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RESEARCH ARTICLE

Local indigenous knowledge about medicinal plants in and around Kakamega forest in western Kenya [version 1; peer review: 2 approved with reservations]

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Abstract

Kakamega forest is Kenya's only rainforest and is distinguishably rich in biodiversity but threatened by agricultural encroachment and other forms of human activity. It is also one of Kenya's Important Bird Areas and a significant source of natural products to neighboring rural communities, such as medicinal plants, food, wood and other fibers. By using structured questionnaires for direct interviews, local indigenous knowledge was tapped through involvement of a focal group of elderly key informants in three blocks of the forest. Forty key species of medicinal plants used by local people were identified and recorded. Fifty-five percent of these were shrubs, thirty-two percent trees, seven-and-a-half percent lower plants such as herbs or forbs while five percent were climbers. About seventy percent of the medicinal plants occurred inside the forest itself and thirty percent around the edge and the immediate surroundings outside the forest. Thirty-eight (95%) of the plants were indigenous to Kenya and two (5%) exotic. Such extensive indigenous knowledge of the medicinal uses of the plants, including their distribution trends in the forest, may be tapped for decision support in rural health service planning, policy formulation for conserving the forest, tracking and mitigation of climate change impacts.

Open Peer Review

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Sovenga, South Africa

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Any reports and responses or comments on the article can be found at the end of the article.

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Editorial note:

Please note that the refereeing status of this version was changed from “indexed” to “[v1; ref status: approved with reservations 2]”.

When Version 1 of this article was first published, *F1000Research* was still in its beta phase; during this period articles that received any two of “Approved” or “Approved with Reservations” statuses from the reviewers were labelled as “indexed”. When the journal was formally launched in January 2013, the requirements for indexing were tightened, and now only articles that are given either two “Approved” or one “Approved” plus two “Approved with Reservations” statuses by the reviewers are labelled “indexed”.

Later version(s) of this article received the necessary approval status from the reviewers and are “indexed” according to the new criteria.

Introduction

Although community development goals are not always consistent with biodiversity conservation objectives¹ there are often many opportunities for mitigating negative effects by tapping into local indigenous knowledge with reference to certain aspects of environmental use and conservation². Indeed, application of knowledge and values of communities that are resident within or around key biodiversity areas has been gaining increasing global popularity as significant elements in enriching and improving strategies for conserving biodiversity³. This is because integration of such indigenous knowledge into conservation programs facilitates cross-borrowing of ideas, promotes constructive engagement, and instills a sense of common ownership and responsibility towards achievement of a synergy of goals². This echoes the concept of social capital³ that, apart from amassing local support and goodwill, adoption of local indigenous knowledge in conservation may also promote and provide sustainable insurance against conflicts of purposes. This results in increased chances of achieving the dual goal of biodiversity conservation stewardship as well as community development. For instance, Studies have shown that rainforest ethno-botanical checklists prepared by communities living in or near them tend to be more exhaustive because they are based on practical day-to-day uses that are firmly ingrained in local cultural norms and values⁴.

Like in many parts of the developing world, there is a growing upsurge in demand for herbal and other traditional remedies for various ailments among communities in Kenya. This is due either to increasing cost of conventional modern medicine or, or inadequacies in public health service delivery. However, the bulk of “technical” information on traditional cures is still disparate and privately held, with limited accessibility to the public or in peer-review domain⁵.

This study sought to set in motion a process for comprehensive and systematic documentation of plants of medicinal value for Kakamega forest, with a view to consolidating indigenous knowledge about them and making these available to the wider community around the forest itself as well as other stakeholders, in the process of underscoring highlighting ecosystem and other socio-economic services offered by Kakamega forest to society. The study also sought to highlight any plant species in the forest that may have medicinal value that are also of conservation concern, either as endangered or as a problem species.

