



Research Article

A SURVEY OF TRADITIONAL MEDICINAL USES OF *CATHA EDULIS* (CELASTRACEAE) IN MERU AND EMBU COUNTIES OF KENYA

Josphat K. Kiunga^{1*}, Catherine W. Lukhoba¹, Saifuddin F. Dossaji¹, Abiy Yenesew²

¹School of Biological Sciences, University of Nairobi, P.O. Box 30197-00100, Nairobi, Kenya.

²Department of Chemistry, University of Nairobi. P.O. Box 30197-00100, Nairobi, Kenya

Correspondence should be addressed to **Josphat K. Kiunga**

Received August 08, 2016; Accepted August 15, 2016; Published August 23, 2016;

Copyright: © 2016 **Josphat K. Kiunga** et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Cite This Article: Kiunga, J. Lukhoba, C. Dossaji, S. Yenesew, A. (2016). A Survey of Traditional Medicinal Uses of *Catha Edulis* (Celastraceae) in Meru and Embu Counties of Kenya International Journal of Ethnobiology & Ethnomedicine, 3(1).1-12

ABSTRACT

Catha edulis (qat) is an evergreen tree or shrub whose young leaves and stems are widely chewed in Eastern Africa. The aim of the present study was to document ethnomedicinal value of *Catha edulis* as used traditionally by the Ameru and Aembu communities of Kenya.

The study was conducted between the months of September (2014) and February (2015), and involved 42 key informants (32 males and 10 females) aged between 45 and 84 years. Snowball and purposeful sampling techniques were used in the selection of key respondents. A semi-structured questionnaire was administered to collect ethnomedicinal data using face-to-face interviews and discussions with key respondents.

Eleven traditional varieties based on information from key informants were identified and described. Out of these, 5 were from Embu County while 6 were from Meru County. Plant samples were collected and deposited at the University of Nairobi herbarium as voucher specimens. A total of 13 ethnomedicinal uses of qat were documented. Of these, 62% were reported only in Meru County while 15% were reported only in Embu County. The remaining (23%) were reported in both Meru and Embu counties. The major parts of the plant reported to have medicinal value were leaves. Young stems and roots had scanty medicinal value. Chewing fresh material was identified as the major method of crude drug preparation, although in some cases such as in the treatment of diarrhea, gonorrhoea and toothache, boiling of fresh material was reported. The main mode of administration of drug is oral and there was no precise dosage reported for any given ailment.

The present study indicates that there is a rich knowledge of ethnomedicinal uses of qat particularly in Meru which forms groundwork for further efficacious study of the plant as that may provide a lead to the discovery of novel bioactive therapeutic agents. In addition, the traditional varieties of *C. edulis* identified by some morphological characters of taxonomic importance provide a vital clue of possible existence of infraspecific taxa of *C. edulis* which, to date, has no documented infraspecific taxa.

KEY-WORDS: Qat, ethnomedicinal, traditional varieties, psychostimulant.



INTRODUCTION

Catha edulis (Vahl) Forssk. Ex Endl. (Celastraceae) is an ancient plant whose young leaves and stems are widely chewed as psychostimulant in Eastern Africa and some parts of Arabic Countries (23). In Kenya, the plant is extensively cultivated in Meru and Embu counties. It is a commercially important plant known by a wide range of common names such as *miraa*, *khat*, *kat*, *qat*, *chat*, *cafta*, bushman's tea (South Africa), Arabian tea, Abyssinian tea (Ethiopian tea), African tea, flower of paradise (12). Qat and khat are the most common names used in many publications. In urban areas of Kenya including its capital, Nairobi, qat goes by several street names, *veve*, *miraa*, *ngomba*, *jaba*, and *muguka* among others. Recently, qat has elicited heated debate both locally and internationally due to its socio-economic impact. Increasing numbers of youth are involved in chewing of qat in social gatherings as well as a way of relieving stress or fatigue and the chewing of qat material is widespread (18). Traditionally, however, the chewing of qat used to be the preserve of only the elderly men in the community (5).

The trade of qat material, facilitated by air transport, occurs openly in Kenya, Djibouti, Ethiopia, Somalia, Uganda, and Yemen but it is illegal in the Sudan, Kuwait, Saudi Arabia, Eritrea, Tanzania, and Zambia (11). Somalia has the highest percentage of qat consumers in the world with most of the qat consumed in this country being imported directly from Kenya (34). The export and local sale of qat material generates approximately \$150 million annually in Kenya (32).

