5)	**0.000**
Selling UTI herbs	17 (4.2)	10 (2.5)	12 (3.0)	8 (2.0)	13 (3.20	0.341
Availability of herbs	78 (19.5)	70 (17.5)	71 (17.8)	79 (19.8)	76 (19.0)	**0.029**
Safety of UTI herbs	77 (19.2)	62 (15.5)	50 (12.5)	74 (18.5)	77 (19.2)	**0.000**
Herbs for microbes	57 (14.2)	21 (5.2)	30 (7.5)	20 (5.0)	24 (6.0)	**0.000**
Appreciation of herbs	69 (17.2)	59 (14.8)	44 (11.0)	53 (13.2)	50 (12.5)	**0.000**
Total percentages (%)	**(77.7)**	**(63.1)**	**(60.1)**	**(72.2)**	**(68.8)**	

Significant p-values (<0.05) according to Chi-square test

Source: Field data (2022).

3.6 Awareness of UTI and its medicinal plants according to education level

Based on education level, tertiary education level had awareness (75%) than primary (71.2%), informal (70.4%), and lastly secondary educated members (62.4%). Tertiary education has good awareness in UTI aetiology, transmission and treatments compared to other levels, while informal education level followed by primary levels were most aware on how to use medicinal plants, selling medicinal plants, their availability locations and herbs for treating other microbial infections compared to other levels at a significant difference p-value of < 0.05 (Table 6).

Table 6: Awareness of UTI and its medicinal plants among education levels of participants

Awareness on UTI and its medicinal plants in:	**Education level answer frequencies and (%)**				**P-value**
	Informal	Primary	Secondary	Tertiary	
	n = 20	n = 167	n = 174	n = 39	
Diagnosed or heard UTI patients	19 (4.8)	166 (41.5)	169 (42.2)	39 (9.8)	0.213
Mentioning UTI clinical signs	17 (4.2)	141 (35.2)	146 (36.5)	37 (9.2)	0.360
Understanding mode of transmission	5 (1.2)	67 (16.8)	66 (16.5)	29 (7.2)	**0.000**
Understanding UTI aetiology	6 (1.5)	61 (15.2)	71 (17.8)	26 (6.5)	**0.005**
Treatment of UTI by medicinal plants	15 (3.8)	113 (28.2)	67 (16.8)	19 (4.8)	**0.000**
Identification of UTI medicinal plants	20 (5.0)	167 (41.8)	173 (43.2)	38 (9.5)	0.231
Use of medicinal plants to treat UTI	20 (5.0)	164 (41.0	151 (37.8)	36 (9.0)	**0.003**
Selling UTI medicinal plants	7 (1.8)	28 (7.0)	19 (4.8)	6 (1.5)	**0.030**
Availability of UTI medicinal plants	19 (4.8)	165 (41.2)	153 (38.2)	37 (9.2)	**0.007**
Safety of UTI medicinal plants	17 (4.2)	163 (40.8)	127 (31.8)	33 (8.2)	**0.000**
Knowing Herbs for related microbes	9 (2.2)	64 (16.0)	54 (13.5)	25(6.20)	**0.002**
Appreciation for UTI medicinal plants	15 (3.8)	128 (32.0)	106 (26.5)	26 (6.5)	0.214
Total percentages of items (%)	**(70.4)**	**(71.2)**	**(62.4)**	**(75.0)**	

Significant p-values (<0.05) according to Chi-square test

Source: Field data (2022).

3.7 Awareness of UTI and its medicinal plants among participant occupations

Among participant occupations, traditional healers had good awareness (85.7%) compared to businessmen (72.7%), farmers (70.9%) and lastly other less dominant occupations (65%). On other hand traditional healers had good awareness in UTI causes, transmission, using medicinal plant in treatments, equipped with psychomotor skills in preparation and selling of UTI herbs, their side effects and safety, understanding of medicinal plants able to treat UTI and other related microbial infections like gonorrhoea and syphilis, with high appreciation to medicinal plants compared to other occupations at the significant difference of p-values of < 0.05 (Table 7).