Materials and methods

Study area: Kakamega forest lies in western Kenya between 00°08'30.5" – 00°23'12.5" N and 34°18' 08" – 34°57'26.5" E from 1520–1680 m above sea level^{6,7}. The mean annual rainfall is 2000 mm, with long rains in April/May and short rains in September/October⁶ while mean annual temperature is 20°C. Due to anthropogenically-driven fragmentation over many decades, its main closed-canopy area now occupies only 60% (85 km²) of its original area (Figure 1). The forest is Kenya's only true tropical rainforest (BirdLife International, 2004) and constitutes one of Kenya's 61 Important Bird Areas (IBAs) due to many endemic birds species found in it (BirdLife International, 2004). Apart from birds, it also has remarkable biodiversity richness, hosting several species of mammals, reptiles, amphibians, invertebrates and plants^{8,9}. It is currently under increasing threat of loss to agriculture and settlement by the increasing local human population. The neighbourhood of the forest, where the western Kenya Bantu ethnic community called Luhya reside, is densely populated with an average density of 250 persons per kilometer^{10,11}.

The study was carried out within the three main blocks of Isecheno-Yala-Ikuywa group of fragments (south), Buyangu-Salaza-Kisere blocks (north) and the detached Kaimosi fragment (see Figure 1). The sections were covered in two field seasons of 11 days each, first during April–May while the effects of the long rains were still evident and many plants bore fruit (wet season) and then late July when full fruiting is reduced and some leaves are shed off (dry season). This was to control for any rainy-season effects.

Sampling strategy: A key informant was identified from each block/area of the forest during each sampling week, to be interviewed about the medicinal plants as outlined in Kothari¹². The key informant was selected on the following criteria: (1) seniority of age in the community (not less than 50 years old); (2) local residency for a period not less than 20 years; (3) appreciable knowledge of forest plants in the local dialect and well versed with their use(s). Current or previous experience as herbalist was preferable but not essential. Such selection was based on prior consultation with the local community leaders.

Data was collected through field excursions using interviews that employed structured questionnaires guided by a mix of closed- and open-ended questions for the key informants. This was combined with free-style discussions, actual field excursions and visits with the respondents. For data consistency, the same informants were involved each sampling season in each area. In addition, eventually there was a joint focused group discussion¹² with all the key informants to synergize the information gathered. Information captured and recorded included include: 1) Local name of plant in question; 2) Disease/condition cured by plant; 3) Plant part(s) used for the cure; 4) Preparation method; 5) Common (English) name of plant. These were determined from standard field guides; 6) Scientific name.

Questionnaire provided to local informants to identify local medicinal plants

<http://dx.doi.org/10.6084/m9.figshare.96908>

Figure 1. Map of Kakamega forest (This figure has been reproduced with kind permission from Otieno and co-authors¹²).

Data analysis

A checklist of all observed plants of medicinal values was compiled, including their indigenous, common and scientific names; condition(s) cured; methods of preparing and administering them to a patient; as well as the age and gender of the target patients (see link to data file below). All the lists generated by the different key informants were scrutinized and synchronized into a final one at the joint focused group discussion¹³. With help from the informants/respondents, each plant was observed in its natural habitat and a digital image taken using a digital camera. Further, for each medicinal plant, a small part (preferably with leaves) was collected while fresh and digitally photographed for identification and pressed for herbarium. Plants whose common (English) and scientific names were not immediately identifiable in the field were taken for specialized identification at the East African Herbarium in Nairobi.

Results

A total of 40 key species of medicinal plants used by the people around Kakamega forest were identified and recorded (see Appendix). The plants fall into 24 positively identified families while the family of the remaining one species *Bequaertiodendron oblanceolata* was not clearly discerned (Table 1). The most dominant families

were Asteraceae, Fabaceae and Lamiaceae, each representing 10.3% each of all plants.

Medicinal plant species identified in and around Kakamega forest

1 Data File

<http://dx.doi.org/10.6084/m9.figshare.96402>

Of the 40 plants, 22 were shrubs, 13 trees, 3 lower plants such as herbs or forbs, and 2 climbers (Figure 2). Twenty-six of the medicinal plants occurred inside the forest itself and 14 occurred outside. One of the medicinal plants (*Prunus africana*) is also listed in the IUCN Red List as Vulnerable to extinction. The majority of the medicinal plants identified (95%) were indigenous and only 5% exotic.

