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Ethnobotanical survey of food and medicinal plants of the Ilkisonko Maasai community in Kenya

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Abstract

Aim of the study: Pastoralist communities such as the Maasai are heavily reliant on traditional foods and medicines. This survey sought to identify traditional foods and/or medicinal plants of the Ilkisonko Maasai community living in Kenya.

Materials and methods: Ethnobotanical knowledge of traditional plants used as food and human/veterinary medicine was obtained using structured and semi-structured questionnaires administered through face to face interviews of key informants.

Results: A total of 30 species from 21 families and 25 genera were reportedly used as food and/or medicinal plants by 48 respondents. The most commonly encountered genus was the Fabaceae. The growth forms encountered were tree (47%), shrub (33%) and herb (20%). Plants that were commonly mentioned by respondents were Salvadora persica (85%), Grewia villosa (52%), Ximenia americana (52%), Albizia anthelmintica (50%), Acacia robusta (46%) and Acacia nilotica (42%). The root/root bark was the most commonly used plant part (35%), followed by the stem/stem bark (30%), fruit (15%), leaves (11%) and whole plant (9%). Common ailments treated were stomach aches, constipation, back aches, joint aches, body pains and sexually transmitted infections. The plants were also used as tonics, digestives, and restoratives.

Conclusion: It was evident that traditional medicine was the preferred health care system for the Ilkisonko Maasai community. It is important to document and use this knowledge in producing novel products that could improve nutrition and healthcare in rural communities.

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1. Introduction

The Ilkisonko Maasai, part of the eight Maasai clusters of Kenya, are a pastoralist community living near or around Loitokitok, neighboring Mt. Kilimanjaro (Fig. 1). The Maasai have set traditions carried out through the ages which have attracted considerable interest globally. They depend heavily on the environment for food and medicine and have been known to practice African traditional medicine through folklore (Kiringe and Okello, 2005; Ole-Miaron, 2003). The Maasai have been known to use certain medicinal plants as dietary additives for preventive or curative care for the community (Johns et al., 1999). This traditional medicine practice is under threat from formal educational systems and urbanization where the Maasai are educating more of their children who move to the towns looking for work, leaving few to harness this important knowledge. The diverse number of plants used in traditional medicine practice are also reducing due to subdivision of communal land for use in small scale irrigation farming (Johns et al., 1994).

Research into plant foods and medicine used by the Maasai is important in obtaining and documenting their rich knowledge. By identifying these indigenous plants it may be possible to deter their extinction and even encourage their propagation and cultivation to obtain the medicinal compounds.

2. Methods

2.1. Study area

The Ilkisonko Maasai are found in and around Loitokitok sub-county which is located in Kajiado County that lies in the southern part of Kenya. Although Loitokitok is in close contact with Mt.
Kilimanjaro and the lush forest surrounding it, heavy rains are only experienced in the mountainous zones and much less around Loitokitok. Rainfall patterns in Loitokitok are bimodal with the long rains falling between March and May and the short rains between October and December. The soils are fine, inherently fertile volcanic clays, very prone to erosion. These soils support bushland vegetation and open grassland suitable for agropastoralism and wildlife. The main economic activities are tourism in the neighboring national parks, commercial farming, and peasant livestock farming. Commercial farming has made the sub-county considerably wealthier than before but this investment is localized and many areas of Loitokitok remain poor. Loitokitok is a semi-arid region with great plant biodiversity, which is slowly disappearing due to intermittent drought, overgrazing and population increase.

Interviews were conducted in three locations in Loitokitok sub-county namely Rombo, Kimana and Entonet. Rombo and Kimana were chosen as they are under the Endangered Ecosystems list of Kenya, while Entonet was included as it is in the nearby area (Reid et al., 2004).

2.2. Study approval

Ethical approval for this study was obtained from Kenyatta National Hospital-University of Nairobi Research Ethics Review Committee (Reference number: KNH-ERC/A/173). Permission to conduct the study in Loitokitok was obtained from the respective sub-county administrators in Rombo, Kimana and Entonet. Written consent was sought from the study participants after information was provided to them on the purpose, benefits and risks associated with the study.