Table 7: Awareness of UTI and its medicinal plants among participant occupations

Awareness on UTI and its medicinal plant in:	Correct answer frequencies and (%)				P-value
	Farmers	Business	Healer	Others	
	n = 139	n = 47	n = 33	n = 181	
Diagnosed or heard UTI patients	137 (34.2)	47 (11.8)	33 (8.2)	176 (44)	0.598
Mentioning UTI clinical signs	115 (28.8)	43 (10.8)	29 (7.2)	154 (38.5)	0.547
Understanding mode of transmission	44 (11.0)	24 (6.0)	17 (4.2)	82 (20.5)	**0.044**
Understanding UTI aetiology	44 (11.0)	23 (5.8)	16 (4.0)	80 (20.3)	**0.088**
Treatment of UTI by medicinal plants	89 (22.2)	30 (7.5)	25 (6.2)	70 (17.5)	**0.000**
Identification of UTI medicinal plants	139 (34.8)	47 (11.8)	33 (8.2)	179 (44.8)	0.639
Use of medicinal plants to treat UTI	134 (33.5)	44 (11.0)	33 (8.2)	160 (40)	0.134
Selling UTI medicinal plants	9 (2.2)	3 (0.80	30 (7.5)	18 (4.5)	**0.000**
Availability of UTI medicinal plants	136 (34.0)	44 (11.0)	33 (8.2)	161 (40.2)	0.071
Safety of UTI medicinal plants	133 (33.2)	45 (11.2)	29 (7.2)	113 (33.2)	**0.000**
Knowing Herbs for related microbes	46 (11.5)	13 (3.2)	19 (4.8)	74 (18.6)	**0.021**
Appreciation for UTI medicinal plants	102 (25.5)	36 (9.0)	30 (7.5)	107 (26.8)	**0.036**
Total percentages of items (%)	**(67.63)**	**(70.74)**	**(82.58)**	**(63.26)**	

Significant p-values (<0.05) according to Chi-square test

Source: Field data (2022).

3.8 Awareness of UTI and its medicinal plants among tribes of participant

In awareness of UTI and its herbs, Hangaza were more knowledgeable compared to other tribes as they encountered (80.2%,) followed by Subi (70.2%), Haya 69%), Ha (66.4%) and finally a mixture of other tribes (63.3%). Based on statistical significance, Hangaza followed by Subi possessed good awareness on UTI and its medicinal plants in diagnosis and hearing patients, UTI transmissions, treatments of UTI by using medicinal plants, identification of UTI herbs, use of herbs to treat UTI, safety of UTI herbs and herbs to treat related microbial infections compared to other tribes at a significant difference p-value of < 0.05 (Table 8).