The diseases reported to be cured by the medicinal plants identified in the study varied widely but were grouped into 14 categories including use in treatment of a number of livestock diseases (Figure 3). Ninety percent of the diseases cured are those that affect humans and about ten percent for livestock diseases. Most of

Table 1. Checklist of the medicinal plants identified in and around Kakamega forest species accounts.

Scientific name	Local name	Common name	Family	Plant origin	Plant form	Diseases or conditions targeted
<i>Albizia grandis bracteata</i>	Mukhonzuli	Large-leaved Albizia	Fabaceae	Indigenous	Tree	Gonorrhea
<i>Albizia gummifera</i>	Musenzei	Peacock flower	Fabaceae	Indigenous	Shrub	Sexually transmitted infections Stomach-ache
<i>Azadirachta indica</i>	<i>Muarubaini</i>	Neem tree	Meliaceae	Exotic	Tree	Fever, aches, pains Malaria attack Insect bites Pest control Skin infections
<i>Aspilia pluriseta</i>	Shralambila	Dwarf Aspilia	Asteraceae	Indigenous	Herb/ forbe	Stopping bleeding in wounds Drippy nose in poultry
<i>Bequaertiodendron oblancofolata</i>	Musamia	Not established	Not established	Indigenous	Tree	Ulcers in digestive track Boils around belly
<i>Chrysocephalum sp</i>	Mwikalo	Yellow Buttons	Asteraceae	Indigenous	Shrub	Stomach problems related to STIs
<i>Clematopsis scabiosifolia</i>	Lunyili	Not established	Ranunculaceae	Indigenous	Climber	Stuffy nose and associated respiratory problems
<i>Clerodendron pygmaeum</i>	Luseshe	Cashmere Bouquet	Verbenaceae	Indigenous	Shrub	Common flu and associated
<i>Coffea eugenioides</i>	Itikwa	Mufindi coffee	Rubiaceae	Indigenous	Shrub	Eye problems in livestock
<i>Conyza floribunda</i>	Liposhe	Asthma weed	Asteraceae	Indigenous	Shrub	Tooth-ache
<i>Desmodium adscendens</i>	Matite	Not established	Fabaceae	Indigenous	Herb/ forbe	Stomach-ache
<i>Desmodium repandum</i>	Not established	Not established	Fabaceae	Indigenous	Shrub	Stomach upset
<i>Diospyros abyssinica</i>	Lusui	Giant Ebony	Ebenaceae	Indigenous	Tree	Recurrent nightmares Sores
<i>Dissothis speciosa</i>	Lunyili	Not established	Melastomataceae	Indigenous	Shrub	Diarrhea
<i>Dovyalis macrocalyx</i>	Shinavatevia	Shaggy-fruited dovyalis	Flacourtiaceae	Indigenous	Shrub	Constipation Peptic ulcers
<i>Entada abyssinica</i>	Shivayamboga	Abyssinia Entada	Leguminosae	Indigenous	Tree	Stomach-ache

