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African elephants putatively self-medicate with medicinal plants in the Mount Elgon region, Kenya

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The Mount Elgon region in Kenya is renowned for its rich floral biodiversity, its extensive cave systems containing mineral deposits exploited by the elephants and some of the highest density of both total and endemic plant species within the country. This study presents and discusses first-hand accounts from eight local experts from the Sabaot indigenous community, including wildlife community scouts, a retired ranger, and elders, all of whom have witnessed local elephants selectively consuming materials, such as plants, they believe aid in the treatment and prevention of medical disorders. Using semi-structured questionnaires, interviewees linked their indigenous knowledge of local human medicinal resource use to their first-hand observations of elephant dietary behaviors in the region. For the first time in African elephants in the region we report the potential medicinal use of 35 plant species from 23 families, along with four types of soils, minerals or clays. All plant species mentioned in the surveys were taxonomically identified through preparation of herbarium voucher specimens. Interviewees were able to provide specific anecdotes to support these claims for 19 of these zoopharmacognostic resources, including unusual feeding events and specific preparation methods, infrequent targeting of resources, and allocare. Of the 39 total resources mentioned across interviews, informants named 34 (87%) as having traditional human medicinal uses. Of these 34 resources with ethnomedicinal uses, informants identified 25 resources which they perceive to be medicines for elephants. To analyze these interviews and assess the behavioral evidence supporting informants' claims, we classified each resource into different modes of medication behaviors. In total, eight plant species were classified as Mode 4 (medicines sought by visibly sick elephants for perceived therapeutic purposes or administered to their offspring for their healthcare benefit). These included *Aloe arborescens*, *Bersama abyssinica*, *Coleus barbatus*, *Dombeya burgessiae*, *Dombeya rotundifolia*, *Dombeya torrida* subsp. *torrida*, *Ficus natalensis* and *Kuloa usambarensis*. We also report some notable anecdotes from these interviews which include stories of mother elephants providing medicinal resources to their calves. These first-hand reports from local experts suggest that elephants may intentionally seek out medicinal plants, indicating a targeted rather than random foraging behavior. Taken together, our findings suggest that African elephants may have more diverse and complex medicinal repertoires than previously recognized, and can selectively target these resources when their health is compromised.

Keywords Zoopharmacognosy, Self-medication, Traditional healers, Elephants, Mount Elgon, Kenya, Medicinal plants

Self-medication in the animal kingdom has been a focus of attention in recent years, with reports indicating the presence of new self-medication behaviors in a vast number of species (e.g., orangutans¹; chimpanzees^{2,3}; great bustard birds⁴; Indo-Pacific bottlenose dolphins⁵). Historically, animal self-medication was thought to

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be exclusive to vertebrates⁶, however, more recent studies suggest that invertebrates also self-medicate^{7–11}. In addition to animals self-medicating^{11,12}, several studies present reports of prosocial medicinal behaviors (allo-medication) in non-human animals, in which an individual provides medicinal care to another^{3,13–16}. The general study of animal medicinal knowledge is called zoopharmacognosy.

Since the discovery of animal self-medication in the late 1970s, e.g.,^{6,17,165}, many medicinal resources have been identified in the diets and medicinal repertoires of wild animals. While the majority of these resources are botanical (e.g., bark¹⁹; pith¹⁷; leaves¹; resin²⁰), animals have been observed treating themselves using other natural materials, such as charcoal²¹, clay^{22,23}, insects¹⁶, and invertebrate mound soil²⁴. Thus far, non-human medication behaviors appear to target several common ailments, including, but not limited to, endoparasite infestations, respiratory and fungal infections, wounds, and gastrointestinal upset.

The current classification of self-medication behaviors in the animal kingdom encompasses five fundamental modes: (1) 'sick behaviors' characterized by observable physiological and psychological responses, including lethargy, depression, anorexia, behavioral fever, and thermoregulatory basking; (2) behavioral strategies aimed at reducing disease transmission, such as avoiding feces-contaminated food, water, and environmental substrates; (3) dietary selection of medicinal resources consumed in limited quantities (intentionally or unintentionally) for preventative health maintenance; (4) targeted ingestion of non-nutritional substances for therapeutic treatment of an existing condition, involving the careful consumption of materials with mechanical or pharmacological properties in low frequencies or minimal amounts; and (5) external substance application to body or living spaces for vector control and management of external health conditions, exemplified by behaviors like fur rubbing, anting, and den or nest fumigation^{25,26}. Determining the specific mode of a medicinal behavior requires multiple forms of evidence, typically encompassing behavioral observations, health data, and pharmacological or ethnomedicinal information about the resource in question. Long-term studies of habituated wild animal populations provide the most comprehensive insights, allowing researchers to track behavioral and health patterns over extended periods. However, where such intensive research is not feasible, anecdotal evidence becomes critical.

Many studies consequently incorporate complementary sources of information, including direct observations of animals consuming potential medicinal species and ethnomedicinal uses of therapeutic resources by local human communities (e.g.,^{15,16,25,27–30}). These anecdotal accounts can provide substantive supplementary evidence for classifying self-meditative behaviors into the established modes (e.g.,³¹). By integrating diverse sources of information, researchers can more accurately assess and categorize potential self-medication behaviors across different species.

Evidence of elephant self-medication

While self-medication practices have been well-documented in species such as chimpanzees (*Pan troglodytes*), many other species remain underrepresented in the scientific literature. Elephants, for example, despite their renowned intelligence and complex social structures (e.g.,³²) remain an understudied subject in zoopharmacognosy research. Elephants are generalist post-gastric herbivores with highly diverse diets. In the wild, elephants feed on a wide range of botanical species, life forms, and plant parts³³. The earliest reports of elephant self-medication date to the 2nd–3rd century, in the writings of Claudius Aelianus³⁴. In his text, *De natura animalium* (On the Nature of Animals), Aelianus describes the unusual behaviors of a wounded elephant who, after being hit with several spears and arrows, proceeded to eat the flowers of an olive tree and drink the oil. The elephant made a full recovery, which Aelianus attributed to the properties of the medicinal tree.

Among Asian elephants (*Elephas maximus*), self-medication behaviors have been preliminarily investigated at a few sites. In existing published reports on this topic, mostly from Laos and Thailand, Asian elephants have been found to consume several plants which also have local ethnomedicinal uses^{35,36}. Some of this observed overlap in human-elephant medicinal repertoires has been attributed to the interspecies transference of medicinal knowledge from humans to elephants and from elephants to humans³⁵. More specifically, it has been theorized that elephants may learn about new medicinal resources through human-guided ethnoveterinary practices, and in turn, humans may learn about new medicinal resources through observing which resources elephants target when sick.

Across existing studies on elephant self-medication, several plant species have been identified as putative therapeutic resources for Asian elephants (e.g., *Harrisonia perforata*)^{33,36}. Associated ailments reported in these elephants include diarrhea, tremors or dizziness, fever, loss of appetite, and issues related to motherhood or gestation³³. In Thailand, during the rainy season, Asian elephants have been observed consuming only clay soil for several days at a time. This behavior has been hypothesized to expel intestinal parasites³⁶. Mahouts and Karens, who serve as elephant guardians, have been reported to adopt these plants into their own medicinal repertoires.

In African elephants (*Loxodonta africana* and *Loxodonta cyclotis*), there appear to have been even fewer investigations into self-medication; however, several anecdotal reports suggest that medicinal behaviors are indeed part of their behavioral repertoire. In one such report from the WaTongwe ethnic group in Tanzania, an African elephant exhibiting symptoms of digestive discomfort was reported to crush leaves of the species *Piliostigma thonningii*, soak them in water sucked into their trunks, discard the leaves, and then drink the remaining water^{31,37}. It has been speculated that this behavior treats digestive problems in elephants. *P. thonningii* is used as a traditional medicine across Africa and its pharmacological properties are well-documented¹⁰. Other reports^{10,38} suggest that female African elephants consume certain plant species (e.g., the leaves of *Cordia goetzei*) to induce labor. Interestingly, the leaves of this species are also brewed into tea by women in certain parts of Kenya and are used for the same purpose³⁸. A recent study by Ngama et al.³⁹ investigates whether crop-raiding in African forest elephants (*L. cyclotis*) in Gabon could be associated with self-medication, specifically for treating gastrointestinal parasite infections. However, further research is needed to support these findings.

African elephants are also known to regularly consume clay⁴⁰, a form of geophagy that has been well documented in over 300 non-human animal species¹¹⁵. There are two general (non-exclusive) hypotheses proposed for the adaptive function of geophagy: the **Supplementation Hypothesis**, which suggests that soil can provide consumers with nutrients and minerals, including microelements, macroelements, and trace elements to rectify dietary deficiencies (e.g.,^{42–44}); and the **Protective Hypothesis**, under which geophagy is considered a behavioral strategy to mitigate gastrointestinal upset or infection (e.g.,^{45–47}). The most recent literature on non-human geophagy proposes that the supplementation and protective hypotheses are not mutually exclusive, and that geophagy is likely a multi-functional behavior with both nutritional and medicinal benefits²³.