Table 8: Awareness of UTI and its medicinal plants among tribes of participants

Demographic information	**Tribal answer frequencies and (%)**					P-value
Awareness in:	Subi n = 105	Ha n = 157	Haya n = 44	Hangaza n = 16 (4)	Others n = 78	
Diagnosed or heard UTI	104 (26.0)	156 (39.0)	43 (10.7)	16 (4.0)	74 (18.5)	**0.017**
Mentioning UTI signs	88 (22.0)	128 (32.0)	39 (9.8)	15 (3.8)	71 (17.8)	0.118
Understand transmission	39 (9.8)	60 (15.0)	17 (4.3)	12 (3.0)	39 (9.8)	**0.019**
Understanding etiology	39 (9.8)	57 (14.2)	19 (4.8)	11 (2.8)	38 (9.4)	**0.098**
Treatments by using herbs	70 (17.5)	86 (21.5)	25 (6.2)	9 (2.2)	24 (6.0)	**0.001**
Identification of UTI herbs	105 (26.2)	157 (39.2)	44 (10.4)	16 (4.0)	76 (19.0)	**0.002**
Use of herbs to treat UTI	103 (25.8)	148 (37.0)	42 (10.6)	16 (4.0)	62 (15.5)	**0.02**
Selling of UTI herbs	21 (5.2)	21 (5.2)	6 (1.4)	5 (1.2)	7 (1.7)	0.188
Availability of UTI herbs	101 (25.2)	148 (37.0)	43 (10.8)	16 (4.0)	66 (16.5)	0.26
Safety of UTI herbs	93 (23.2)	136 (34.0)	38 (9.5)	15 (3.8)	58 (14.5)	**0.005**
Herbs related microbes	44 (11.0)	54 (13.5)	22 (5.4)	11 (2.8)	21 (5.2)	**0.021**
Appreciation for herbs	77 (19.2)	100 (25.0)	30 (7.5)	12 (3.0)	56 (14)	0.833
Total percentages (%)	**(70.2)**	**(66.4)**	**(69.7)**	**(80.2)**	**(63.3)**	**0.135**

Significant p-values (<0.05) according to Chi-square test

Source: Field data (2022)

3.9 Information dissemination on UTI and its medicinal plants in Baramulo's societies

Information dissemination on UTI and its medicinal plants among Biharamulo societies were distribute by villagers among themselves (49.5%) followed by medical expertise and public health extension educators (18.8%), parents (11.8%), traditional healers (5.5%), from other occupations (2.3%) and lastly those who did not remember where they acquired UTI information (0.8%). These indicated that there was a need for furtherprovision of UTI information by responsible institutions, as most of education were provided by villages who were less knowledgeable about UTI (Figure 2).

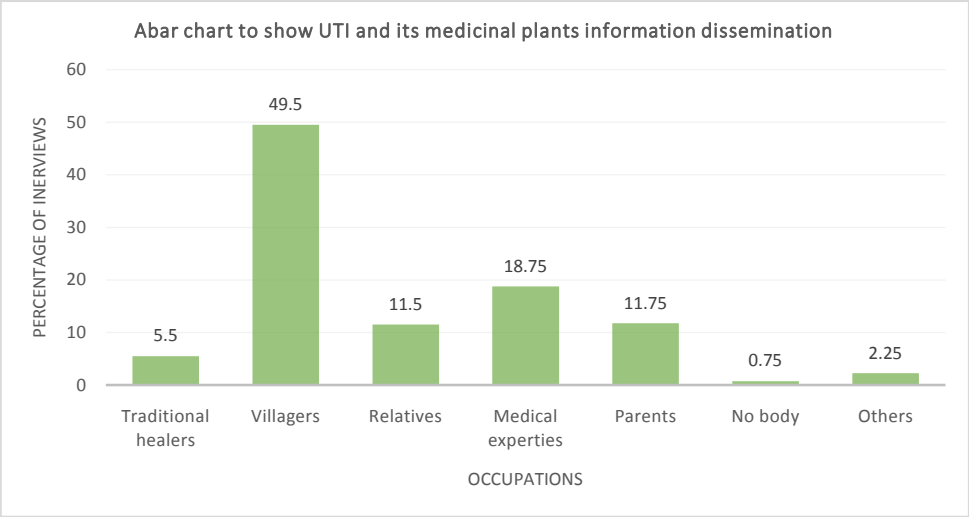

Figure 2: A bar chart for UTI information disseminations.
Source: Field data (2022)

3.1 Medicinal plants and their information

Based on interviews' information in ethnobotanical survey, among the 42 medicinal plants identified only 29 (69%) were supported from literature to have pharmacological significances to treat UTI. Furthermore their vernacular and botanical names, families, parts, usable states, preparation methods, and diseases treated were documented, whereby among the active 29 herbs, pharmacologically treated UTI (96.5%), typhoid (48.3%), malaria (34.5%), anthelmintic (24.1%), STDs (20.9%), cough (17.2%), worm infections (11.9%), wounds and ulcers (17.2%), fungal infections (13.7%), anaemia (10.3%), diabetes, cancer and toothache were each represented by cancer (6.9%), measles, cardial vascular diseases and yellow fever were each represented once by (3.4%) (Table 2.9). The 29 medicinal plants belonged in 20 families where by the dominant were Lamiaceae (17.24%), Asteraceae, Rutaceae and Myrtaceae each accountered (6.9%) while the rest appeared once as 3.45% (Table 9)