Scientific name	Local name	Common name	Family	Plant origin	Plant form	Diseases or conditions targeted
<i>Erythrococca atrovirens</i>	Shirietso	Not established	Euphorbiaceae	Indigenous	Shrub	Wounds, especially septic
<i>Hibiscus</i> sp	Lubulwa	Not established	Malvoideae	Indigenous	Shrub	Stomach-ache General fever
<i>Justica flava</i>	Lihululwa	Yellow Justicea	Acanthaceae	Indigenous	Herb/forbe	Reducing post-natal pains
<i>Lantana trifolia</i>	Imbulimutacha	Three-leaf Shrub	Verbenaceae	Indigenous	Shrub	Malaria and general fever (humans) Diarrhea in livestock
<i>Leucas calostachys</i>	Lumetsani	Not established	Lamiaceae	Indigenous	Shrub	Severe diarrhea especially accompanied with blood
<i>Leucas deflexa</i>	Shitsunzune	Not established	Lamiaceae	Indigenous	Shrub	Eye infection/effects in livestock
<i>Markhamia lutea</i>	Lusiola	Nile Tulip tree	Bignoniaceae	Indigenous	Tree	Ear pain in humans Eye problems in cattle
<i>Mondia whytei</i>	Mukomer	White's ginger	Apocynaceae	Indigenous	Climber	Loss of appetite Low libido Fatigue Mineral deficiency
<i>Ocimum kilimandscharicum</i>	Not established	Kilimanjaro basil	Lamiaceae	Indigenous	Shrub	Nasal congestion, colds, flu, Insect bites General aches and pains
<i>Olea capensis</i>	Mutukhuyu	Elgon Olive	Oleaceae	Indigenous	Tree	Stomach-ache Peptic ulcers
<i>Paullinia pinnata</i>	Not established	Bread and cheese plant	Sapindaceae	Indigenous	Shrub	Hiccup
<i>Paulownia tomentosa</i>	Musembe	Foxglove tree	Paulowniaceae	Exotic	Tree	Stomach problems Boils
<i>Piper capense</i>	Not established	Staart Pepper	Piperaceae	Indigenous	Shrub	Cough
<i>Piper umbellatum</i>	Indava	Cow-foot leaf	Piperaceae	Indigenous	Shrub	Head-ache and fever
<i>Plectranthus forsteri</i>	Shikhokho	Spur flower	Lamiaceae	Indigenous	Shrub	Worm infection in livestock
<i>Prunus africana</i>	Mwiritsa	Red Stinkwood	Rosaceae	Indigenous	Tree	Prostate cancer Stomach-ache

Scientific name	Local name	Common name	Family	Plant origin	Plant form	Diseases or conditions targeted
<i>Rhus natalensis</i>	Busanguli	Desert date	Anacardiaceae	Indigenous	Shrub	Worm infections in humans and livestock
<i>Sapium ellipticum</i>	Musasa	Jumping seed tree	Euphorbiaceae	Indigenous	Tree	Eye problems in livestock such as by injury or infection
<i>Senecio moorei</i>	Not established	Not established	Asteraceae	Indigenous	Shrub	Cough
<i>Solanum incanum</i>	Indalandalwa	Sodom Apple	Solanaceae	Indigenous	Shrub	Stomach-ache
<i>Thunbergia alata</i>	Indereresia	Black-eyed Susan vine	Acanthaceae	Indigenous	Shrub	Joint dislocation in both humans and livestock
<i>Toddalia asiatica</i>	Not established	Orange climber	Rutaceae	Indigenous	Shrub	Worms in cattle
<i>Trichilia emetica</i>	Munyama	Banket mahogany	Meliaceae	Indigenous	Tree	Fever Stomach-ache Sexually transmitted infections Malaria
<i>Zanthoxylum gilletii</i>	Shikhoma	Not established	Rutaceae	Indigenous	Tree	Cough and chest complications associated with bacterial infection

Figure 2. Proportion of plant forms represented by the medicinal plants identified.

Figure 3. Overall distribution of categories of disease claimed to be cured using medicinal plants identified.

the human diseases cured using the plants, fell into the categories of digestive or peptic; respiratory, vector-borne; and reproductive ailments (Figure 3). Furthermore, these 'cures' are applicable for both genders and almost all age groups except in 17% and 7% of the cases where the 'cures' are applicable to adults and elderly people only, respectively.

In preparing the 'cures' from the plants, the local people mainly use leaves, roots and barks, but in a few plants, the 'cures' are derived from flowers, fruits and young shoots (Figure 4). Additionally, since many of the plants are used for curing digestive or peptic, respiratory or vector-borne ailments, the majority of them are administered orally.