The mechanisms through which elephants acquire or transmit medicinal knowledge remain unknown. However, both African and Asian elephants possess high intelligence and social acuity that would enable cognitive learning and intergenerational information transfer³⁶. Elephants are known to socially transmit behavioral and ecological information, including information on diet (e.g.,^{35,48}) within their close-knit social units, with younger individuals learning essential survival strategies from experienced herd members^{33,36,49,254}. Consequently, the potential propagation of medicinal behaviors in elephants is likely influenced by an intricate interplay of physiological mechanisms, social structure, and herd dynamics.

Elephant self-medication in the Mount Elgon region

Mount Elgon, a volcanic massif on the Kenya–Uganda border, offers an exceptional setting to study African elephant medication behaviors. The region combines high floral biodiversity with extensive cave systems that contain mineral- and clay-rich deposits⁵¹. Elephants' exploitation of these clays and soils, including minerals such as zeolite, has long been hypothesized to serve medicinal purposes^{40,52–54}. The site also benefits from the deep experiential knowledge of national park guides and community wildlife scouts, many of whom grew up in the area and have observed the elephants for decades.

This study aims to shed light on the complex interplay between African elephant health, behavior, and the unique environmental resources of the Mount Elgon region. To do so, we employ a multispecies approach that combines experiential ethological knowledge with ethnographic data³⁵. The objectives of this study are to: (1) obtain further information on putative self-medication behaviors exhibited by wild African elephants in and around the Mount Elgon caves using semi-structured interviews; (2) document the potential overlap in the use of medicinal materials by elephants and local human communities; and (3) explore any resulting implications for the conservation of local biodiversity and the medical field.

Methods

Study site and subjects

Mount Elgon straddles Kenya's western border with Uganda, rising to about 4,321 m above sea level (a.s.l.). It is the largest solitary volcanic mountain in East Africa, having the largest volcanic base in the world (4,000 km²)^{55–57}. The mountain exhibits a pronounced altitudinal gradient, with ecosystems ranging from lowland montane to bamboo zones, heathlands and Afro-alpine vegetation⁶⁵. Kenya has a thriving biodiversity, with more than 6,290 indigenous species of higher plants⁴¹. The early administrative division of Kenya, based on "*Flora of Tropical East Africa*," established seven plant distribution regions (K1–K7). The Mount Elgon region is situated within Trans-Nzoia and Bungoma counties falling under K3 vegetation zones, which contain the highest density of both total and endemic plant species within the country^{41,59}. Kenya is also notable for its diversity of ethnic groups (42+) and local languages^{60,61}.

Rich farmland extends southward from the Kenyan side of Mount Elgon toward Lake Victoria. To the east, the farmland ultimately connects with the Great Rift Valley, which also stretches to more arid areas north of Mount Elgon. This fertile farmland has attracted several waves of settlement dating back to the archaeological record. The southern foothills of Mount Elgon were inhabited by some of the very earliest agriculturists⁵⁹, who were later succeeded by the various ethnic communities that now predominate in the area. Around the start of the twentieth century, there was a wave of European settlement largely for farming, which gave way in the years around the 1970s when most of these farms were sold⁶². Since then, the diversity of the ethnic groups in the area has grown. The middle and upper slopes of Mount Elgon, where our study site is located (see Fig. 1), have remained sparsely populated, predominantly with people who identify as Ogiek (a subgroup of the Sabaot)—who have traditionally inhabited the area—continuing to be the predominant community. In its recent history, Mount Elgon has unfortunately suffered several severe conflicts, and ongoing court cases over land rights, driven by the region's diversity of communities, strong feelings of historical injustice, and continued demand for land⁶³.

The slopes of Mount Elgon are also characterized by an extensive network of caves, whose formation has attracted much speculation over the years^{54,64}. They predominantly lie in layers of volcanic ash agglomerate and are widely believed to have been excavated, in part or in whole, by elephants and other herbivores seeking minerals to supplement their diets⁵².

Data used in this study were collected at seven locations in the counties of Trans-Nzoia and Bungoma in the Mount Elgon region of Kenya (Fig. 1). The primary indigenous ethnic groups in the region are the Sabaot, Teso and Luhya. In total, the study area encompasses 344.9 km². Mount Elgon receives, on average, between 1,500–2,000 mm of rainfall per year on the western slopes and 1,200–1,500 mm on the eastern slopes⁵⁵. The maximum precipitation occurs between 2,300 and 2,700 m a.s.l.⁵⁵. The montane belt is divided into upper and lower montane belts. The upper montane forest occurs at elevations of approximately 3,000 to 3,450 m a.s.l., while the lower montane forest ranges from about 2,150 to 2,350 m a.s.l.⁶⁵. The altitudinal variation of vegetation structure and floristic composition along the slopes of Mount Elgon below 2,200 and 2,500 m is rugged, due to both human disturbances and intense agriculture (e.g., burning) and herbivore activity, particularly from elephant and buffalo populations. Above 2,200 and 2,500 m, large supratropical forests with scattered *Aningeria adolfi-friederici*, *Podocarpus latifolius*, camphor, and riverine *Afrocrania* forests are still intact⁵⁵. On the eastern

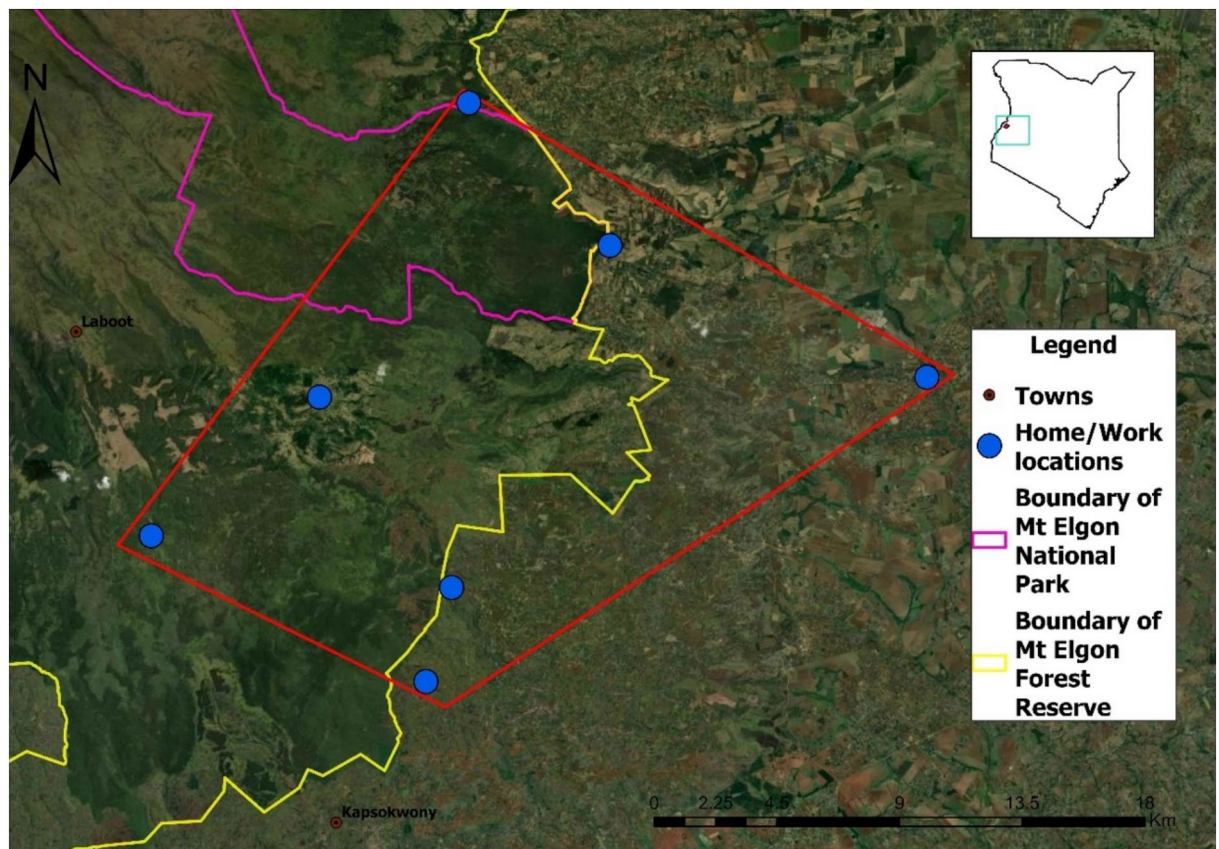


Fig. 1. Map of the study area in the Mt. Elgon region (344.9 km²), illustrating the seven locations where interviews were conducted (The map was created by the authors using Google Earth and ArcGIS Pro version 3.3.2 (Esri, Redlands, CA, USA; <https://www.esri.com/en-us/arcgis/products/arcgis-pro/overview>)).

side above 2,200 and 2,500 m, dry orotropical forests are dominated by *Afrocarpus gracilior*, *Olea capensis*, and scattered cedars. The bamboo zone occurs between approximately 2,450 and 3,050 m a.s.l. on the wetter western slope but is absent on the northernmost part^{55,65}. The western mountainous region is primarily characterized by the survival of cloud forests featuring *Hagenia abyssinica* and *Erica arborea*. Above the current timberline, a landscape characterized by ericaceous vegetation, including *E. trimera* and *Stoebe kilimandscharica*, along with *Helichrysum* and *Alchemilla* dwarf scrub, and altotropical *Festuca pilgeri* grassland, constitutes the vegetation up to approximately 3,700 m⁵⁵. Afroalpine grasslands, *Helichrysum* scrub, and *Dendrosencio* woodlands extend upward to the summits. Mount Elgon hosts a distinct species within the *Dendrosencio johnstonii* complex, with one subspecies found up to 4,000 m and another between 4,000 and 4,300 m, exhibiting characteristics similar to *D. keniodendron* on Mount Kenya⁵⁵.