Qat contains cathinone as a major psychoactive ingredient (37) although it also contains quite a number of other alkaloids, flavonoids, tannins and essential oils (8). Cathinone is known to be very unstable and is transformed into the more stable compound, cathine, after 48 hours of harvesting the plant material (17, 4). The chemical structure and effect of cathinone are more or less similar to the synthetic amphetamine, thus qat is commonly known as a "natural amphetamine" (26). Although qat is a venerable plant species in communities where it is cultivated, it has been grossly associated with negative health effects including insomnia, hyperthermia, anorexia, mydriasis, endocrinological disturbances and acute autonomic responses including high blood pressure and tachycardia (7,13,14).

There are few reports on ethnomedicinal uses of qat although the psychostimulating effects and behavioral changes associated with chewing of qat are well documented. Furthermore, the limited studies carried out on ethnomedicinal uses of qat have often yielded conflicting information. For instance, (27) reported that qat could be of use in the treatment of erectile dysfunction. In his experiment with olive baboons, he found that qat chewing increased testosterone hormone levels, libido and erection. Also, (38, 21,22) have reported the use of qat in treatment of erectile dysfunction. On the contrary, (15) reported that chewing of qat causes loss of libido and seminal output. (31) showed that low doses of qat extract increases testosterone hormone level while high doses causes reduction of the hormone level. (16) reported that

the oral hygiene status of qat chewers is better than that of non-qat chewers and that qat chewing is not detrimental to periodontal health.

In addition, (28) reported that qat chewing may have anti-gingivitis properties and decreases susceptibility to periodontitis. On the contrary, (3) indicated that long-term qat chewing negatively affects the oral health. (22) reported the use of qat in treatment of stomach upset. On the contrary, (29) reported a close association between qat chewing and gastrointestinal disorders. These results are not only interesting but also conflicting. Thus, there is a need for a thorough and systematic investigation of the ethnomedicinal uses of qat. Given the availability and extensive use in Kenya, qat is a good model for ethnomedicinal studies. The present study was therefore designed to investigate the traditional therapeutic value of qat as used by people of Ameru and Aembu communities of Kenya.

MATERIAL AND METHODS

Study Area

Prior to commencement of the study, permission for informants' participation was first sought from the local administrative (gubernatorial) offices of Meru and Embu counties of Kenya.

Meru and Embu counties

Meru County is found in eastern region of Kenya, approximately 225 km northeast of the capital, Nairobi. It covers a geographical area of 6,936 km² with a population of 1,365,301 according to 2009 population census of Kenya (20). Agriculture is the main economic activity in Meru County with a wide scale growing of qat, a lucrative cash crop for the locals. Qat is mostly grown in Maua, Igembe and Tigania and fetches millions of shillings in the export market for its farmers (32).

Embu County is located approximately 120 km northeast of Nairobi towards Mt Kenya. The total geographical coverage of Embu County is 2,818km² with a population of approximately 516,212 individuals according to 2009 population census of Kenya (20). Embu occupies among the most main fertile lands in the Kenyan highlands, with its weather favorable for a variety of agricultural activities (30).

Ethnomedicinal data collection

Reconnaissance (initial contact with respondents)

A field survey was conducted prior to data collection during which a list of farmers, herbalists, consumers of qat material and agricultural extension officers, in Meru and Embu counties respectively was prepared with the assistance of administrators (chiefs, Assistant chiefs) and the general public of the various locations where they are found in these Counties (33).

Selection of key informants

Forty two key informants (32 males and 10 females) aged between 45 and 84 years were identified for interviews. The selection of respondents was done to get a representative sample and ensure that only individuals with vital information were interviewed. The techniques used in the selection of key informants were snowball and purposive sampling techniques. In snowball technique, when a few traditional herbalists, farmers and qat consumers in the field had been identified, fruitful initial contacts were made and more informants were identified using their existing networks.

Snowball technique has been applied elsewhere in acquisition of information from hidden populations which are hardly inaccessible by researchers (10, 36). Purposeful sampling technique ensured that only key respondents with the desired qualities and quantities of information on qat were selected (35). A probability random sampling technique was not applied in this study as not everyone sampled randomly would have the required knowledge (6,9).

Collection of ethnobotanical information

A semi-structured questionnaire consisting of fourteen questions was used in collecting ethnobotanical data in Meru and Embu counties as shown below.

Questionnaire used for collecting ethno-taxonomic and ethnomedicinal data of *Catha edulis* (qat in Embu and Meru counties of Kenya.

Informants' details:

- Name.....
- Gender.....
- Age.....
- Occupation.....
- Education.....
- Location/Residence.....
- Informants consent agreement.....

PART (A): General information on traditional varieties (Botany)

- i. How many traditional varieties of *Catha edulis* do you know personally? Kindly mention their local names.
- ii. How many varieties exist in this area/farm? Mention their local names.
- iii. How do you distinguish each variety by?