2.3. Data collection

The interviews were carried out on plants used as food and medicine among the Ilkisonko Maasai community. Individuals who were locally recognized as knowledgeable on plant use were identified with the assistance of the village elders. The selection in the questionnaire was described as random but guided sampling was done to obtain more useful information. A total of 48 respondents were interviewed using a semi-structured questionnaire consisting of open and close-ended questions. Pretesting of the semi-structured questionnaire had been conducted with seven key informants not involved in the study.

There were 14 questions in the questionnaire which were conducted in the local dialect of the Maasai language, Maa, or the national language, Swahili, depending on the respondent’s preference.

Due to the dynamic nature of ethnobotanical information, this study included plants mentioned by three or more informants to increase the reliability of the obtained data (Johns et al., 1990). The medicinal plants chosen to undergo further analysis were identified by a botanist using the Flora of Tropical East Africa and voucher specimens were deposited at the University of Nairobi Herbarium (NAI).

3. Results and discussion

All 48 respondents interviewed were males aged 35–75 years of age (Fig. 2). Although our initial intent was to obtain information from both gender, only men participated in the study. This could be due to the patriarchal nature of the Maasai where the male elders speak on behalf of the community (Gneezy et al., 2009). A majority of the interviewees (90%) were pastoralists while 77% of the respondents had no formal education (Fig. 3).

The study showed that the respondents preferred traditional medicine to conventional medicine, in agreement with previous observation (Kiringe, 2006). The traditional medicine was frequently taken together with conventional medicine which was thought to be superior. This is different from what Kiringe observed that the Maasai at that time thought traditional medicine to be superior (Kiringe, 2006). Traditional foods or medicine were first ingested in the early stages of the disease but when ineffective the locals resorted to conventional medicine (Fig. 4).

At least 54% of the respondents use indigenous foods and medicinal plants once a month or less frequently (Fig. 5). Use of indigenous plants as food or food additives may depend on the availability of meat, in which the soup is used to flavor the decoction. The Maasai usually boil the traditional plants and mix the decoction with either bone soup or milk before drinking. This would point towards the presence of heat stable hydrophilic and lipophilic compounds that act as adaptogens and medicines. The decoction was taken as an adaptogen when the herder has a long distance trek in search of pasture, which is infrequent.
plants used as medicine are taken even less frequently because most persons fall ill once a month or less. The most common route of administration was oral (78%) while 19% of the plants were used as topical preparations and only *Ocimum gratissimum* (3%) was used as an inhalation.

A total of 30 species from 21 families and 25 genera were reportedly used as food and/or medicine. A study by Bussmann et al. (2006) in Kajiado County, Sekenani valley shows a great number of plants (155 plant species) as they sought to check on the complete flora of the area, while this study looked at the useful species in Loitokitok sub-county. Muthee et al. (2011) has cited a total of 80 medicinal plants from Loitokitok sub-county, some of which were mentioned by only one respondent while this study identified only those which had been mentioned three or more times. All the respondents mentioned the plant names in the local dialect, Maa. The most commonly encountered family was the Fabaceae with a total of eight plants, followed by Anacardiaceae and Solanaceae with two plants each (Table 1).

Salvadora persica was mentioned by 85% of the respondents due to its importance in dental hygiene and also as a medicine (Hlawanya, 2012). Other plants that were commonly mentioned by respondents were *Grewia villosa* (52%), *Ximenia americana* (52%), *Albizia anethmintica* (50%), *Acacia robusta* (46%) and *Acacia nilotica* (42%) as seen in Table 1. The commonly mentioned plants were all used as tonics except for *A. robusta*. As shown in Fig. 6, the growth forms encountered were the tree (47%), shrub (33%) and herb (20%).