Data collection

The data presented in this study were collected as part of a broader conservation and biodiversity monitoring project aimed at preserving Mount Elgon's natural and cultural heritage. Anecdotal reports of elephants using plants to putatively self-medicate and elephants mining clay found in caves prompted a more targeted inquiry into the local elephants' use of natural remedies. To systematically document these cases, we therefore conducted a series of interviews between October 2023 and September 2024, with a focus on collecting information on local elephants' use of natural medicinal resources. Surveys were conducted among local wildlife community scouts, a retired ranger, elders, an agricultural officer, and guides.

Selection of study participants

A total of eight study participants from seven different workplaces or home locations were selected for interviews. These locations are shown in Fig. 1. The perimeter in which the eight study participants work adds up to an estimated total study area of 344.9 km². Individuals were selected based on their extensive experience in observing the wild elephant populations (all with >20 years). All participants identify as members of the Sabaot indigenous ethnic group, and also had extensive local knowledge of traditional medicinal practices, as many of the primary healthcare needs of people in this area are met through visits to traditional healers and/or self-administering naturally occurring medicinal resources.

Questionnaires for zoopharmacognostic and ethnomedicinal interviews

The following questions were used to guide interviews to create a discussion on the topic of elephant medication and wider zoopharmacognosy practices in the Mount Elgon region, enabling us to record use reports (Tables 1, 2 and 3). Written notes were recorded on a mobile device (see Supplementary Material S1-S8). When interviewees did not know the scientific name of plant species, plant names were given in English or the local Sabao language (Table 5). Several interviewees also volunteered to provide guided plant walks, which allowed certain relevant plants to be photographed (see Figs. 2, 3, 4 and 5, and Supplementary Material S9). Prior to field research, the survey and questionnaires underwent evaluation to ensure they met established recommendations^{66–69}. Written informed consent was acquired from all interviewees, including consent for photographic publication.

Question number	Question
1	What is your occupation in the Mt. Elgon region?
2	How long have you been a member of the community here [Mt. Elgon]?
3	Do you have experience with the elephants that live on Mt. Elgon?

Table 1. Questions to establish interviewee background.

Question number	Question
1	Can you describe some of the plants and trees of Mt. Elgon that elephants feed on?
2	Do you think they might feed on some plants and trees for medicinal purposes?
3	What makes you think these plants/trees might be medicinal for the elephants?
4	Do you think elephants use specific plants to treat an illness?
5	How do you think the elephants might learn which plants are medicinal?
6	Can you think of any other activities of the elephants on Mt. Elgon that might be a form of self-medication?
7	Are you aware that the elephants eat clay in some the caves in Mt. Elgon? Why do you think they might do this?

Table 2. Questions to establish knowledge of local medicinal plants/trees elephants putatively use for self-medication.

Question number	Question
1	Are you aware of local people using plants from Mt. Elgon as a form of medication?
2	If yes, do you know how this knowledge was acquired?
3	Can you describe some of the medicinal plants and trees that local people use?
4	Which part of the plant do people use (roots, bark, and leaves)?
5	Which illnesses are treated with medicinal plants by local people? Which plants are used to treat which illnesses?

Table 3. Questions to establish knowledge of local medicinal plants/trees that local people use in traditional medicine.

Voucher specimen preparation and botanical identification

Voucher specimen materials were collected under the guidance of the local informants. Samples of clay were also collected for this study. Permission for collection was obtained from the National Commission for Science, Technology and Innovation of Kenya (Permit No. 123296). At all times, we ensured that best practice collection procedures were followed^{167,70,71}. Voucher specimens were prepared and deposited in the indexed East African Herbarium of the National Museums of Kenya in Nairobi. Voucher specimen numbers are provided in Table 5. Plants were identified by experienced taxonomists, and cross-checked with an annotated plant checklist of the transboundary volcanic Mount Elgon, East Africa⁷². The accepted scientific names for each species have been verified using the Kew Medicinal Plant Names Service (<https://mpns.science.kew.org>). Plant family assignments were conducted in accordance with The Angiosperm Phylogeny Group IV guidance⁷³.

Data analysis

Following completion of fieldwork, all interview notes, which were taken verbatim, were processed for data analysis. Each interview was transcribed and only relevant information to Mount Elgon elephant self-medication behaviors was extracted. This included data on known resources in the diets of Mount Elgon elephants named by interviewees as being putatively self-medicative and/or as having ethnomedicinal uses. Plant species recorded were analyzed through descriptive statistics, using quantitative ethnobotanical indices. Following analysis, relevant plants and geophagy resources were entered into Table 5, along with (when relevant) plant family, local name, plant part used, herbarium voucher ID, frequency of citation (FC), relative frequency of citation (RFC), proposed function(s) based on interviewee responses, local ethnomedicinal uses, and direct quotes from relevant

interviews. Interview transcriptions can be found in the **Supplementary Information** section (Supplementary Material [S1–S8](#)).

Quantitative ethnobotanical indices

The frequency of citation (FC) column represents the total number of informants interviewed who describe the observed use of a specific plant species by wild elephants in putative self-medicative behaviors (unspecified medicinal use/specified medicinal condition or disease). It varies from 0 (none of the informants mentioned this resource for a specific event) to 8 (all informants mentioned this resource for a specific event; $n=8$). By providing information on the FC, this study ensures transparency and allows for meaningful comparisons with other studies in the region, resulting in a reliable assessment of medicinal plant usage^{66,75}.

The Relative Frequency of Citation (RFC) assesses the consistency of each cited resource mentioned by the informant(s), providing a metric for assessing its use relative to the total number of informants interviewed in the study. The RFC in percentage was calculated via the following formula:

$$RFC = \frac{FC}{N_i} \times 100$$

where N_i is the total number of informants interviewed. The RFC varies from 0% (none of the informants mentioned this resource for a specific event) to 100% (all informants mentioned this resource for a specific event)^{66,75}.

As the number of interviewees was limited ($n=8$) and participants were selected as expert informants rather than as a representative sample of the local population, FC and RFC values were strictly used descriptively rather than as measures of broader cultural importance (as regularly done in ethnopharmacognosy surveys that focus on documenting and interpreting human traditional knowledge and medicine systems).

Ethnomedicinal, ethnoveterinary and zoopharmacognosy literature review of relevant resources

A post-hoc ethnomedicinal review of highly cited species (>25% RFC) recorded in this study was conducted using Google Scholar, the Plant Resources of Tropical Africa (PROTA) database, and Kokwaro's ethnomedicinal pharmacopeia⁷⁶. To search databases, scientific names and synonyms for each plant as keywords were included⁶⁷. Areas of congruence between our original field data and existing literature, concerning plant parts and therapeutic indications, were identified and emphasized in bold within the results table (Table 6).

Mode classification criteria

To classify cases into different modes of animal medication behavior, we only considered resources that were explicitly identified by informants as medicinal (either in local traditional medicinal knowledge systems or for elephants). Mode criteria were based off of previous classifications in the zoopharmacognosy literature^{25,26}. Cases were categorized as **Mode 3** when a resource in the local elephant diet was explicitly cited as a medicine for local elephant populations by at least one informant, but no associated health condition in the elephant was specified. Some of these Mode 3 resources appear to be ingested frequently by elephants, while others are rarely consumed (unusual feeding events). Critically, for Mode 3 resources, informants did not specify whether they believe elephants therapeutically target these medicinal resources for the treatment of an existing condition or whether healthy elephants consume the resource as part of their normal diet (e.g., as a medicinal food) and unintentionally benefit from the resource's bioactive properties.

Mode 4 was assigned when at least one informant provided an account of elephants targeting resources for the perceived therapeutic treatment of an associated health condition OR if elephants administered resources to others to meet their healthcare needs. These observations included cases of elephants with specific health conditions consuming medicinal resources, as well as elephants providing medicinal resources to their offspring for the purpose of buffering their health. For **Mode 4** cases, informants attributed some degree of intentionality to the elephants' medicinal behaviors, suggesting that elephants specifically target the resource as a medicine. The notation **4(!)** was used for putative Mode 4 cases when "sick" elephants targeted a medicinal resource, but when informants failed to identify the specific health condition. An asterisk (*) was added when resources were observed being used by elephants for prosocial allocare. We classified Mode as Not Enough Information (NEI) when informants cited elephants consuming a resource with local ethnomedicinal uses, but when they did not specify whether they considered the resource a medicine for elephants. We classified Mode as Not Applicable (NA) when interviewees explicitly mentioned that a resource was not a medicinal resource for local elephants.