(a) Morphology (outward/physical appearance)

(b) Physiology (based on level of stimulating effect and other associated effects of chewing qat)

- iv. Kindly provide a brief history of the origin of each variety
- v. If you were to plant qat today which variety would you choose and why?
- vi. How is each variety propagated?
- vii. The harvested qat is graded based on their market value. Kindly mention the grades that you are aware of and give the criteria used in grading them.

Which grade is the most preferred and why?

PART (B): SOCIO-ECONOMIC AND CULTURAL IMPORTANCE OF QAT

- i. Other than being used for commercial purposes and as a psychostimulant, mention any social and cultural importance of qat to the local communities that you are aware of.
- ii. Does qat have medicinal value?

(a) Yes () (b) No ()

If yes state the:

- iii. Parts of the plant used
- iv. Name of the disease(s) treated.
- v. Method of crude drug preparation.
- vi. Mode of the drug administration
Prescribed dosage

Conduction of interviews

Questions were asked orally with a help of an interpreter and answers filled by the interviewer. After filling of the well-structured questionnaire, discussion with the selected key respondents was held. This involved a guided exchange of information as well as a mental checklist of pertinent points to confirm whether the information in the questionnaires of other key respondents interviewed earlier was valid.

Collection of plant samples

Following a face to face interview with the selected key respondents, a field trip was made to identify and collect sample specimens of the listed traditional varieties of qat. Three to five branchlets with flowers and fruits were collected from each individual sampled to provide enough material for herbarium vouchers deposited at University of Nairobi herbarium. GPS waypoints of locations where plant samples were collected were recorded in a field notebook.



RESULTS

General information on *Catha edulis* and the key respondents

General information of key respondents such as their gender, level of education, age as well as origin and health effects of *Catha edulis* were initially summarized as shown in the table below.

Table 1: General information on key respondents and their perception on origin and negative health effects of *Catha edulis* (n=42)

S/n	Description of categories of key respondents	No.of respondents	Percentage (%)
1	Gender		
	a Males	32	76
	b Females	10	24
2	Level of education		
	a Formal	15	36
	b Informal	27	64
3	Age category		
	a 45-54	5	11.9
	b 55-64	10	23.8
	c 65-74	15	35.7
	d 75-84	12	28.7
4	Source of ethnoknowledge of <i>Catha edulis</i>		
	a Personal experience		
	b Inherited from parents/grandparents	20	47.6
	c From close relatives and friends	12	28.6
		10	23.8
5	Origin of <i>Catha edulis</i> in the community		
	a Indigenous	30	71
	b Introduced from other places	10	24
	c Unknown	2	5
6	Negative health effects of chewing <i>Catha edulis</i>		
	a Depends on the amount consumed	10	24
	b Specific ‘varieties’ have negative health effects	22	52
	c No negative effects(it’s just a mild stimulant)	10	24

Traditional nomenclature of *Catha edulis* in Meru and Embu Counties.

4 The table below gives a summary of some of the common names (traditional varieties) of qat identified in Meru and Embu Counties.

Table 2: Traditional varieties of *Catha edulis* found in Meru and Embu County

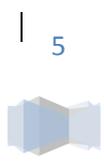
S/n	Local name	County	Latitude	Longitude	Altitude(ft)	Voucher
1	Gitu	Embu	S0.65746	E37.56912	3793	JK2014/09
2	Kibwe	Embu	S0.62732	E37.54423	3822	JK2014/11
3	Kigwe	Meru	N0.28766	E37.92004	5863	JK2014/02
4	Kilantune	Meru	N0.13227	E37.74410	4993	JK2014/03
5	Kiraa gikiiru/Asili	Meru	N0.28596	E37.92127	5837	JK2014/01
6	Kithaara	Meru	N0.13507	E37.74546	4882	JK2014/04
7	Muchuri	Meru	N0.13523	E37.74356	4938	JK2014/05
8	Muguka	Embu	S0.62800	E37.54269	3757	JK2014/06
9	Mugumo	Embu	S0.65753	E37.56936	3806	JK2014/12
10	Mugwathingi	Embu	S0.62740	E37.54428	3825	JK2014/08
11	Muti-mutiri	Embu	S0.65746	E37.56931	3802	JK2014/07

Identification of traditional varieties of *Catha edulis* by Meru and Embu people

The Ameru and Aembu people of Kenya have traditionally developed a classification system of qat has shown in the table below. Some of the characters used by locals were not easily noticeable in the field although such differences were very important to the farmers when it came to grading qat for sale.