Discussion

The results of the study demonstrate that apart from Kakamega forest's already well known position as a significant Kenyan rainforest in terms of the rich biodiversity, eco-system service provider and as a remarkable tourist site, it is also important to the local community as a repository for ethno-pharmacological resources that play a crucial role in supplementing the government's effort in providing healthcare at the grass-root level. This also includes remedies for the treatment of livestock diseases. Unfortunately, much of the indigenous knowledge about these plant-based remedies, however,

Figure 4. Percentage instances of use of the various parts of the medicinal plants identified.

is still restricted to only a minority among the local population, particularly the elderly. Furthermore, these elderly knowledge holders are only those who have ancestry to a select number of families with long histories of the practice of traditional medicine. Traditionally, such indigenous knowledge, which is often regarded as spiritual, is closely guarded by such families, and is only passed on down the generation line to members of the family who use the knowledge and skills as a form of livelihood when they serve society as traditional medical consultants. In the process, such families wield immense respect in the society.

In-depth discussions with the key informants and a cross-section of some respondents among the local residents further revealed that even when the consultants prescribe treatment to their patients, only the already-prepared form of the cure is provided by the "medicine man" rather than revelation about the plant from which it is obtained, or how the concoctions are prepared. Nevertheless, this system is slowly changing and in recent years, some flexibility appears to be emerging, with the "medicine men", including the ones interviewed in this study, are quite willing to provide information about the traditional cures in exchange for financial inducement or compensation. The wider society is also getting increasingly skillful in identification, preparation and administration of plant-based remedies at the local level⁴.

With the increasing cost of healthcare from modern facilities occasioned by global economic challenges which make medication expensive and out of reach to most rural dwellers in developing countries¹⁴, there is an increasing need to identify more affordable alternatives for the treatment of common ailments that affect rural human populations. For this reason, promotion of the use of natural remedies derived from various locally based resources such as medicinal plants, should form an important priority of governments' strategies to make healthcare accessible to the rural populations in a more affordable way.

Wider availability of such knowledge, including from such research projects as these when published and distributed, would go a long way in improving access to basic healthcare. In addition, to protect

Table 2. List of families and corresponding number of species of medicinal plants identified (Note: Family of one species was not immediately established).

Family	No of species	% proportion (N = 39)
Acanthaceae	2	5.1
Anacardiaceae	1	2.6
Apocynaceae	1	2.6
Asteraceae	4	10.3
Bignoniaceae	1	2.6
Ebenaceae	1	2.6
Euphorbiaceae	2	5.1
Fabaceae	4	10.3
Flacourtiaceae	1	2.6
Lamiaceae	4	10.3
Leguminosae	1	2.6
Malvoideae	1	2.6
Melastomataceae	1	2.6
Meliaceae	2	5.1
Oleaceae	1	2.6
Paulowniaceae	1	2.6
Piperaceae	2	5.1
Ranunculaceae	1	2.6
Rosaceae	1	2.6
Rubiaceae	1	2.6
Rutaceae	2	5.1
Sapindaceae	1	2.6
Solanaceae	1	2.6
Verbenaceae	2	5.1

the local community from exploitation of their indigenous medicinal knowledge by “external” prospectors and their agents for commercial purposes, a modality for a locally-based medicinal plant enterprise including charges for demonstrations, medicinal plant checklists and herbal medicine preparations sold to willing buyers, could be established and proceeds shared with or amongst the local stakeholders.

For instance, already underway is a project known as the Kakamega Forest Integrated Conservation Project, which involves a section of the local people in collaboration with the International Centre for Insect Physiology and Ecology (ICIPE). Part of this project involves commercial cultivation of two of the medicinal plants (see link to data file) *Mondia whytei* and *Ocimum kilimandscharicum* on farms. The income generated benefits the farmers and helps to supplement their subsistence needs. From ICIPE’s science park in Nairobi, an extract from *Ocimum kilimandscharicum* is used to

make a commercial product called *Naturub*, which helps to relieve nasal congestion, colds, flu, insect bites, aches and pains¹⁵.