Results

Informant information

Overall, we conducted eight interviews during the course of the study period. All participants were male, ranging in age from 35 to 78. The occupations of our interview subjects included two guides, two local elders (a retired agricultural officer and an ex-Kenya Wildlife Service park ranger), and four wildlife community scouts. All informants have spent >20 cumulative years living within the study area, and all have spent substantial time interacting with the Mount Elgon elephant population. All interviews took place within the study area. Table 4 provides a summary of anonymized interviewee information.

Interview #	Occupation	Sex	Age [years]	Time spent in study area with local elephant populations [years]	Interview Location	Interview length [mins]
1	Guide	Male	47	47	Guide and porter station, Mt. Elgon National Park: Chorlim gate	45 min
2	Guide	Male	45	45	In the field in Mt. Elgon National Park	180–240 min
3	Local elder/retired agricultural officer	Male	68	31 (birth to age 31)	Elgon View Hotel, Kitale town and in the field in Sosio Forest Reserve block	60 min
4	Local elder/ex-Kenya Wildlife Service ranger	Male	78	78	Mt. Elgon National Park: Chorlim Gate	45–60 min
5	Wildlife scout	Male	40	22 (birth to age 6; age 24 to age 40)	Sosio block, Mt. Elgon Forest Reserve	30–45 min
6	Wildlife scout	Male	60	60	Sosio block, Mt. Elgon Forest Reserve	30–45 min
7	Wildlife scout	Male	35	35	Sosio block, Mt. Elgon Forest Reserve	30–45 min
8	Wildlife scout	Male	41	41	Sosio block, Mt. Elgon Forest Reserve	30 min

Table 4. Anonymized interviewee information.

Summary of behavioral observations

The results in Table 5 have been compiled from the analysis of the eight interviews (see interview transcriptions in Supplementary Information Tables S1–S8). During these interviews, participants described all known or observed putative medication behaviors among the Mount Elgon elephants from their personal experiences living and working within the study area. Table 5 presents a list of all resources mentioned in these interviews that are established parts of the Mount Elgon elephants' diet and are: (a) known to have local ethnomedicinal uses, (b) observed being consumed in infrequent or unusual ways by healthy or sick elephants, or (c) resources known to be used in geophagy behaviors, and have formerly been proposed as medicinal resources for Mount Elgon elephants. In total, 39 cases met our relevancy criteria and were extracted for analysis. Of these, 35 cases included plants and four included substrates (e.g., clays and soils). In two cases, when just a local name was given, we identified multiple scientific names associated with the vernacular name. In these cases, we included all associated scientific names for these species in Table 5.

Interviewees frequently linked their knowledge of local herbal medicine to their first-hand observations of elephants' diets in the Mount Elgon region. Of the 39 resources, informants explicitly named 34 (87%) as having traditional human medicinal uses, and of these, 25 (64%) were associated with treating specific human ailments. An additional resource was named as being used locally as a mineral supplement. In many cases, interviewees described the plant parts used and methods of consumption, extraction, or preparation of these resources by both people and elephants.

All eight participants asserted that people in and around the region believe wild African elephants self-medicate using natural resources on Mount Elgon. From the 39 resources reported in Table 5, 25 (64.1%) were explicitly named as having a medicinal function for the elephants, all of which were plant species, and all of which had local ethnomedicinal uses. These included all resources classified as either Mode 3, Mode 4(!), Mode 4, or Mode 4*. Supporting evidence provided by informants to support claims of elephant medicinal resource use included: (1) Elephant uses or consumes resource in unusual way (e.g., mixing plant with breast milk); (2) Elephant resource use is associated with a specific ailments; (3) Plant is associated with specific ailment in another local animal species; (4) Elephant targets resource infrequently or seasonally; and (5) Elephant travels far distance to resource without stopping to feed on other plants, e.g., "For example [if the resource] is 20 km away, they go straight there without eating anything to get there quickly" (see Interviewee 7, Supplementary Material S7; quote was generalized and not associated with a specific case or anecdote).

Among the resources that could be classified (all of which were plants and had local ethnomedicinal uses), we classified $n = 10$ as **Mode 3**, meaning at least one study participant considered them a medicine for elephants, but there was no mention of the elephants' health state and not enough evidence was provided to determine if elephants target them therapeutically or consume them unintentionally as a prophylactic medicinal food. These plants include *Afrocarduus nyassanus*, *Afrocarium buwalddii*, *Gymnosporia heterophylla*, *Juniperus procera*, *Olea europaea*, *Prunus africana*, *Rhamnus prinoides*, *Solanum mauritianum*, *Urtica massaica*, and *Vachellia seyal*.

We further classified $n = 7$ plant species as **Mode 4(!)** resources, meaning they were explicitly named as medicines used by or administered to a sick elephant, but no specific ailment or symptoms were provided. These plants, all of which also have local ethnomedicinal uses, include *Afrocarpus falcatus*, *Bambusa vulgaris*, *Croton macrostachyus*, *Olea welwitschii*, *Podocarpus latifolius*, *Solanum campylacanthum*, and *Warburgia ugandensis*. While some of the study participants provided general explanations for how they classify sick elephants, these explanations were not associated with specific resources or observations (see Interviewee 7, Supplementary Material S7).

Based on our Mode Classification Criteria, we classified $n = 8$ plant species as **Mode 4** resources. These plants were named by informants as medicines targeted by or administered to sick or vulnerable elephants for a specified medicinal purpose. These resources, all of which have local ethnomedicinal uses, include *Aloe arborescens*, *Bersama abyssinica*, *Coleus barbatus*, *Dombeya burgessiae*, *Dombeya rotundifolia*, *Dombeya torrida* subsp. *torrida*, *Ficus natalensis* and *Kuloo usambarensis*. Across all resources, we found $n = 5$ identified by informants as being used in elephant allocate (*), specifically between mothers and their calves. Of these

observations, one involves a **Mode 4(!)** resource and four involve **Mode 4** resources. Resources used in these allocate observations include *A. arborescens*, *B. abyssinica*, *C. barbatus*, and *F. natalensis*.

Finally, we classified two resources (both substrates) as non-medicinal (NA) for elephants by interviewees. All informants stated their belief that elephants target these clay and mineral resources solely for their mineral value. We classified an additional 12 resources as (**NEI**).