Table 3: Traditional delimitation of the 11 traditional varieties of *Catha edulis*

S/n	Traditional Variety	County	Key morphological features	Qat features and associated physiological effects
1	Kigwe/kiraa gikieru	Meru	Leaves broad; young twigs red on abaxial surface and light green on adaxial surface	Bitter taste; highly potent with negative physiological effects if chewed in excess amounts such as delirium,insomnia,and formication(feeling of insects crawling over the body)
2	Kilantune	Meru	Young twigs red	Tasteless; less preferred
3	Kiraa gikiiru/asili/nyeusi	Meru	Young twigs crimson red	Produces softer qat; tastes nice; powdery when chewed; no negative physiological effects like delirium, insomnia etc. Most preferred variety
4	Kithaara/Nthaara	Meru	Leaves narrow; profuse branching; branches flexible	Sugary taste; potent but not as much as <i>kigwe</i> ; commonly found in Tigania region of Meru county
5	Muchuri	Meru	Evergreen tree; young twigs red in colour	Highly productive in all seasons. Common in Tigania region of Meru county



6	Gitu	Embu	Leaves large; shoots light greenish	Less preferred; less potent than <i>muguka</i>
7	Kibwe	Embu	Leaves oblong; shoots light greenish	Less potent than <i>muguka</i> ; less preferred
8	Muguka	Embu	Bushy shrub; bitter taste; red shoots; branches inflexible	Highly potent with effects being felt immediately after masticating a few leaves; most preferred variety because it's cheaper and has strong inebriating effects.
9	Mugumo	Embu	It's referred by this name due to its evergreen nature even in drought like the famous fig(<i>mugumo</i>) tree; shrub	Breaks easily; moderate potency level when chewed; not preferred by consumers
10	Mugwathingi	Embu	Leaves large; shoots light greenish to purplish	Less potent than <i>muguka</i> ; less preferred
11	Muti-mutiri	Embu	Bushy shrub; shoots light greenish; tends to grow tall	Not as potent as <i>muguka</i>

Ethno-medicinal uses of *Catha edulis*

A total of thirteen diseases/ill conditions were reported to be treated using qat in Meru and Embu counties. A summary of the medicinal uses and their percentage use per county is given in Tables 3 and 4 respectively.

Table 4: Ethno medicinal uses of *Catha edulis* in Meru and Embu counties

S/n	Disease/ill-health condition	County	Parts used	Method of drug preparation	Mode of administration
1	Helminthiasis	Embu	Leaves	chewing fresh material	Oral
2	Toothache	Embu	Leaves	Boiling fresh material, then inhaling the vapour through the mouth.	Oral
3	Asthma	Meru	stems	chewing fresh material	Oral
4	Erectile dysfunction	Meru	Stems	chewing fresh material	Oral
5	General body pain	Meru	stems	chewing fresh material	Oral
6	Gonorrhoea	Meru	Roots	Boiling fresh material	Oral
7	Heartburn	Meru	Stems	Chewing fresh material	Oral
8	Influenza	Meru	Stems	chewing fresh material	Oral

9	Pneumonia	Meru	leaves	Chewing fresh material	Oral
10	Stomach upset	Meru	leaves	Chewing fresh material	Oral
11	Coughing	Meru& Embu	Leaves and stems	Chewing fresh material	Oral
12	Diarrhoea	Meru& Embu	Roots and stems	Boiling fresh material	Oral
13	Fatigue	Meru& Embu	Stems	Chewing fresh material	Oral

Table 5: Percentage ethnomedicinal uses of *Catha edulis* based on the county

County	No. of diseases(n=13)	Percentage (%)
Meru	8	62
Embu	2	15
Meru&Embu	3	23

In the table above, the reported cases of diseases treated by qat material were higher in Meru County (62%) compared to Embu County (15%). It was noted that in both counties, qat is used as anti-fatigue, anti-diarrhoea and also remedy for coughing comprising 23% of the total medicinal uses. However, most of the key informants in Embu County were not aware of medicinal uses of qat (only two cases were reported) other than its use as a psychostimulant. The total numbers of ailments reported were put into four categories based on the part of the body affected as summarized in the table 5 below.

Table 6: Percentage ethnomedicinal uses of *Catha edulis* based on the system of the body affected

System(part) of the body	No. of diseases treated(n=13)	Percentage (%)
Respiratory	4	31
Gastrointestinal tract	4	31
Reproductive	2	15
General pain	3	23

Parts of the plant used

Leaves and young stems were the most common parts of qat used as a traditional therapeutic measure against common human diseases. Roots have scanty usage although cases of treatment of gonorrhoea and diarrhoea were reported. It is possible that the medicinal value of leaves and stems might have been realized in the process of trying to acquire the psychostimulating effects of qat as these are the most common consumable parts of qat.