Similarly, there is a commercial medicinal product extracted from the roots of one of the plants in the forest. The product is named *Mondia Tonic* and is produced from extracts of the roots of *Mondia whytei* (see link to data file) and this is used as an appetizer, a flavoring agent, a stimulant or for mineral supplementation¹⁵. Such initiatives, if structured to incorporate indigenous knowledge of the local community, would be a further boost to economic empowerment of the community by using part of the returns from the market to compensate them for such knowledge.

Conclusion

In conclusion, there is sufficient indigenous knowledge among the community around Kakamega forest about medicinal plants, to contribute not only to sustainable provision of grass-root health care but also a potential to share this knowledge beyond western Kenya. This knowledge also has a potential for boosting economic empowerment of the people around Kakamega forest. A tertiary potential benefit is incorporation of the knowledge into policies to guide conservation action for the rainforest and its biodiversity. This crucial benefit has further significant implications for mitigation of climate change impacts that would otherwise result in destruction or loss of this important water catchment for many rivers in western Kenya.

Recommendations

- More extensive excursions into the Kakamega forest and its immediate surroundings to reveal more medicinal plant species, particularly through involvement of a larger number key informants.
- Collation of the results of this study together with existing but unpublished results of all other studies of medicinal plants of Kakamega forest, anecdotal and otherwise.
- Establishment of a comprehensive working database of the indigenous knowledge of the local community about the medicinal plants and other such resources in Kakamega forest.

Author contributions

NO conceived the study and designed the experiments, NO prepared the first draft of the manuscript while both authors were involved in the revision of the draft manuscript and have agreed to the final content.

Competing interests

There are no competing interest with regard to the project, the research, manuscript production and submission, be it financial, in kind or institutional.

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scheme. The grant was awarded to Nickson Otieno. The grant had no grant number.

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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This is an interesting piece of work, although very incomplete. I actually hesitated between recommending acceptance or rejection, but decided to settle on the former because any new contribution on traditional knowledge related to medicinal plants should be welcomed. However, I do have several important concerns to raise about this article.

First, it should be made very clear that the study is based on the knowledge of only 3 respondents. Each of them might know a lot, but they still are just 3 respondents. Completely different results altogether could have been obtained by interviewing 3 other respondents.

Second, it is hard to evaluate the actual contribution of the study to the scientific knowledge, as no other study on traditional knowledge related to medicinal plants in Kenya or tropical Africa is cited. A quick search in Web of Science shows that 87 papers were published in the last 15 years for Kenya alone.

Third, more details should have been provided about the forests in which sampling took place. Calling them tropical is not enough. Information on species richness, for example, would have been needed to appreciate if the 40 species recorded as medicinal plants form a significant or trivial proportion of the complete species set. In addition, dominant species and forest dynamics should have been provided to facilitate comparison with other studies. Also, the choice of the forest blocks where sampling took place should have been justified.

Fourth, information should have been provided about how ethical issues were addressed. Traditional knowledge is a sensible topic (even the more so when it relates to medicinal plants) and a precautionary approach should be taken to ensure protection of intellectual property rights.

Fifth, the choice of the 3 respondents should have been explained in more details. Why only 3? Why these 3? Were they men or women? Knowledge is not shared equally between genders. Etc.

Other comments:

- The abstract is too general and does not provide all the relevant results.
- The English should be checked by a native speaker. Some sentences are awkward, some words are missing, and some words are uselessly repeated.
- Figure 1 does not show the effect of forest fragmentation, so the first paragraph of the "Study area" section should not imply that.
- Why wasn't BirdLife International (2004) added to the reference list and cited properly?
- Population density should be given as a number of people per SQUARED kilometers.
- "Salaza" is not shown on Fig. 1.
- Please make clearer the distinction between "block", "fragment", "section", etc.
- Herbarium voucher numbers should be provided, or, at least, the name of the herbarium where samples are kept should be given.
- A total of 40 medicinal plant species seems low. How does it compare with other studies in African tropical forests?
- Why use quotation marks when writing "cure"? This uselessly sheds a doubt on the efficacy of medicinal plants.
- I am surprised that none of the species (especially herbs) was used entirely (instead of just leaves, or fruits, or other parts).
- How were the disease classes chosen? The "vector-borne" class is not a type of disease, but rather a way of transmission. It can include digestive, psychic, or other types. Furthermore, several common ailment categories were not reported to be treated with medicinal plants. Explanations should have been provided as to why. Authors should have followed, for example, Cook's (1995) classification : Cook FEM (1995) Economic Botany Data Collection Standard. Kew: Royal Botanic Gardens.