Species	Family	Local and common name(s)	Plant part eaten	Herbarium voucher specimen ID ¹	FC [n = 8]	RFC [n = 8]	Proposed function(s) for Mt. Elgon elephants [provided evidence]	Local ethnomedicinal uses documented during interviews	Relevant direct quotes from informants (information related to elephant medication in bold)	Mode
<i>Abutilon pycnodon</i> Hochr.	Malvaceae	Porowet (Sabaot) Wild almond (English)	Leaves, Bark	JS345	1	12.5%	Unspecified	Diarrhea	"Porowet is the most fed by elephants out of plants I have mentioned. If someone has diarrhea you can boil the bark of this tree and it stops this problem. They [elephants] take both the bark and the leaves." (Interviewee 5, Supplementary Material S5)	NEI
<i>Afrocardus nyassanus</i> (S. Moore) N.Garcia, Moreyra & Susanna	Asteraceae	Markasheet (Sabaot) Tamarind (English)	Roots, Leaves	JS366	2	25.0%	Medicine [Unspecified]	Weakness, digestive disorders, stomachaches, STIs	"People use the tap roots of Markasheet (a 3.5-foot-tall shrub) as a medicine by stewing them and drinking the broth when their bodies are weak and they need help with digestion or stomachaches. This medicine works very well. The elephants also just eat the roots as medicine. " (Interviewee 4, Supplementary Material S4) "Elephants feed on the leaves but not the roots of the Markasheet. In people, they take the roots and combine with other plants to cure STIs. It is almost always combined to make it more effective." (Interviewee 5, Supplementary Material S5)	3
<i>Afrocarpus falcatus</i> (Thunb.) C.N.Page	Asteraceae	Sidetet/Saptet (Sabaot) Podo tree (English)	Bark, Seeds	JS333	4	50.0%	Medicine [Elephants feed on bark when sick with unspecified illness, as do other animals] Food [Unspecified]	To prevent illness after eating old meat	"Elephants eat both the seeds and the bark of the Podo tree. They crush the hard seeds to eat them, but this might just be nutritional. Local people use the bark of the Podo tree by burning it and soaking in water – soda ash – to soften old hard meat and prevent illness after eating it." (Interviewee 1, Supplementary Material S1) "Elephants also feed on the barks of the Podo, Elgon Teak, <i>Warburgia ugandensis</i> and Croton trees as a medicine when they are sick. Other animals in the park such as buffalo, baboons, and water buck also feed on the barks of these trees when they are sick." (Interviewee 2, Supplementary Material S2) "The Podo trees there are two [elephants consume for medicine], the <i>Afrocarpus falcatus</i> and <i>Podocarpus latifolius</i> ." (Interviewee 3, Supplementary Material S3) "Women over 49 also take the bark of the Saptet but I don't know why they do and only people above this age. The elephants also eat the bark. " (Interviewee 4, Supplementary Material S4)	4(t)
<i>Afrocarium buchwaldii</i> (O.Hoffm.) Calleja, N.Garcia, Moreyra & Susanna	Asteraceae	Karasheet (Sabaot)	Roots, Bark	JS301	2	25.0%	Medicine [Unspecified] Food [Unspecified]	Allergies, worms, stomach problems, STIs	"Humans and elephants take the roots and bark of the Karasheet. The elephants like this one a lot too but they may take it as food as well as medicine. In people, it is used for young children to treat allergies, worms, and stomach problems." (Interviewee 4, Supplementary Material S4) "There are others [medicinal plants] such as Karasheet which humans take the roots for treating STIs..." (Interviewee 6, Supplementary Material S6)	3
<i>Aloe arborescens</i> Mill.	Asphodelaceae	Rotiichekukwa (Sabaot) Aloe vera (English)	Leaves	JS339	2	25.0%	Medicine [Elephants feed to calves to increase appetite]	Allergies, STIs	"Elephants also eat <i>Aloe vera</i> and it is highly medicinal. The elephants take the leaves." (Interviewee 7, Supplementary Material S7) " <i>Aloe vera</i> is used by the elephants as an appetizer by giving it to the calves so they want to eat. It is also used by humans for allergies and treating STIs by boiling into a broth for drinking." (Interviewee 8, Supplementary Material S8)	4*
<i>Bambusa vulgaris</i> Schrad. ex J.C.Wendl.	Bambusoideae	Tekandet (Sabaot) Bamboo (English)	Roots, Entire shoots	JS357	2	25.0%	Medicine [Take roots when sick with unspecified ailment] Food [Unspecified]	General medicine	"People, elephants and baboons feed on bamboo. Elephants eat the bamboo directly and humans smoke the split bamboo shoots over a fire before eating them as both a nutritional food and a general medicine." (Interviewee 1, Supplementary Material S1) "The bamboo is also medicinal. Humans use the roots as a human medicine by eating it. The young shoots are smoked over a fire and eaten. The elephants also eat this as food but when they are sick they take the roots. " (Interviewee 7, Supplementary Material S7)	4(t)
<i>Bersama abyssinica</i> Fresen.	Francoaceae	Nyaltit/Nyalit (Sabaot) Climber plant (English)	Leaves Leaves mixed with roots of other trees, then with the mother elephant's milk	JS332	2	25.0%	Medicine [Elephants chew this plant, combine with roots of other trees, and mix with their milk to feed to calves. Believed to function as an immunization]	Stomachache in babies	"Nyaltit is also a medicinal plant for elephants and people by taking the leaves, but I am not sure what to treat exactly." (Interviewee 5, Supplementary Material S5) "Elephants use Angurweet as a medicine to give to babies, removing just the leaves and chewing it until it's smooth along with the roots of some other trees. Then they mix it with their milk and give it to the babies who chew on it themselves and spit out the solids remaining. They use it as a kind of immunization along with <i>Nyalit</i> and <i>Simotweet</i> also. For humans, when babies cry they take the roots of the Angurweet, cook them, and take a spoonful which cures stomachache in the babies." (Interviewee 6, Supplementary Material S6)	4*

Table 5. Summarized interview results reporting resources in the Mt. Elgon elephant diet with putative medicinal functions and/or ethnomedicinal uses.

Cave clay	Not applicable	Clay (English)	Clay from Mt. Elgon caves Clay from caves near Labot	Not applicable	6	75.0%	Sodium Acquisition [Unspecified] Fun [Perceived enjoyment]	Unspecified medicinal uses	"In these caves [Mt. Elgon caves] they also eat clay which might contain additional mineral. Sometimes, and normally seasonally based, the elephants smear the clay on their bodies which can be observed as they exit the cave much darker in color. Exactly why they eat the clay remains unknown. Some of the caves they are known to visit include Kitum and Kibalo cave – in Chesame – where they mine salt and also eat clay. In Chemombut cave, they mine salt and eat the clay, but human activity such as smoke from fires has discouraged the elephants from frequenting the cave. In Tupkeber cave – approx. 1 km from Chemombut – the elephants have also been known to visit but collapsing of the cave has stopped them from visiting. In Chepnayil cave the elephants visit but they do not mine salt or do any other activities that we know of." (Interviewee 1, Supplementary Material S1) "They also eat the clay in Kitum." (Interviewee 2, Supplementary Material S2) "Elephants eat the clay in the caves in my area but I don't know why. I think they might just eat this for fun and not for medicine. When the elephants eat the clay they shower and make noises and seem to enjoy it." (Interviewee 5, Supplementary Material S5) "This is a very unique mountain as they [elephants] can take salt from the caves. The elephants also sometimes eat clay but I think this is just to get more salt." (Interviewee 6, Supplementary Material S6) "The elephants in the caves scrape the rock. Where they eat the clay is concentrated around where they mine the salt." (Interviewee 7, Supplementary Material S7) "Elephants eat clay but not as medicine but just because it contains salt. They also do it for fun." (Interviewee 8, Supplementary Material S8)	NA
Cave minerals and salt	Not applicable	Minerals, Salt (English)	Minerals from salt-rich rock of cave walls, Cave salt, Salty water	Not applicable	4	50.0%	Salt/Mineral Acquisition [Targeted for mineral deficiencies as elephants lack key minerals at this site due to leaching.]	Unspecified medicinal uses	"Mt. Elgon receives a lot of rain causing leaching so elephants lack key minerals which they must source outside their usual plant diet. One of the places they get these minerals is the caves of Mt. Elgon by tucking the salt-rich rock of the cave wall. Some of the caves they are known to visit include Kitum and Kibalo cave – in Chesame – where they mine salt and also eat clay. In Chemombut cave, they mine salt and eat the clay, but human activity such as smoke from fires has discouraged the elephants from frequenting the cave. In Tupkeber cave – approx. 1km from Chemombut – the elephants have also been known to visit but collapsing of the cave has stopped them from visiting. In Chepnayil cave the elephants visit but they do not mine salt or do any other activities that we know of." (Interviewee 1, Supplementary Material S1) "In Kitum cave elephants mine for minerals which may be due to the high rainfall Mt. Elgon receives causing leaching and mineral deficiencies in the elephants' normal diets. In Chepnayil cave the elephants visit but they do not mine for minerals." (Interviewee 2, Supplementary Material S2) "The elephants may also direct you to where there is water and salt licks. They like taking the salty water and can stay there for 2 or 3 days. This is a very unique mountain as they can take salt from the caves. The elephants also sometimes eat clay but I think this is just to get more salt." (Interviewee 6, Supplementary Material S6) "The elephants in the caves scrape the rock. Where they eat the clay is concentrated around where they mine the salt. In certain swampy areas but not all the water is salty and then they take this too. Elephants are very social. They don't fight one another even when drinking water they allow one to drink then the next. For the many years I have been with the elephants I only see the males playing not fighting." (Interviewee 7, Supplementary Material S7)	NA
<i>Coleus barbatus</i> (Andrews) Benth. ex G.Don	Lamiaceae	Angurweet/Angurweet (Sabaot)	Leaves mixed with roots of other trees, then with the mother elephant's milk	JS288	1	12.5%	Medicine [Elephants chew this plant, combine with roots of other trees, and mix with their milk to feed to calves. Believed to function as an immunization]	Stomachache in babies	"Elephants use Angurweet as a medicine to give to babies, removing just the leaves and chewing it until its smooth along with the roots of some other trees. Then they mix it with their milk and give it to the babies who chew on it themselves and spit out the solids remaining. They use it as a kind of immunization along with Nyalit and Simotweet also. For humans, when babies cry they take the roots of the Angurweet, cook them, and take a spoonful which cures stomachache in the babies." (Interviewee 6, Supplementary Material S6)	4*

Table 5. (continued)