Method of drug preparation and Route of administration of prescribed dosage

Chewing raw material was reported to be the main method of acquiring medicinal potential of qat although in some cases,boiling of the material is applied.The route of administration of crude extracts is generally oral.In most cases,this was reported to happen in the pursuit of stimulating effects of qat. There is no precise dosage reported that can be administered for any given ailment.

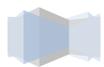
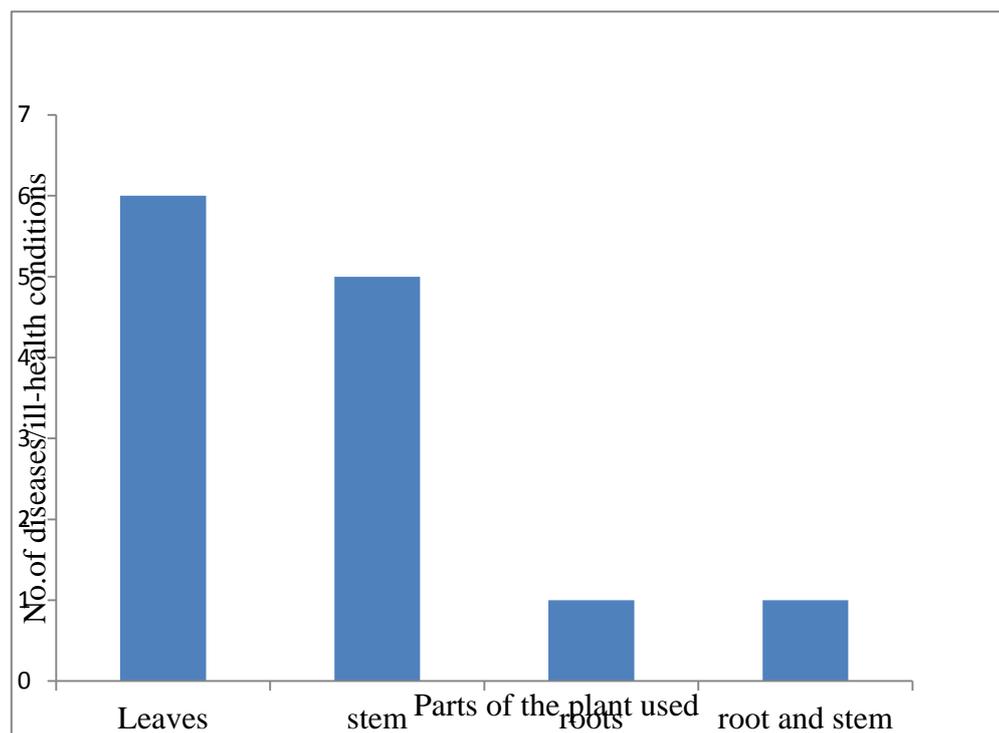


Figure 2: Graph showing parts of the plant used and number of diseases treated by use of different parts of the plant



DISCUSSION

The present study aimed at exploring the traditional knowledge of Ameru and Aembu communities of Kenya with special focus on ethnomedicinal uses and traditional classification of qat. The approach of collecting folk biological knowledge on qat involved mainly communicating with people through face to face interaction. The forty two key informants interviewed comprised more males (32) than females (10). This is due to the fact that traditionally, the value of qat (chewing habit) has been associated with men (1,2), compared to women in these counties. Thus, cultivation of this crop has been carried out by men for centuries hence they harbor a vast knowledge of the plant than their female counterparts.

The source of ethnoknowledge of qat is mainly out of personal experience as reported by 47.6% of the respondents. Others (28.6%) argued that knowledge of qat has been bequeathed to children by their parents and their grandparents over several generations. The remaining (23.8%) believed that close friends and relatives are key players in disseminating ethnoknowledge of this psychostimulant. *Catha edulis* is believed to be indigenous in Kenya as reported by 71% of the respondents although 24% believed that the plant may have been introduced from other unspecified places. The rest (5%) had no idea of where qat might have come from in their communities. Although qat is known for its negative health effects, 52% of the key respondents argued that some specific traditional varieties such as *kigwe/gikieru* were grossly associated with negative physiological effects such as insomnia and delirium while other traditional varieties like *asili/gikiiru*

had no known health effects. Others (24%) argued that the negative health effects depends on the quantity of qat leaves/stems consumed while the remaining (24%) believed that none of the traditional varieties of qat has negative health effects and that qat is just a psychostimulant comparable to coffee and not a narcotic drug.