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 14 Dec 2012

Nickson Otieno, National Museums of Kenya, Kenya

Dear Dr. Asselin,

Thank you for your review. We have made the following changes in light of your comments.

Choice of respondents: We have now made it clear that there were 3 main focal respondents but that there were 2 other opportunistic random respondents that provided additional information for the study in each forest block, making a total of 9 respondents. Such selection was based on prior consultation with local community leaders and additional guidance by field assistants. Since this study was not meant for gauging opinions, we did not set out to interview as many respondents as possible. That is why we state that we had

a key focal group of respondents chosen for their knowledge about the same, and of a minimum age that is generally recognized globally to possess the greatest of such knowledge. One of our key respondents was a practicing healer with long experience in the practice.

Consultation of existing literature on the subject, in Kenya: We have incorporated more references to the literature in the revised version.

Ethical issues in data use: Prior consent was obtained from each informant before information was obtained including information that the data would be shared widely. All respondents were duly acknowledged in the manuscript and are publicly acknowledged in the final publication. A condition for publication of the manuscript was to provide the detailed data so it was not optional not to disclose the full dataset of all the medicinal plants in detailed form. Abstract too general: We have now provided more details about the results in the abstract. Grammatical errors etc: More careful revision has been made in this regard including in-house pre-review by experienced authors.

Figure 1 not related to fragmentation: The reference to Figure 1 is now placed in a more explicitly relevant part of the paragraph.

BirdLife International reference: A more recent reference has now been included. Population density unit: This is now provided (in per square kilometers).

Block/fragment/section: This is now clarified as referring to forest blocks.

Herbarium vouchers: The plant specimens that were collected were not part of herbaria specimens and so did not have voucher numbers. They are yet to be curated and catalogued as the EA Herbarium in Nairobi is rather short of space for replicate specimens.

Total of 40 medicinal plants: This number of species identified has now been put in perspective by comparing with other studies elsewhere in Kenya.

Quotation marks on "cure": The term "cure" has been replaced with "treatment" which we feel is more appropriate.

I am surprised that none of the species (especially herbs) was used entirely (instead of just leaves, or fruits, or other parts: In Table 1, a number of plants for which more than one part is used for treatment is provided).

Choice of classification of disease: The diseases were classified mainly on the basis of the parts of the body that are affected. Obviously this does not apply for "vector-borne" and "livestock" but the idea about including the former was to highlight such vector transmitted diseases, which are common in the area, such as malaria, which would otherwise easily be subsumed by the other classes since malaria presents with a multitude of symptoms. For "livestock" diseases, again this was to highlight them as non-human and compare them with the non-human ones. More details about the forest: We have now added more details in describing Kakamega forest where the study was carried out, including floral and other species status, and the overall vegetation structure.

Selection of blocks: We have described the rationale for the choice of forest blocks.

Competing Interests: No competing interests were disclosed.

Reviewer Report 06 November 2012

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Martin Potgieter

Department of Biodiversity, University of Limpopo, Sovenga, South Africa

This is potentially a very interesting article, and I think it could ultimately make a positive contribution to the evidence base. However, this paper has a number of serious flaws.

More information and detail required:

- The abstract and results are superfluous and do not report on some of the major findings.
- More can be made of the data in figure 4. Why, for example, are leaves so much used, when in the rest of Africa roots are being predominantly used?
- The information from figure 3 is not reported in the results or discussion. For example it would be interesting to know why digestive was so much treated.