<i>Croton macrostachyus</i> Hochst. ex Delile	Euphorbiaceae	Tobosweet/ Toboswet (Sabaot) Croton tree (English)	Bark, Leaves	JS300	5	62.5	Medicine [Elephants feed on bark when sick with unspecified illness, as do other local animals]	Feed sick babies, malaria	"Humans also use the bark [of <i>Vachellia seyal</i>], along with the bark of the Croton tree, to feed sick babies." (Interviewee 1, Supplementary Material S1) "Elephants also feed on the barks of the Podo, Elgon Teak, <i>Warburgia ugandensis</i> and Croton trees as a medicine when they are sick. Other animals in the park such as buffalo, baboons, and water buck also feed on the barks of these trees when they are sick." (Interviewee 2, Supplementary Material S2) "The Elgon Teak is called the <i>Olea welwitschii</i> and the Croton is the <i>Croton macrostachyus</i>." (Interviewee 3, Supplementary Material S3) "Elephants take the leaves of the Tobosweet (Croton) and people take the bark. They only use a small piece of it as sometimes if you use too much it is poisonous. If you have malaria you take it and it makes you better." (Interviewee 6, Supplementary Material S6) "The elephants eat the bark and leaves of the Croton." (Interviewee 7, Supplementary Material S7)	4(1)
<i>Dombeya burgesiae</i> Gerrard ex Harv.	Malvaceae	Poromet-apamo (Sabaot) Dombeya plant (English)	Cambium ("slippery substance") between the bark and stem	JS295	4	50.0%	Medicine [Aids in digestion and softens droppings]	Stomach problems	"Elephants eat part of the Dombeya plant, which has a slippery substance between the bark and the stem." (Interviewee 1, Supplementary Material S1) "The elephants also eat strips of bark from the Dombeya plant (<i>Dombeya goetzenii</i> and <i>Dombeya rotundifolia</i>) that contains a slippery substance that aids their digestion and softening of their droppings." (Interviewee 2, Supplementary Material S2) "There are certain shrubs also with red flowers and spikes they take as medicine. In English it is called the <i>Dombeya rotundifolia</i>." (Interviewee 3, Supplementary Material S3) "For Dombeya, they [elephants] only eat the bark and the leaves. Humans use it for stomach problems." (Interviewee 7, Supplementary Material S7)	4
<i>Dombeya rotundifolia</i> (Hochst.) Planch.	Malvaceae	Poromet-apamo (Sabaot) Dombeya plant (English)	Cambium ("slippery substance") between the bark and stem	JS289	4	50.0%	Medicine [Aids in digestion and softens droppings]	Stomach problems	"Elephants eat part of the Dombeya plant, which has a slippery substance between the bark and the stem." (Interviewee 1, Supplementary Material S1) "The elephants also eat strips of bark from the Dombeya plant – <i>Dombeya goetzenii</i> and <i>Dombeya rotundifolia</i> – that contains a slippery substance that aids their digestion and softening of their droppings." (Interviewee 2, Supplementary Material S2) "There are certain shrubs also with red flowers and spikes they take as medicine. In English it is called the <i>Dombeya rotundifolia</i>." (Interviewee 3, Supplementary Material S3) "For Dombeya, they [elephants] only eat the bark and the leaves. Humans use it for stomach problems." (Interviewee 7, Supplementary Material S7)	4
<i>Dombeya torrida</i> subsp. <i>torrida</i> (synonym: <i>Dombeya goetzenii</i>)	Malvaceae	Poromet-apamo (Sabaot) Dombeya plant (English)	Cambium ("slippery substance") between the bark and stem	JS307	4	50.0%	Medicine [Aids in digestion and softens droppings]	Stomach problems	"Elephants eat part of the Dombeya plant, which has a slippery substance between the bark and the stem." (Interviewee 1, Supplementary Material S1) "The elephants also eat strips of bark from the Dombeya plant – <i>Dombeya goetzenii</i> and <i>Dombeya rotundifolia</i> – that contains a slippery substance that aids their digestion and softening of their droppings." (Interviewee 2, Supplementary Material S2) "There are certain shrubs also with red flowers and spikes they take as medicine. In English it is called the <i>Dombeya rotundifolia</i>." (Interviewee 3, Supplementary Material S3) "For Dombeya, they [elephants] only eat the bark and the leaves. Humans use it for stomach problems." (Interviewee 7, Supplementary Material S7)	4
<i>Echinops aberdaricus</i> R.E.Fr.	Asteraceae	Metip Sorin (Sabaot)	Roots, Leaves	JS361	2	25.0%	Food [Unspecified]	Fertility problems, respiratory problems, general medicine	"Women take Matip Sorin when they are pregnant or have problems with fertility. If fertility is a problem, then both partners take the roots of Matip Sorin (look like cassava). Elephants take the leaves and roots but leaves might just be a food. In people it makes you feel fresh and like you can breathe well and exercise." (Interviewee 4, Supplementary Material S4) "There is a shrub called Matip Sorin and people dig the roots. It is expensive and used as a general medicine. People sell the roots of this for 500 Ksh sometimes." (Interviewee 7, Supplementary Material S7)	NEI
<i>Ekebergia capensis</i> Sparrm.	Meliaceae	Bumeetet (Sabaot)	Bark	JS353	1	12.5%	Unspecified	Unspecified	"...Bumeetet which humans and elephants take the bark..." (Interviewee 6, Supplementary Material S6)	NEI

Table 5. (continued)

<i>Ficus natalensis</i> Hochst.	Moraceae	Simotweet (Sabaot)	Bark, Leaves Leaves mixed with roots of other trees, then with the mother elephant's milk	JS287	5	62.5%	Medicine [Elephants combine other plants and milk with this plant to feed to calves as an immunization; All eat from same tree despite the presence of other available trees nearby]	Chest problems, malaria, wounds, allergies	"Elephants use Angurweet as a medicine to give to babies, removing just the leaves and chewing it until its smooth along with the roots of some other trees. Then they mix it with their milk and give it to the babies who chew on it themselves and spit out the solids remaining. They use it as a kind of immunization along with Nyalit and Simotweet also." (Interviewee 6, Supplementary Material S6) "The specific trees elephants use as medicine are also the ones that people use and are mostly found there in their habitat. Whether people learned which plants are medicinal from the elephants is not something we have studied, but there are certain human families with special relationships to elephants. For example, it was told that when the elder of one of these families passed, the elephants came to their dwelling and mourned their death without destroying anything... There is a specific type of fig tree where elephants take the bark as medicine..." (Interviewee 3, Supplementary Material S3) "Simotweet is a plant people use as medicine by cutting the bark and taking just a teaspoon of a milky substance and mixing with other plants. This can be used to treat wounds in people. Elephants just chew the bark but also as a medicine." (Interviewee 4, Supplementary Material S4) "Elephants also dig the roots and eat the bark and leaves of the fig tree. Humans mainly use the bark to treat chest problems and malaria. Elephants are very clever. When they come to an area with many fig trees, they eat only one and they all eat from that one. That way they don't waste the medicine if they need it tomorrow." (Interviewee 7, Supplementary Material S7) "There is a plant called Simotweet which I have seen the elephants eating the bark and giving to the child [calf]. It cures allergies in people but combined with other herbs too." (Interviewee 8, Supplementary Material S8)	4*
<i>Gymnosporia heterophylla</i> (Eckl. & Zeyh.) Loes.	Celastraceae	Chepkata (Sabaot)	Roots	JS317	1	12.5%	Medicine [Unspecified]	STIs	"Another plant Chepkata is mixed with Matip Sorin and Moobawara and taken to treat for STIs and is a very powerful medicine. You first take an injection and then take the plant medicine. If you get the injection but don't take the plant medicine recovery is much slower but you do have to go to the doctor first before taking the traditional medicine. Both people and elephants eat the roots as medicine." (Interviewee 4, Supplementary Material S4)	3
<i>Ipomoea batatas</i> (L.) Lam.	Convolvulaceae	Neporig (Sabaot) Sweet potato (English)	Leaves	V70	1	12.5%	Unspecified	Unspecified	"Back when my grandmother used to get game meat and honey from the bush, they would follow the elephants and observe what they were eating from their droppings. When they saw sweet potato leaves in the droppings, they found the plant with these leaves and discovered sweet potatoes in the ground. People here will follow elephants and try to eat what they eat as they believe it will also be good for them." (Interviewee 1, Supplementary Material S1)	NEI
<i>Juniperus procera</i> Hochst. ex Endl.	Cupressaceae	Torokiondet (Sabaot) Cedar tree (English)	Bark	JS311	2	25%	Medicine [Bark feeding on this species is unusual]	Flu	"Mostly during the dry season, the elephants sometimes eat the bark of the cedar tree. Local people also use cedar bark to treat the flu by eating the inner part of the bark." (Interviewee 1, Supplementary Material S1) "Elephants eat the bark of the cedar trees. Local people also eat this bark as a medicine. I think this is likely a medicinal plant for the elephants as they only eat it sometimes." (Interviewee 2, Supplementary Material S2)	3
<i>Kulou usambarensis</i> (Engl.) Trofimov & Rohwer	Lauraceae	Lulyondeet/Lulyondeet (Sabaot)	Bark	JS360	1	12.5%	Medicine [Elephants who have shown visible sickness behaviors (e.g., below average movements) target and tusk bark of this species]	Unknown	"Elephants take Lulyondeet which works for everything as sometimes when there is a sick elephant they go to the tree and eat the bark by tussing it. I have seen elephants that look sick because they do not move more than 300 meters for 2 or 3 days which suggests they might be sick. Normally they would walk 10 km per day. People do also use the bark of this tree too, but I am not sure for what." (Interviewee 6, Supplementary Material S6)	4
<i>Olea europaea</i> subsp. <i>cuspidata</i> (Wall. ex G.Don) Cif.	Oleaceae	African olive (English)	Leaves, Bark	JS331	1	12.5%	Medicine [Unspecified]	Clean body and blood stream, STIs	"The bark of the <i>Olea europaea</i> subsp. <i>africana</i> is used by locals and mixed with some other plants not fed on by elephants, honey and water. It then keeps a long time and has a sour taste. It is used to clean the body and blood stream and to treat STIs so it is taken a lot. Elephants eat both the leaves and the bark as medicine." (Interviewee 5, Supplementary Material S5)	3
<i>Olea welwitschii</i> (Knobl.) Gilg & G.Schellenb.	Oleaceae	Pekoriondet (Sabaot) Elgon Teak tree (English)	Bark	JS299	3	37.5%	Medicine [Elephants feed on bark when sick with unspecified illness, as do other local animals]	Unspecified medicinal uses	"For example, elephants tusk many of the indigenous and protected trees of Mt. Elgon, such as the Elgon Teak tree. People saw these trees had been tusked by the elephants and thought it might be medicinal so began to eat mostly the bark but also the roots by boiling into broths." (Interviewee 1, Supplementary Material S1) "Elephants also feed on the barks of the Podo, Elgon Teak, <i>Warburgia ugandensis</i> and <i>Croton</i> trees as a medicine when they are sick. Other animals in the park such as buffalo, baboons, and water buck also feed on the barks of these trees when they are sick." (Interviewee 2, Supplementary Material S2) "The Elgon Teak is called the Olea Capensis..." (Interviewee 3, Supplementary Material S3)	4(t)