The traditional varieties of qat were classified based on several criteria such as age of trees, morphology, and stimulating effects. However, taste properties and inebriating effects were the major criteria used to delimit various traditional varieties of qat in the present study. The problem with such a criterion is that it is very difficult to identify variations in the field. Such a classification can be biased since it is usually based on individual perceptions and may not represent what is actually happening in nature. In the present study, caution was taken to avoid unnecessary duplication of names given to different varieties of qat because of different dialects/phonetics existing within Meru and Embu Counties. In addition, several names which exist in literature only refer to grades of harvested twigs but not the whole tree/shrub names. It was made clear to the respondents that only names of tree/shrub types with some noticeable characters in the field were needed but not grades of qat.

Miraa (singular *muraa*) is a common vernacular name of harvestable young twigs from qat. The people of Meru classify both the miraa trees and the young twigs harvested. Thus names such as *kangeta* and *giza* commonly encountered in markets denotes grades of miraa and do not in any way refer to a particular tree type. They are graded

based on the length of the twigs harvested. For instance, *kangeta* refers to twigs of *miraa* of length 20-30 cm. anything shorter than this is referred to as *giza (kisa)* (Carrier, 2007). *Mbaine* is a kimeru word for any *miraa* tree dating back to over three centuries and does not refer to any particular traditional variety of qat. Younger trees of *miraa* in Meru are locally known as *Mithairo*.

The Ameru community recognizes five traditional varieties which include: *Kiraa gikiiru (Asili)*, *kigwe (gikieru)*, *Muchuri*, *kithaara* and *kilantunc*. *Muchuri* and *Kithaara (nthara)* are mainly encountered in Tigania region of the county whereas the other traditional varieties have uniform distribution in the county. *Kiraa gikiiru* also known as *asili* (in Swahili) meaning “original” is a major traditional variety that is highly reputed in Meru County as it is known to produce softer twigs which is sweet tasting and no known negative physiological effects associated with it. It is the most expensive variety in the market where qat grade locally known as *miraamiiru* (“black miraa”) is harvested from it. A bundle of this grade locally known as “kilo” consisting of about 10 small bundles tied into one big bundle may be sold up to Ksh 4,000. *Kigwe* also known as *Kiraa gikieru* is the second known traditional variety in Meru as chewing of excess amount of this produces negative physiological effects such as insomnia and formication. *Miraamiiru* (“white miraa”) grade derived from this traditional variety fetches very little amount of money in the market. In Meru County, a single piece of land may have a cluster of all the traditional varieties of qat distinguishable by experienced farmers only.

The Aembu/mbeere community recognizes six major traditional varieties which include *muguka*, *muti-mutiri*, *kibwe*, *mugwathingi*, *mugumo* and *gitu*. The cultivation of these traditional varieties is more pronounced in Mbeere region than any other part of the Embu County. However, other regions of the county are emerging with intense cultivation of qat such as Runyenjes constituency of Embu Sub-County where large tracts of land have been converted into qat plantations. It is important to note that in the market, the harvest from these traditional varieties is known under a single umbrella name “*muguka*” and hence the other names are only known in the rural set-up specifically by farmers. Perhaps this is because *muguka* is the most preferred variety in the market as it is characterized by deep splash of red leaves and rapid psychoactive effects after mastication of few leaves.

Although most of the differences mentioned during the survey (Table 2) were difficult to assess in the field (because they were based on personal experience of the taste properties and stimulating effects), there was a unanimous agreement by the farmers that the whole group of traditional varieties found in Meru differ from those found in Embu/Mbeere region. The traditional classification of the plant reveals a deep understanding of this species by the people in the two counties.

10

The use of taxonomically important characters such as leaf shapes by farmers to distinguish traditional varieties is also an indicator of deep knowledge enshrined in the traditional set-up. For instance, *kithaara* in Tigania region of Meru

County is mainly identified by its lanceolate leaf shape. Similarly, all the traditional varieties from Embu County are distinguished from those of Meru by their broader leaves apart from their stronger psychoactive effects.

Although qat is well known controversially for its amphetamine-like effects, the people of Meru and Embu counties of Kenya have used the plant as a traditional therapeutic measure against common human diseases. A total of thirteen diseases were reported to be cured using qat. Of these, four were categorized respiratory illnesses, the other four were categorized under gastrointestinal infections, and two were put into the category of reproductive defects/illnesses, while the remaining three were categorized as general body pain. More cases of the medicinal uses were reported in Meru County (62%) compared to Embu County (15%). The rest (23%) were reported in both counties. With more cases of medicinal uses coming from Meru County, it may be suggested that qat might have been in cultivation in Meru for a longer period of time than in Embu County. Therefore, there is no doubt that the claim made by Carrier (2007) that the origin of Kenyan qat is Nyambene hills (Meru County) would hold true in this case. The respondents treated all traditional varieties as one group in each county when assessing the medicinal value of qat. No specific traditional variety was claimed to have a specific cure for a given disease in both counties.