Discussion, conclusion and recommendations:

- The discussion focuses most on generalities and not specifics as is found in the results.
- Data on methods of preparation, administration, age and gender are not reflected in the results and discussion. This is particularly important for gender as the level of knowledge of local/rural African communities vary. Women are generally more knowledgeable in local households, but men are more knowledgeable when they are traditional healers.
- References are seriously lacking in the discussion – thus no scientific authority is applied to most of the statements presented here. Thus this discussion is basically just an opinion.
- Some parts of the discussion need rearranging to either the results (end of 2nd paragraph) or the conclusion (3rd paragraph).
- Significant tracts of the discussion do not appear to be relevant to the study at hand, particularly the last two paragraphs of the discussion; the authors should consider removing these.
- The current conclusion does not address the core data of this manuscript.
- The authors should provide reasons for the points made in the 'Recommendations' section.

Inconsistencies:

- Questionnaires: In the abstract and main text it is implied that multiple questionnaires are used but only one is provided.
- It says in the sampling strategy that experience as a herbalist was not essential, yet in the discussion it states that indigenous medicinal knowledge is a closely guarded only passed to family members. It would have been worthwhile to know the ratio of interviewed traditional healers/practitioners vs. lay people – there is a significant difference in their level of knowledge.
- In the discussion the authors state that indigenous knowledge is confined to mainly the elderly but this study targeted only people above 50. In Africa that constitutes the elderly. Thus we have no data on the knowledge level of people younger than 50. Therefore we have no data to backup this statement.

Language:

- Some attention to the accuracy of language used is required; some words need removing, the authors should define what they mean by 'key species' (abstract) and appreciable knowledge (page 2)

and replace the term 'cured' with 'treated'.

Notes on plant family classification:

- *Bequartiodendron oblancoolata* is from the Sapotaceae family.
- Malvaceae is the correct family name for *Hibiscus spp*; Malvoideae is a subfamily.

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 14 Dec 2012

Nickson Otieno, National Museums of Kenya, Kenya

Dear Dr. Potgeiter, Thank you for your review.

We have made the following changes in light of your comments.

Title: We have added the word "some" in the title to preclude the presumption that we sought to list all medicinal plants from Kakamega forest in the one survey. Abstract: We have restructured and re-written the abstract to reflect suggested changes. We have also clarified that we used one structured questionnaire and not many types of questionnaire.

Introduction: We have cited two references as suggested to support our assertion about other studies having been conducted on the subject.

Materials and methods: We have corrected the indicated errors and have also specified how respondents were selected, including the proportions of practitioner to lay respondents, and key to random respondents.

Data analysis: Suggested errors now corrected.

Results: *Bequartiodendron oblancoolata* is now assigned to the family *Sapotaceae* as has been helpfully noted by the reviewer. The reference for IUCN is now provided. The word "cure" is now replaced by "treatment". We have also provided a clarification on methods of administering medicinal plants other than orally.

Discussion: We have now merged the Results with the Discussion under the new heading "Results and discussion" to make a more lucid connectivity between the two. In table 1, the Malvoideae subfamily is now corrected to *Malvaceae* family, as informed by the reviewer. The original Figure 2 depicting proportions of medicinal plant forms is now removed to avoid repeating results in text. As a result, Figure 3 becomes Figure 2 and Figure 4 becomes Figure 3. Figure 2 (new) is now reported in the text of results and discussion, together with an expoundment on the predominance of digestive-related diseases treated using the medicinal species. The new Figure 3 now bears, in text, discussion as to the predominance of the use of leaves for treatments, viz-a-viz other plant parts. Table 2 is corrected as

suggested; parts of the discussion suggested as not strongly related to the core data and results by reviewer, have been removed. The link between access to information on medicinal cures by local and improvement of basic healthcare is now more clearly explained. The conclusion is now more closely tied to the results of the study. Recommendations are now better justified.

References: Corrections on the original reference number 12 is now effected; Due to additional references (also reflected in the body text) the reference section has now been reorganized accordingly.

Competing Interests: No competing interests were disclosed.

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