Table 5. (continued)

<i>Periploca linearifolia</i> Quart.-Dill. & A.Rich	Apocynaceae	Sinendet (Sabaot)	Entire plant	JS367	1	12.5%	Unspecified	Unspecified medicinal uses	"There is a certain plant that is like a grass that makes small piping that is a human medicine. They [the elephants] finish what is there when they find it because it does not grow often." (Interviewee 7, Supplementary Material S7)	NEI
<i>Podocarpus latifolius</i> (Thunb.) R.Br. ex Mirb.	Podocarpaceae	Sidetet/Sapteet (Sabaot) Podo tree (English)	Bark, Seeds	JS334	4	50.0%	Medicine [Elephants feed on bark when sick with unspecified illness, as do other local animals] Food [Unspecified]	Prevent illness after eating old meat	"Elephants eat both the seeds and the bark of the Podo tree. They crush the hard seeds to eat them but this might just be nutritional. Local people use the bark of the Podo tree by burning it and soaking in water – soda ash – to soften old hard meat and prevent illness after eating it." (Interviewee 1, Supplementary Material S1) "Elephants also feed on the barks of the Podo, Elgon Teak, <i>Warburgia ugandensis</i> and Croton trees as a medicine when they are sick. Other animals in the park such as buffalo, baboons, and water buck also feed on the barks of these trees when they are sick." (Interviewee 2, Supplementary Material S2) "The Podo trees there are two [elephants consume for medicine], the <i>Africanus falcatus</i> and <i>Podocarpus latifolius</i> ." (Interviewee 3, Supplementary Material S3) "Women over 49 also take the bark of the Sapteet but I don't know why they do and only people above this age. The elephants also eat the bark." (Interviewee 4, Supplementary Material S4)	4(t)
<i>Prunus africana</i> (Hook.f.) Kalkman	Rosaceae	Armootit (Sabaot)	Bark	JS291	1	12.5%	Medicine [Unspecified]	Unspecified medicinal uses	"Armootit is a tree which elephants remove the bark of for medicine and so do local people. It is a very good herbal medication for both people and elephants." (Interviewee 6, Supplementary Material S6)	3
Red soil	Not applicable	Red soil (English)	Soil	Not applicable	2	25.0%	Iron Acquisition [Females target soil more than males] Food [Elephants dig for red soil both when they are sick and healthy]	Iron supplement	"The elephants dig out areas of red soil with their tusks, especially near elephant platform in the park. This is mainly done by the female elephants. The males sometimes also dig out the soil to sprinkle it on their bodies but the females eat this soil. I learned from the local people that red soil is rich in iron and they might have learned this from elephants. It is possible that they replenish their iron by eating this soil and may be related to their reproductive cycle." (Interviewee 1, Supplementary Material S1) "Mostly when it is wet, elephants dig red soil for termites and mushrooms. They do this both when they are sick and when they are not so it may also be for nutritional reasons." (Interviewee 2, Supplementary Material S2)	NEI
<i>Rhamnus prinoides</i> L'Her.	Rhamnaceae	Moobarawa (Sabaot)	Roots, Leaves	JS296	1	12.5%	Medicine [Elephants targeted resource after observing interviewee take it for medicine.]	Allergies in young children, STIs	"Moobarawa is a strong medicinal plant and very expensive that is used to treat allergies in young children. People take the roots and elephants take the roots and leaves." (Interviewee 4, Supplementary Material S4) "Another plant Chepkata is mixed with Matip Sorin and Moobarawa and taken to treat for STIs and is a very powerful medicine. You first take an injection and then take the plant medicine. If you get the injection but don't take the plant medicine recovery is much slower but you do have to go to the doctor first before taking the traditional medicine. Both people and elephants eat the roots as medicine. I remember one day I went to monitor the elephants and I took a Moobarawa for myself then the very next day I find the elephants have taken the same thing. I think they [elephants] pass the knowledge from mother to baby but I don't know how they originally learned to eat certain plants for medicine." (Interviewee 4, Supplementary Material S4)	3
<i>Scopocarpus hypselodendron</i> (Hochst. ex A.Rich.) T.Wells & A.K.Monro	Urticaceae	Kipsogotit/Kipsokotit (Sabaot)	Branches, Seeds	JS324	1	12.5%	Unspecified	Unspecified medicinal uses	"There is a twig we call Kipsokotit which the leaves, stem and roots are used as a good human medicine. The knowledge of this is indigenous and passed down the generations. The elephant has the capacity when they eat the branches to also eat the seeds. They are very good at propagating seeds and seeding the forest. Around the dung there can be many young plants growing." (Interviewee 7, Supplementary Material S7)	NEI
<i>Solanum acaule</i> Bitter	Solanaceae	Sodomepo/Labotweet (Sabaot)	Entire plant from stem to roots	JS351	1	12.5%	Unspecified	Anti-venom	"There are certain plant called Sodomepo humans use. It is good also for human they eat the fruit and the leaves. It can also be used as an anti-venom. They [elephants] eat the whole plant from stem to the roots." (Interviewee 7, Supplementary Material S7)	NEI
<i>Solanum aculeastrum</i> Dunal	Solanaceae	Sikowet/Sigowet (Sabaot)	Roots	JS326	1	12.5%	Unspecified	Unspecified medicine for humans and domesticated animals	"Sikowet is a plant people take as medicine and feed their animals when they are suffering. Elephants and people take the roots." (Interviewee 5, Supplementary Material S5)	NEI
<i>Solanum camplacanthum</i> Hochst. ex A.Rich.	Solanaceae	Kobortit/Labotweet (Sabaot)	Leaves, Roots	JS308	1	12.5%	Medicine [Used to treat unspecified illness in calves]	Veterinary medicine to treat livestock (not taken by humans)	"Elephants also eat the leaves and roots of the Kobortit to treat illnesses in the baby elephants. It is used as a medicine for livestock too by boiling it and giving the broth for them [livestock] to drink. Humans do take it as a medicine." (Interviewee 8, Supplementary Material S8)	4(t)*

Table 5. (continued)