Fig. 7 shows that the root/root bark was the most commonly used plant part (35%), followed by the stem/stem bark (30%), fruit (15%), leaves (11%) and whole plant (9%). Harvesting of roots is an important factor in sustainable land use as good harvesting practices are normally not adhered to leading to loss of plant life. Leaves are the least used plant part possibly because the Maasai are known to consume very little vegetable in their diet (Nestel, 1989).

In this study the common ailments treated were stomach aches, constipation, back aches, joint aches, body pains and sexually transmitted infections (Table 1). The plants were also used as tonics, digestives, and restoratives. Most of these uses were supported by similar studies as illustrated in Table 1. Sixteen families (53%) from each of the studies by Bussmann et al. (2006) and Muthee et al. (2011) are similar to those cited in our study. At least 33% of the plants identified were used as both food and medicine in which plants such as *Ximenia* sp., *Carissa* sp., *Cyphostemma* sp., and Grewia sp. have also been cited as sources of food (Bussmann et al., 2006), while the remaining 67% were used as medicine. Amongst the thirty plants included in Table 1, nine species (30%) find use in management of livestock conditions such as retained placenta, East Coast fever and sometimes used as a tonic.

It was evident that traditional medicine was the preferred health care system for the Ilkisonko Maasai community and some preferred it to conventional medicine. Despite this, there is an emerging threat to local medicinal plants due to charcoal burning, increased consumption emanating from increase in human population and land use changes particularly expansion of agriculture (Kiringe and Okello, 2005). Traditional plants with potential to produce both food and medicine can be an attractive resource in poverty alleviation. Documentation of the medicinal plants and their uses is important in preserving the indigenous knowledge. Further research in these plants could provide novel compounds that could be used as leads in drug discovery.

**Author contributions**

Jacob Miaron directed and planned the ethnobotanical survey. All authors contributed in designing, collecting and analysis of data. Julia Kimondo wrote the first draft and all authors were involved in the revision of the draft manuscript and agreed to the final content.