Fresh leaves and young stems were the most used parts of the plant. It is probable that the medicinal value of leaves and stems might have been realized in the pursuit of psychostimulating effects of qat. Most of the diseases listed in Table 3 form part of what has been reported before (19,22,23, 24,25,27). However, few of the cases such as use of khat as an anthelmintic have not been reported in the literature and needs further investigation. The higher number of reported cases of ethnomedicinal uses of qat in Meru County compared to Embu County alludes to their differences in periods of domestication in these localities. Either qat has been in cultivation for a longer period of time in Meru compared to Embu/Mbeere or perhaps the two groups are different in terms of phytochemical constituents responsible for the medicinal value of the species.

CONCLUSION

The study has divulged a rich ethnoknowledge of *Catha edulis* as used traditionally in Meru and Embu counties of Kenya. The study has shown that qat is a potential medicinal plant and an elaborate efficacious investigation of the plant will be a promising approach in understanding the medicinal potential of this controversial plant. Traditionally, qat is heterogeneous and therefore a taxonomic investigation of the reported traditional varieties should be carried out to confirm whether the differences highlighted are valid taxonomically as this might be a lead to infraspecific delimitation of the species.

ACKNOWLEDGEMENTS

We thank the people of Meru and Embu counties with whom and for whom this research was carried out. Their

invaluable vast amount of information was helpful in compilation of this work. The University of Nairobi is thanked for the Master's degree scholarship it offered to the first author. The National Commission for Science, Technology and Innovation (NACOSTI: 6th Call, 2014-2015FY) is acknowledged for the financial support given to the first author.

COMPETING INTERESTS

The authors declare that they have no competing interests of any kind.

AUTHORS' CONTRIBUTIONS

JKK came up with the idea, carried out ethnomedicinal study as well as statistical analysis and drafted the manuscript. CWL contributed to the design of the study and helped to draft the manuscript. SFD and AY equally helped in coordination and drafting the manuscript. All authors read and approved the final manuscript.

REFERENCES

[1] Al-Motarreb, A., Baker, K., Broadley, K.J. (2002a). Khat: Pharmacological and medical aspects and its social use in Yemen. *Journal of Phytotherapy Research*, 16: 403–413.

[2] Al-Motarreb A, AL-Kebsi, M, Al-Adhi, B.(2002b). Khat chewing and acute myocardial infarction. *Heart*, 87:279-280.

[3] Astatkie, A. Demissie, M., Berhane, Y., & Worku, A. (2015). Oral symptoms significantly higher among long-term khat (*Catha edulis*) users in Ethiopia. *Journal of Epidemiology and Health*, 37. <http://dx.doi.org/10.4178/epih/e2015009>.

[4] Brenneisen. & Geissshuler, S. (1985). Psychotropic drugs III: Analytical and chemical aspects of *Catha edulis* Forsk. *Journal of Pharmaceutical Acta Helvetiae*, 60:290-301.

[5] Carrier, Neil C.M (2007). Kenyan Khat: The social life of a stimulant. *Journal of African Social Studies series*, 15:1568-1203.

[6] Cotton, C.M. (1996). Ethnobotany: principles and applications. 1st edition. John Wiley & Sons, Chichester. New York, USA.

[7] Cox & Rampes, H. (2003). Adverse effects of khat: A Review. *Advances in Psychiatric Treatment*, 9:456-463.

[8] Elmi A. (1983). The chemistry of khat in Somalia. *Journal of Ethnopharmacology*, 8:163-176.

[9] Etkin, N.L. (1993). Anthropological methods in ethnopharmacology. *Journal of Ethnopharmacology*, 38: 93–104.

[10] Gakuubi, M.M., Wanzala W. (2012). A survey of plants and plant products traditionally used in livestock health management in Buuri District, Meru county Kenya. *Journal of ethnobiology and ethnomedicine*, 8:39.

[11] Gerstle, D.J. (2007). Taming the African Horn's Khat Trade. *SIPA News*, 27–29.

[12] Greenway, P.J. (1947). Khat. *East African Agricultural Journal*, 13:98-102.

[13] Hassan, N.A., A.A. Gunaid, A.A. Abdo-Rabbo, Z.Y. Abdel-Kader and M.A.K. Al-Mansoob *et al.*

(2000). The effect of Qat chewing on blood pressure and heart rate in healthy volunteers. *Tropical Doctor*, 30:107-108.