Table 9: Medicinal plants of Biharamulo district used to treat diseases

S/N	Botanical names (family)	Local name	Parts used	Frequenc	Preparation	Disease Treated	Supporting literature for biomedical significances
1	*Aloe vera*(Asphodelaceae)	Shubiri (Swahili)	Leaves	101	Maceration and infusion	UTI, typhoid and malaria	Antibacterial and antifungal[12]
2	*Azadirachtaindica* (Meliaceae)	Mwarobaini (Swahili)	Leaves	108	Infusion	UTI, typhoid and malaria	Antimicrobial activity [13]
3	*Bidenspilosa (L)* (Asteraceae)	Shanda (Subi)	Leaves	60	Decoction and infusion	UTI and anaemia and ulcers	Antimicrobial activities [14,15]
4	*Cinnamomumverum*(Lauraceae)	Mdalasini (Swahili)	Barks	1	Maceration and decoction	UTI and ulcers	Antimicrobial [14]
6	*Clematis terniflora* (Ranunculales)	Bukakara (Subi)	Whole	17	Infusion and decoction	UTI, gonorrhoea, wounds and yellow fever	Antimicrobial [16]
7	*Clerodendrumtrichotomum*(Lamiaceae)	Kiseke (Subi)	Leaves	1	Decoction and infusion	UTI, malaria and worms	Antimicrobial [17]
8	*Cymbopogancitratus (*Poaceae)	Mchaichai (Swahili)	Whole	205	Maceration and decoction	UTI, ant allergic, antifungal, antibacterial	Antimicrobial [18,19]
9	*Erythrina abyssinica*(Leguminosae)	Omlinzi (Subi)	Barks	40	Maceration and decoction	UTI, gonorrhoea and typhoid	Antimicrobial [20]
10	*Ipomoea cairica (L) (*Comnvulvulaceae)	Kalandarugo (Haya)	Whole	93	Concoction and decoction	UTI and typhoid	Antibacterial [21]
11	*Jacaranda mimosifolia (*Bignoniaceae)	Mmea (Subi)	Whole	3	Maceration and decoction	UTI and typhoid	Antimicrobial [22]
12	*Jatrophercurcas L. (*Euphorbiaceae)	Mbono (Ha)	Whole	19	Maceration and decoction	UTI, wounds, gonorrhoea, cough and toothache	Antimicrobial [23]
13	*Kleiniafulgens (L.) (*Asteraceae)	Kanyoro (Haya)	Roots	3	Maceration and decoction	UTI, syphilis and gonorrhoea	Antimicrobial [24]
14	*Lantana camara (L.) (*Verbenaceae)	Nyanunda (Subi)	Leaves	4	Concoction and infusion	UTI	Antibacterial [25]
15	*Leonotisleonurus (L) (*Lamiaceae)	Kitatelante (Subi)	Leaves	5	Infusion and decoction	UTI, anthelmintic and anti-malaria	Antimicrobial [26,27]
16	*Moringa oleifera (*Moringaceae)	Mlonge (Swahili)	Whole	26	maceration and decoction	UTI, typhoid, B. P, malaria, diabetes and cancer	Antimicrobial activity [14]
17	*N. macrophylla (*Chrysobalanaceae)	Omnazi (Swahili)	Roots	7	Maceration and decoction	UTI and typhoid	Antimicrobial [28]
18	*Ocimum sanctum (*Lamiaceae)	Kashwagara	Leaves	156	Tisane and decoction	UTI and typhoid and malaria	Antimicrobial activity [14,29]
19	*Physalis peruviana (L) (*Solanaceae)	Ntuntunya (Subi)	Leaves	69	Infusion and decoction	UTI and typhoid	Antimicrobial [17]
20	*Senna didymobotrya (*Leguminosae)	Mbagabaga (Ha)	Leaves	1	Maceration and infusion	Cough and anthelmintic	Antimicrobial [30]
21	*Senna siamea (*Fabaceae)	Mjoholo (Swahili)	Roots	16	Maceration and infusion	UTI, malaria, typhoid and gonorrhoea	Antimicrobial [31]
22	*Syzygiumcordatum (*Myrtaceae)	Mgege (Ha)	Barks	1	Maceration and decoction	UTI and fungus	Antimicrobial [32]