**Conflict of interest**

The authors declare that there is no conflict of interest.
<table>
<thead>
<tr>
<th>Voucher number</th>
<th>Family and scientific name</th>
<th>Local Maasai name (Maa)</th>
<th>Uses</th>
<th>Reported traditional uses</th>
<th>Reported pharmacological/ chemical activity</th>
<th>Part used</th>
<th>Number of mentions</th>
<th>Habit</th>
</tr>
</thead>
<tbody>
<tr>
<td>JW2014/01</td>
<td>Amaranthaceae Achyroctheca aspera L.</td>
<td>Olerubat</td>
<td>Teeth and new wounds, back and knee aches, conjunctivitis</td>
<td>Used to treat malaria and toothache (Bussmann et al., 2006; Karrera et al., 2007b)</td>
<td>Anti-inflammatory effect (Vetrivelvan and Jegadeesan, 2003)</td>
<td>Whole plant</td>
<td>3</td>
<td>Herb</td>
</tr>
<tr>
<td>JW2014/02</td>
<td>Rhus natalensis Krauss</td>
<td>Olmusigiyoi</td>
<td>Strengthener, respiratory disorders, stomachach, malaria</td>
<td>Used as food (Orwa et al., 2009). Roots used for digestive disorders and gonorrhoea (Arbonnier, 2004)</td>
<td>Water and methanol extracts showed anti-plasmodial activity (Gathirwa et al., 2008)</td>
<td>Root, fruit, stem</td>
<td>3</td>
<td>Tree</td>
</tr>
<tr>
<td>JW2014/03</td>
<td>Sclerocarya birrea (A. Rich.) Hochst.</td>
<td>Oloisuki</td>
<td>Cold and flu in children, edema of limbs, respiratory disorders, joint pains, toxic in cows, food</td>
<td>Used in inflammatory disorders, malaria, nausea, tonic for man and cattle food, timber, dye (Arbonnier, 2004)</td>
<td>The methanol extract exhibited antifungal activity (Hamza et al., 2006)</td>
<td>Root, stem bark</td>
<td>8</td>
<td>Tree</td>
</tr>
<tr>
<td>JW2014/04</td>
<td>Apocynaceae Carissa spinarum L.</td>
<td>Olamuriaki</td>
<td>Food, colds</td>
<td>Have edible fruits (Maundu et al., 2001)</td>
<td>Isolated compounds were found to have anti-oxidant effects, while the extract had anti-bacterial effect (Sanwal and Chaudhary, 2011; Wangteeraprasert et al., 2012).</td>
<td>Fruit</td>
<td>5</td>
<td>Shrub</td>
</tr>
<tr>
<td>JW2014/05</td>
<td>Asphodelaceae Aloe secundiflora Engl.</td>
<td>Osukuroi</td>
<td>Tonic, respiratory problems, East Coast fever, wounds, headache</td>
<td>Used for chest pain, headaches, malaria, rheumatism and topicaly on wounds (Kokwaro, 2009; Muthee et al., 2011)</td>
<td>The leaf exudate has antibacterial property which may be due to the presence of aloenin (Rebecca et al., 2003; Wagate et al., 2010).</td>
<td>Leaf sap</td>
<td>13</td>
<td>Herb</td>
</tr>
<tr>
<td>JW2014/06</td>
<td>Canellaceae Warburgia ugandensis (Sprague) subsp. ugandensis</td>
<td>Osokonoi</td>
<td>Diarrhea, respiratory problems, stomach ache, malaria</td>
<td>Used by the Maasai to treat respiratory disorders (Muthee et al., 2011), as a tonic and aphrodisiac (Kiringe, 2006)</td>
<td>The crude extract showed antibacterial, antifungal and antioxidant effects and antioxidant molecules were obtained (Ohla et al., 2001; Manguro et al., 2003).</td>
<td>Root, stem bark</td>
<td>14</td>
<td>Tree</td>
</tr>
<tr>
<td>JW2014/07</td>
<td>Capparaceae Maesoa triphylla A. Rich.</td>
<td>Olmalogoi</td>
<td>Food, cleaning wounds, aphrodisiac, headache, toxic</td>
<td>Leaf paste is used to clean boils (Hasan-Abdallah et al., 2013)</td>
<td>No reported pharmacological activity</td>
<td>Stem bark, leaf</td>
<td>3</td>
<td>Tree</td>
</tr>
<tr>
<td>JW2014/08</td>
<td>Combretaceae Combretum roxb. ex C. Dons.</td>
<td>Olmaroroi</td>
<td>Sexually transmitted infections, backache</td>
<td>Used to treat respiratory disorders and backache (Muthee et al., 2011)</td>
<td>Anti-inflammatory triterpenoids are present (Ponou et al., 2008).</td>
<td>Root</td>
<td>3</td>
<td>Tree</td>
</tr>
<tr>
<td>JW2014/09</td>