[14] Hassan, N. A., Gunaid, A. A., Murray, I. M. (2007). Khat (*Catha edulis*): Health aspect khat chewing. *Health Journal*, 13: 1-13

[15] Islam M.W., Tariq M., Ageel A.M., El-Feraly F.S., El-Meshal A. and Ashraf I. (1990). An evaluation of the male reproductive toxicity of cathinone. *Toxicology*, 60:223-234.

[16] Jorgensen, E., & Kaimenyi, J. T. (1990). The status of periodontal health and oral hygiene of Miraa (*Catha edulis*) chewers. *East African Medical Journal*, 67(8): 585-590.

[17] Kalix, P. and Braenden, O. (1985). Pharmacological aspects of chewing of khat leaves. *Journal of Pharmacology*, 37:149-164.

[18] Karunamoorthi, K., Udeani, G., Babu, S.M., Mossie, A. (2010). Psychopharmacological Aspects of *Catha edulis* Forsk. (Fam. Celastraceae). *African Journal of Pharmaceutical Sciences*, 1(1):112-129.

[19] Kennedy, J.G. (1987). The Flower of Paradise: The institutionalized use of the drug qat in North Yemen. D. Reidel, Dordrecht, Netherland.

[20] KNBS (2015) Website of the Kenya National Bureau of Statistics (KNBS), www.knbs.or.ke, accessed 6/6/2016.

[21] Kokwaro, J.O (1993). Medicinal Plants of East Africa. Nairobi: East Africa Literature Bureau.

[22] Kokwaro, J.O. (2009). Medicinal Plants of East Africa. Nairobi. Third Edition. University of Nairobi Press.

[23] Krikorian, A.D. (1984). Qat and its use: An historical Perspective. *Journal of Ethnopharmacology*, 12:115-178.

[24] Lemessa, D. (2001). Khat (*Catha edulis*): Botany, distribution, cultivation, usage and economics in Ethiopia. Report UN emergencies unit for Ethiopia.

[25] Margetts, E.L. (1967). Miraa and Myrrh in East Africa. Clinical notes about *Catha edulis*. *Journal of Economic Botany*, 21:358-362.

[26] Mathys, K. and Brenneisen R. (1993). HPLC and TLC profiles of phenylalkylamines of khat (*Catha edulis* Forsk) confiscated in Switzerland. *Journal of Pharmaceutica Acta Helvetiae*. 68:121-128

[27] Mwenda, J.M., Arimi, M.M., Kyama, M.C. and Langat, D.K. (2003). Effects of khat (*Catha edulis*) consumption on reproductive functions: a review. *East African Medical Journal*, 80: 318-323.

[28] Nezar, N.A. and Mohammed, S.A. (2010). Experimental gingivitis in male khat (*Catha edulis*) chewers.

[29] Nigussie, T., Gobena, T., Mossie, A. (2013). Association between khat chewing and gastrointestinal disorders: A cross sectional study. *Ethiopian Journal of Health Sciences*, 23(2):123-130

[30] Njeru, M.K. (2015) Challenges and benefits of organic farming among farmers in Nembure Division, Embu County-Kenya. *International journal of Humanities and Social sciences*, 5:12

- [31] Nyongesa, A.W., Patel, N.B., Onyango, D.W., Odongo, H.O. and Wango, E.O. (2008).Khat (*Catha edulis*) lowers plasma luteinizing hormone (LH) and testosterone secretion, but increases cortisol levels in male rabbits. *Journal of Ethnopharmacology*, 116: 245-250.
- [32] Nyongesa, A.W.,Onyango,D.W.(2010). Khat (*Catha edulis* Forssk): A bane or boon to humanity. *Journal of Ethnomedicine*, 28:187-209.
- [33] Owuor B.O. (1999).Ethnobotanical and phytochemical study of herbal remedies of Migori District, Kenya.Msc.Thesis, University of Nairobi.Unpublished.
- [34]Perlez, J. (1992). Guns, Greed and Khat Define a Once-graceful Somali City. The New YorkTimes.<http://www.nytimes.com/1992/12/07/world/missionsomalia-reporter-s-notebook-guns-greed-khat-definc-once-graceful-somali.html>.
- [35] Russell, B. (2002). Research methods in anthropology. Qualitative and quantitative methods. 3rd edition California, USA.
- [36] Salganik, M.J., Heckathorn, D.D. (2004). Sampling and estimation in hidden populations using respondent-driven sampling. *Journal of Sociological Methodology*, 34(1):193–239.
- [37] Szendrei, K. (1980). The chemistry of khat. *Bulletin on Narcotics*, 3:25-35.
- [38] WHO (2006). Expert Committee on Drug dependence. Critical Review of Khat. Expert Committee Meeting 28-31 March, Geneva.