23	*Syzygiumguineense (*Myrtaceae)	Msalazi (Subi)	Roots	5	Maceration and decoction	UTI, typhoid, skin infections and worms.	Antimicrobial [33]
24	*Terminalia mollis(L).* (Combrelaceae)	Mhongoro (Subi)	Whole	2	Maceration and decoction	UTI, anthelmintic and cough	Antimicrobial [20,34]
25	*Tetradeniaulticifolia (*Lamiaceae)	Mchunchu (Subi)	Leaves	3	Infusion and decoction	UTI and cough	Antimicrobial [17]
26	*Vernonia amygdalina (*Compositae)	Mbirizi (Subi)	Whole	29	Infusion and decoction	UTI, malaria and measles	Antimicrobial [18]
27	*Ximeniacaffra (*Olacaceae)	Mseka (Subi)	Roots	2	Maceration and decoction	UTI, gonorrhoea, typhoid and malaria	Antimicrobial [35,36]
28	*Zanthoxylumchalbeum (*Rutaceae)	Entareyilungu (Haya)	Roots	11	Maceration and tisane	UTI, fibrosis, ulcers and cough	Weak antimicrobial [37]
29	*Zingiberoffcinale (*Zingiberaceae)	Ginger (Swahili)	Rhizomes	4	Maceration and tisane	UTI, typhoid and cough	Antimicrobial [14]

Source: Field data (2022

4.0 Discussion

This study has revealed the society to have awareness on UTI and its medicinal plants as well as other related microbiological infections like typhoid, gonorrhoea, and syphilis. In sex female were more knowledgeable for UTI and its medicinal plants compared to male, it was attributed to the fact that women have genital anatomical structures that expose them to susceptibility to UTI infections compared to males, and they also play the role of maintaining health status of their families. Support for the same argument came from [38] and [3] whorealized that women had the major responsibility of providing healthcare in a family, a circumstance that sparked their keen interest in researching accessible and effective medicinal plants against for nosocomial infectious including UTI.

The age groups were associated with acquisition of knowledge on UTI medicinal plants. The Old age group were more knowledgeable followed by middle and finally youth age.This was linked to the elderly's prolonged exposure to herbs against ailments, especially traditional healers, who acquire herbal knowledge and experiences throughout their lifetime. [38] gave a similar finding that the level of understanding of herbs and experiences in a community varies directly proportion to seniority, provided that senescence had not deteriorated the mental activities. The same ideal was observed by [39] who argued that youths irriterate in medicinal plants was associated with seniors' concealment in herbs and youth preferences for orthodox over herbal remedies.

Biharamulo town wards were more knowledgeable in UTI and its medicinal plants due to extensive connection with individuals who brought their ancestral herbal knowledge from rural to urban areas, as opposed to other rural wards with few tribes fixed to a limited number of herbs. The previous studies from Lagos [40] and [41] provided proof that about 66% of urban inhabitants recognized and used medicinal plants for contagious infectious ailments like UTI at affordable expenses.