<td>Acacia drepanolobium Harms ex Sjöstedt</td>
<td>Eluai</td>
<td>Retained placenta in cows, postpartum pain in humans, fertility, tonic</td>
<td>Used to expel retained placenta (Kiringe, 2006; Maundu et al., 2001)</td>
<td>Presence of tannins and proanthochyanidins (Kusano et al., 2011)</td>
<td>Stem bark</td>
<td>15</td>
<td>Shrub</td>
</tr>
<tr>
<td>JW2014/10</td>
<td>Acacia nilotica (L.) Willd.</td>
<td>Enkloriti</td>
<td>Strength in skin tonic, appetizer, body ache, stomachache, stamina, stimulant/excitant</td>
<td>Antioxidant (Sultiana et al., 2007)</td>
<td>Umbelliferone has antioxidant activity (Singh et al., 2010), niloticanne has anti-inflammatory and antibacterial effect (Eldeen et al., 2010)</td>
<td>Stem/root</td>
<td>20</td>
<td>Tree</td>
</tr>
<tr>
<td>JW2014/11</td>
<td>Acacia melilfera (M. Vahl) Benth.</td>
<td>Oiti</td>
<td>Postpartum tonic, appetizer, sore throat, East Coast fever</td>
<td>Stomachache (Johns et al., 1999), appetizer (Kiringe, 2006)</td>
<td>Lupanes isolated had cytotoxic activity while its triterpenoids have antioxidant activity (Mutai et al., 2002).</td>
<td>Stem bark</td>
<td>4</td>
<td>Tree</td>
</tr>
<tr>
<td>JW2014/12</td>
<td>Acacia reficiens subsp. misera (Vatke) Brenan</td>
<td>Olchurrai</td>
<td>Strengtheners, appetizers, tonic, adaption, laxative</td>
<td>Spice and condiment, fodder, aphrodisiac (Kokwaro, 2009)</td>
<td>No reported activity</td>
<td>Root, stem bark, root bark</td>
<td>5</td>
<td>Tree</td>
</tr>
<tr>
<td>JW2014/13</td>
<td>Acacia nubica Benth.</td>
<td>Oldepe</td>
<td>Sexually transmitted infections, postpartum tonic, facilitat lactation, rejuvenation</td>
<td>Tonic and joint pains (Johns et al., 1994), postpartum (Kiringe, 2006)</td>
<td>Root bark contains triterpenes with antifungal activity (Elfadil et al., 2015).</td>
<td>Root bark</td>
<td>16</td>
<td>Tree</td>
</tr>
<tr>
<td>JW2014/14</td>
<td>Albizia anthelmintica Brongn.</td>
<td>Olmukutan</td>
<td>Purgative, dewormer, anti-malarial, tonic, food for goats</td>
<td>To induce vomiting in malaria (Kiringe, 2006) and treat fevers (Johns et al., 1999)</td>
<td>Contains triterpenes with potent analgesic and antioxidant activity (Mohamed et al., 2013)</td>
<td>Root, stem bark</td>
<td>24</td>
<td>Tree</td>
</tr>
<tr>
<td>JW2014/15</td>
<td>Acacia robusta Burch.</td>
<td>Olmunumyi</td>
<td>Retained placenta in cows and humans</td>
<td>To induce vomiting in malaria (Kiringe, 2006) and treat fevers (Johns et al., 1999)</td>
<td>The methanol extract exhibited antifungal activity (Hamza et al., 2006), presence of biflavonoids and antimicrobial activity (Phoole et al., 2010).</td>
<td>Root bark</td>
<td>22</td>
<td>Tree</td>
</tr>
<tr>
<td>JW2014/16</td>
<td>Ormoscarpus kurki S. Moore</td>
<td>Enkokirisi</td>
<td>Stops postpartum bleeding, prevents abortion</td>
<td>To remove placenta after birth (Kiringe, 2006)</td>
<td>The methanol extract exhibited antifungal activity (Hamza et al., 2006)</td>
<td>Root, fruit</td>
<td>3</td>
<td>Shrub</td>
</tr>
<tr>
<td>JW2014/17</td>
<td>Labiatae Ocimum gratissimum L.</td>
<td>Olemorran</td>
<td>Treatment of colds, headache, fragrant</td>
<td>Used for bronchitis and malaria (Karrera et al., 2007b)</td>
<td>Extracts were found to have anti-inflammatory effects (Chiu et al., 2012).</td>
<td>Leaf</td>
<td>5</td>
<td>Herb</td>
</tr>
</tbody>
</table>
| JW2014/18 | Malvaceae  
Growing (Wildd.) | Olmankulai | Food, galactagogue, strength/tonic, stomachache in kids
Used as an anticancer (Kareru et al., 2007b), for oral hygiene (Bussmann et al., 2006) | Root, stem, fruit | 25 | Shrub |
| JW2014/19 | Oleaceae  
Ximenia americana L. | Enkamai | Stomachache in kids, food, tonic, constipation