Participants with higher educational levels had higher awareness on UTI but they were less knowledgeable in its medicinal plants as most of them used antibiotics and ignored medicinal plants. Vice versa was true at the informal and primary level where most of them were aware of medicinal plants compared to higher levels of education (Table 6). Similar findings from [42] indicated a negative relationship between attainededucation and knowledge of folk medicine, with the argument being that as education levels rises it initiates the loss of interests in folk medicines and they supported the argument by providing evidences that uneducated exemplified more herbs than scholars.

Compared to other professions, traditional healers had a better understanding of UTI and its medicinal plants as they treated a large number of patients and marketed herbs as commodities, which gave them a lot of experience on antimicrobial plants. Aspects similar to these were addressed by [38].

Hangazatribes were more aware in medicinal plants for treating UTI compared to other tribes due to their proximity to neighbouring nations like Burundi and Rwanda which have historically swapped information about herbs dating back to colonial era [9].In additional to that, people were able to participate by disclosing the details of UTI medicinal plants. According to popular belief, healers keep secret in disseminating herbal information [39] This could account for Haya who were suspected to know many medicinal plants however, they mentioned a small number of UTI medicinal plants.

As a result of their accessibility and commitment to plant protection, the majority of participants from Biharamuloapplied leaf decoctions and infusions as preparation methods for UTI treatments. This scenario was in line with a previous study conducted by [43]who credited for accessibility and consistency of leaves throughout the year with the exception of a few arid climate zones. Furthermore [17] appreciated people fromKagera for utilizing leaves in medicinal plants.

Information dissemination on UTI and its medicinal plants within Biharamulo's societies was enhanced among villagers themselves by less than 50%. Public health extension

educators, traditional healers and parents have educated the society on UTI to a small extent that is why most of the respondents had less understanding on causes and transmission of UTI. Comparable research from Kenya by [44]shown that non-traditional healers, particularly older women are the best sources of herbal information for over 50%, while traditional healers hinder the herbal details. These signified that there is a need for further provision of UTI information to the majority where UTI education is provided by villages themselves. In regard to [2],African folk medicine innovation has been hampered bythe absence of reliable and secure supervision, inconsistent dosage, toxicity assessment, and recordkeeping.Herbalists are urged to adhere to these restrictions.

Biomedical justification for UTI herbal efficiencies. Literature review confirmed for all 42 medicinal plants to possess tannins, phenols and flavonoids with different extinctions of phytochemicals as described below; It has been ascertained that the combretaceae family, which includes *Terminalia mollis*, contains resins and combrelatannins that kill microorganisms by precipitating their amino acids in cell walls [45]. The anticancer myrtucommulones was reported in the family myrtaceae (*S. guineense*, and *S. cordatum*) to have antimicrobial, hypoglycaemic, anthelmintic, and virucidal activities [46]. On the other hand, it was contended that members of Olacaceae family, notably *X. caffra*, had antimicrobial, anticarcinogenic, and antiparasitic properties [36]. Inulin found in the Asteraceae was reported by [47] to have antimicrobial properties including UTI.There were many plants in the Lamiaceae family, but some of them, like *S. hispanica*, *P. barbatus*, and *H. opposte*, had poor antibacterial activity reported in the literature.

According to[48]rutaceae family (*C. limon* and *Z. chalbeum*) contain limonoids, carbazole, benzylisoquinolines, and anthranilate, all of which have antimicrobial, antitumour and anti-HIV. *Kleinia*sp had oleanolic acid which accounts for antimicrobial activities [24]. Family Solanaceae (*P. peruviana*) was reported by [49] to comprise solanine, solasonine, and solamargine, which enhances antibacterial, anticancer, and cardiac impairments. Family lauraceae (*C. verum*) contains aroma, Benzylisoquinoline,

cinnamaldehyde, benzyl benzoate and terpenoids, which elicits antimicrobial activities, antidiabetic and anti-ulcerspotentials [50]. Iridoids, quinones, and phenylpropanoids were reported by [51] in Bignoniaceae (*J. mimosifolia*) to be accountable for the antibacterial, antiprotozoal, antidiabetic and antitumor. *Aloe vera* contains anthraquinones and phenols which are responsible for the antibacterial and antiplasmodial actions [52]*Azadirachta indica* was reported by [53] to consists of limonoids, phenols, terpenoids, and coumarins, used as antimicrobial, antiplasmodial and antiulcer.

Jatrophercurcas found to produce jatrophine, terpenoids, and curcin which were associated with antibacterial, anti-HIV, relieve toothache, wound and tumour healing properties[23]. *Lantana camara* yields verbascoside and lantadene had antimicrobial activities [25]. Moringa oleifera contains Benzyl glycosylates and gallic acid which signify for antimicrobial, anticancer, antihyperglycemic, anti-infertility and modulating the immune system [54,55]. Clematis terniflora contains clematichinenoside, benzylisoquinolines, and triterpenoid, which have antibacterial, antiplasmodial, antitumour, and facilitates programmed cell death [16]. Cymbopogon citratus was investigated by [56] and found that it possesses a scent citral and limonene, which are utilized as anticarcinogenic and had potentials to kill bacteria. [57] and [58]reported the family Leguminosae (*E. abyssinica*, *S. siamea*, and *S. didymobotrya* to possessed resins, quinolizidine, bianthraquinones, sennosides, naphthalene, and naphthalene with pharmacological significance in helminth and microbial infections[59]

According to the previous study, *Harunganamadagascariensis* (Hypericaceae) produces the anthraquinones hypericin, hyperoside, and harungin that are used to treat diabetes, ulcers, and typhoid. *Ipomoea cairica* (Convolvulaceae) has phenylpropanoid, glycoresins, convolvine, cyanogenic glycoside and phytate, used as antimicrobial, antidiabetic, treats high blood pressure, and antitumor (60,61). *Neocaryamacrophyla* which incorporates terpenes and stigmasterol was reported to be vital for antimicrobial and skin infections [62] Cucurbitacin and phytosterols from *Zehneriascabra* are used to fight against cancer and microbiological infections [63]. Finally phytochemical analysis

conducted by [64] revealed synthesis of gingerol isomers and zingiberene in *Zingiber officinale* both of which have antibacterial and antifungal potentialities. Other species and their antimicrobial activities in different families are indicated in (Table 9). The 29 medicinal plants (69%) of the medicinal plants identified out of the total 42 were found to have related therapeutically implications, ethnobotanical assertions, pharmacological justifications in literature, or possessed potential phytochemicals enough to treating UTI or related microbial illnesses.

5.0 Conclusion

This study had succeeded to document UTI medicinal plants used in Biharamulo district rather than oral herb information dissemination as practiced by indigenous. Phytochemical screening and sensitivity tests in literature revealed that medicinal plants well known and mentioned at high frequencies from ethnobotanical survey had little active phytochemicals which accounted weak antimicrobial activities compared to those mentioned by few people at low frequencies, this indicated that active UTI medicinal plants are known by few people due to secrecy of traditional healers and this study will disseminate efficacies of the selected UTI medicinal plants.

This study justified claims of traditional healers and herbalists on the uses of identified selected medicinal plantsto have efficacies againstUTI microbes and other related microbial infections. Therefore, the present study provided a direction, evidence and scope for further discovery of new UTI drugs for combating antimicrobial resistances.

6.0 Recommendations

Further researchers should be conducted to evaluate antimicrobial effectiveness of identified medicinal plants and ensure their safety to users. The society and public health officers should educate people who are unaware on UTI and its medicinal plants. Due to their pharmacological activities the society is advised to use environmentally friendly utilization of the herbs for sustain them so that they become reliable in next generation.

NOTE:

The study highlights the efficacy of "Herbal remedies " which is an ancient tradition, used in some parts of India. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized partially if found suitable.

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