Stomachaches (Muthee et al., 2011) used in Mali as a tonic (Le et al., 2012) and to manage HIV related symptoms in Kenya (Nagata et al., 2011) | Stem | 5 | Tree |
| JW2014/20 | Oleaceae  
Oxycoccus sinuatum (Hochst. & Steud) Dammer | Oloiren | Preserve milk, tonic, cold and fever, East Coast fever
For respiratory ailments (Muthee et al., 2011) | Leaf | 4 | Herb |
| JW2014/21 | Oleaceae  
Ximenia americana | Enkaisi | Tonsillitis, food, conjunctivitis
Used to treat gonorrhea (Kareru et al., 2007a) | Whole plant | 3 | Shrub |
| JW2014/22 | Oleaceae  
Rhamnus prinoides L. | Olikonyil | Sexually transmitted infections, back and joint aches, arthritis, aids in digestion, tonic
The plant was observed by Muthee et al. (2011) to treat sexually transmitted infections and some parasitic infections | Root | 16 | Shrub |
| JW2014/23 | Salvadoraceae  
Sapindas persica L. | Oremet | Eye infections, worms, malaria, stomachache, constipation, tonic, cold, teeth hygiene, respiratory infections
Used for abdominal disturbances (Kokwaro, 2009) | Antimicrobial properties and contains flavonoids with known antioxidant effect (Hala- wany, 2012) | Root | 41 | Shrub |
| JW2014/24 | Simaroubaceae  
Papua capensis Eckl. & Zeyh. | Olimigomi | Strengthens, food, fertility, stomach ache, stamina
Used for stomach aches, as an aphrodisiac and an adaptogen (Kokwaro, 2009; Muthee et al., 2011; Johns et al., 1999) | Leaf and stem bark extracts have antioxidant activity (Kara et al., 2012) | Stem bark | 17 | Tree |
| JW2014/25 | Solanaceae  
Harrisonia abyssinica Oliv. | Enkisarang’tuny | Arthritis, sexually transmitted infections
Arthritis (Johns et al., 1999; Kareru et al., 2007a) | Bark and root produced compounds with potent anti-microbial activity (Balde et al., 1995; Lee et al., 2014) | Root, fruit, leaf | 7 | Shrub |
| JW2014/26 | Solanaceae  
Solanum incanum L. | Entulelei | Oral hygiene, strength, stomachache, sore throat
Used for throat infections (Muthee et al., 2011), also for symptoms of diabetes (Moshi and Mtifwambu, 2002) | Anti-tumor glycoalkaloids (Lin et al., 2000) | Fruit, stem | 4 | Shrub |
| JW2014/27 | Withania somnifera (L.) Dunal. | Olesayiet | Blood tonic and rejuvenator, back and joint aches, galactagogue, appetite and tonic for calves
Treats symptoms related to diabetes and also used as a tonic (Keter and Mutiso, 2012; Kokwaro, 2009) | Antioxidant and anti-inflammatory effect of the withanolides (Yang et al., 2013) | Root bark | 10 | Shrub |
| JW2014/28 | Urticaceae  
Urtica massaica Mildbr. | Enjameji | Food, stomachache
Stomachache (Kokwaro, 2009)
Contains acetylcholine and histamine which affect smooth muscle (Maitai et al., 1980)
Contains essential oil which has acaricidal activity (Kosgei et al., 2014) | Whole plant, leaf | 5 | Shrub |
| JW2014/29 | Vernoniaeae  
Lippia kituiensis Vatke | Osinoni | Respiratory problems, measles, protects cattle from ectoparasites
Management of chronic pain (Wambugi et al., 2011) | Whole plant | 3 | Herb |
| JW2014/30 | Vitaceae  
Cyphostemma nodiglandulosum (Th. Fr. Jr) | Enkilenya | Sexually transmitted infections, tonic, galactagogue, stomachache
No reports | No reported pharmacological activity | Whole plant | 3 | Herb |

*Plants outlined in Table 1 were only those mentioned three or more times by the respondents.*
Fig. 6. The predominant growth forms in the area.

Fig. 7. The plant parts used as food and medicine. R/RB – root/root bark, S/SB – stem/stem bark, F – fruit, L – leaves, WP – whole plant.

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Appendix A. Supplementary information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jep.2015.10.013.

References