<i>Solanum mauritanium</i> Scop.	Solanaceae	Kibiriti (Sabaot)	Leaves	JS 290	1	12.5%	Medicine [Herbalists take it. Elephants target it infrequently]	Antibiotic	"People go into the bush and remove the roots of the Kibiriti. This plant you can put in the fire still wet and it burns very well. I don't know why elephants take this as medicine but I have seen them eating it. For me to discover that maybe this is medicine is because the herbalists take it. I think they take it [Kibiriti] as an antibiotic when mixed with other plants. People take the roots and elephants take the leaves but the elephants only eat it [Kibiriti] sometimes." (Interviewee 6, Supplementary Material S6)	3
Swamp clay	Not applicable	Clay (English)	Clay from swamps	Not applicable	1	12.5%	Unknown	Unspecified	"Elephants eat clay also but I don't know for what purpose. They like to eat it in a swamp but we never know why." (Interviewee 4, Supplementary Material S4)	NEI
<i>Urtica massaiica</i> Mildbr.	Urticaceae	Siywondet (Sabaot) Stinging nettle (English)	Uproot the plant and only eat the upper part	JS310	2	25.0%	Medicine [Unspecified] Food [Unspecified]	Unspecified medicinal uses	"The elephants eat stinging nettles by uprooting the plant and eating only the upper part and discarding the rest but this is likely just nutritional." (Interviewee 1, Supplementary Material S1) "Stinging nettles are medicinal and high in zinc. In Kenya they sell dried leaves of the nettle (100g is 400 Ksh). This is a routine medication for the elephants." (Interviewee 7, Supplementary Material S7)	3
<i>Vachellia seyal</i> (Delile) P.J.H.Hurter	Fabaceae	Ndiliat (Sabaot) Red acacia tree/ Acacia tree (English)	Leaves, Bark, Roots	JS313	3	37.5%	Medicine [Elephants target tree in small quantities]	Feeding sick babies, diarrhea	"Elephants pull down Acacia trees to eat the leaves and the bark. Humans also use the bark, along with the bark of the Croton tree, to feed sick babies. The bark can be boiled into a broth or the inner part of the bark can be eaten directly and is commonly used by local people to treat diarrhea." (Interviewee 1, Supplementary Material S1) "There is a specific type of fig tree where elephants take the bark as medicine, and the roots of the red acacia and the leaves of the <i>Warburgia</i> ." (Interviewee 3, Supplementary Material S3) "In the park the trees also live in families in one area, and the elephants will often only browse on one or two trees or small shrubs which suggests it is not food but medicine. For example, they might just uproot one or two of the Acacia trees which suggests it is medicinal." (Interviewee 3, Supplementary Material S3) "There are various varieties of acacia. The umbrella shape acacia is used as food but the other with very hard wood is used as a medicine. People use the roots of this for medication and it is very good. It is called Kwalet in our local dialect." (Interviewee 7, Supplementary Material S7)	3
<i>Yerpr nobilis</i> (Delile) Mitrav	Rutaceae	Kwiriondet/ Kwiryondet (Sabaot)	Roots	JS314	1	12.5%	Unspecified	Diabetes	"...and Kwiryondet which humans use to treat diabetes when mixed with other plants. Elephants take the roots." (Interviewee 6, Supplementary Material S6)	NEI
<i>Warburgia ugandensis</i> Sprague	Canellaceae	Sokwondet (Sabaot)	Young leaves, Leaves, Bark	JS306	3	37.5%	Medicine [Elephants feed on bark when sick with unspecified illness, as do other animals. Plant is also targeted infrequently and in small amounts]	Chest congestion	"Both elephants and local people eat the tender leaves of the <i>Warburgia ugandensis</i> which has a hot peppery taste, and sometimes the bark. Local people use this to clear chest congestion but it is very strong so only a small amount is required. Elephants also only eat a small amount of this [<i>Warburgia ugandensis</i>] sometimes." (Interviewee 1, Supplementary Material S1) "Elephants also feed on the barks of the Podo, Elgon Teak, <i>Warburgia ugandensis</i> and Croton trees as a medicine when they are sick. Other animals in the park such as buffalo, baboons, and water buck also feed on the barks of these trees when they are sick." (Interviewee 2, Supplementary Material S2) "There is a specific type of fig tree where elephants take the bark as medicine, and the roots of the red acacia and leaves of the <i>Warburgia</i> ." (Interviewee 3, Supplementary Material S3)	4(?)
<i>Zanthoxylum asiaticum</i> (L.) Appelhans, Gruppo & J.Wen	Rutaceae	Kwarasiet (Sabaot) Todolia plant/shrub/climber (English)	Bark, Roots	JS294	2	25.0%	Unspecified	STIs, general illness	"Elephants uproot the <i>Todolia</i> plant – a climber – to eat the bark and roots. The elephants really like this plant. Local people also eat the bark of the <i>Todolia</i> by boiling it into a broth to treat sexually transmitted infections – STIs." (Interviewee 1, Supplementary Material S1) "Elephants eat the bark of the <i>Todolia</i> , which is a shrub with spiked bark. Local people consume the bark and the roots of this plant by boiling them into a broth, sieving it, mixing it with honey and drinking after 2 to 3 days. They use this for most illnesses and often mix other plants into this broth too." (Interviewee 2, Supplementary Material S2)	NEI

¹Deposited at the East African Herbarium of the National Museums of Kenya in Nairobi

²–Resource named as used in alliscane.

(?)–Resource named as medicine used by sick elephants, but not enough evidence provided to determine specific health condition or medicinal function.

NEI–Not enough information to classify Mode.

NA–Informant specifically stated this resource was not a medicine for elephants.

Yellow highlight = Mode 3

Light green highlight = Mode 4(?)

Dark green highlight = Mode 4

Red highlight = NEI

Purple highlight = NA

Table 5. (continued)

Plant species ($n = 35$) named in this study came from 23 plant families. The plant families best represented in our surveys are *Asteraceae* ($n = 4$), *Malvaceae* ($n = 4$), *Solanaceae* ($n = 4$), *Oleaceae* ($n = 2$), *Rutaceae* ($n = 2$), and *Urticaceae* ($n = 2$). Across all plant species mentioned, the most commonly referenced plant parts are leaves ($n = 15$), bark ($n = 15$), and roots ($n = 11$). Other plant parts mentioned include cambium ($n = 3$), seeds ($n = 3$), the entire plant ($n = 2$), branches ($n = 1$), young leaves ($n = 1$), entire shoots ($n = 1$), and the upper part of the uprooted plant ($n = 1$). The medicinal resources with the highest RFC scores (62.5%) are *C. macrostachyus* (Fig. 2, center),



Fig. 2. **Left:** Leaves of *S. mauritianum* (Kibiriti), which elephants eat in rare instances. **Center:** A local study participant presents a young *C. macrostachyus* tree (Tobosweet/Toboswet), which elephants feed on the bark of when visibly sick. **Right:** Leaves of *C. barbatus* (Angurweet), a plant mother elephants give to their babies as a type of “immunization.”

reportedly consumed by visibly ill elephants, and *F. natalensis*, which is said to be combined with breast milk by the mother elephant along with *C. barbatus* (Angurweet, Fig. 2, right) and *Bersama abyssinica* (Nyaliit/Nyalit) before being given to the calves as “a kind of immunization.”

Other plant species often cited by the informants in this study are *A. falcatus*, *D. burgessiae*, *D. rotundifolia* (Figs. 3 and 4), *D. torrida* subsp. *torrida* (RFCs: 50%), *O. welwitschii*, *P. latifolius* (Fig. 5), *V. seyal* (Supplementary Material S9, Figure S3) and *W. ugandensis* (RFCs: 37.5%). Supplementary Material S9 (Figures S1–S5) provides further indirect photographic evidence for local elephant self-medication behaviors, as well as information on select plant species recorded in this study.



Fig. 3. **Left:** Stem of *Dombeya rotundifolia*. **Middle:** Leaves of *D. rotundifolia*. **Right:** Suspected elephant tuskings of a section of *D. rotundifolia* stem that lies on the track to Chepanyalil cave known to be visited by the elephants.



Fig. 4. Fallen *D. rotundifolia* tree outside Tupkeber cave, showing markings of fresh tusking by elephants.



Fig. 5. Trunk of *P. latifolius* (Podo tree), showing elephant tusking of the bark.

Ethnomedicinal and ethnoveterinary uses of species recorded

Of the 39 plants mentioned as having medicinal uses (for humans and/or elephants), 10 are mentioned by more than two participants (>25% of informants). In Table 6, we report the results of our ethnomedicinal and pharmacological literature review. Instances of overlap in plant parts or therapeutic indications between our original elephant field data and the existing literature are denoted in bold type.

Plant species	Plant part cited	RFC	Traditional uses	Pharmacological effects
<i>Croton macrostachyus</i>	Bark, leaves	62.5%	Recorded mainly in Ethiopia, Kenya and Somalia: 1. Digestive disorders (abdominal pain, constipation, bloating, diarrhea, dysentery, gastric ulcer, cleansing of GI tract, stomachache) ^{77–88,51,89–94,114,96} 2. Infections (malaria, typhoid fever, pneumonia, hepatitis, ringworms, amoebiasis, tapeworms, ascariasis, fungal skin infections, Tinea capitis, flu, anthrax, STIs such as gonorrhea) ^{97,77,98–102,83,84,103,104,85,105,86,106–108,51,109–111,91,92,112,94,113,203,114,202,96} 3. Wound treatment and skin disorders (wounds, ulcers, skin rash, skin rash in newly born babies, atopic eczema, bleeding and blood coagulant) ^{79,116,81,117,118,120,85,121,105,86,109,91,92,122,112,94,202,96} 4. Inflammation and other ailments (dysmenorrhea, diabetes, cancer, fever, pain, epilepsy, backache, headache, rheumatism, cough, pneumonia, liver problems, as a purgative/laxative, venereal diseases, abortion, allergies, jaundice, as an antidote for snake bites and scorpion envenoming, cleansing of the blood circulation system, insomnia) ^{77,123,80,124,125,100,101,118,120,126,105,127,51,90,92,94,128,203,202,96} 5. Veterinary uses (livestock ailments, such as blackleg and animal cough, rabies, fever in cows, diarrhea, East Coast fever, scabies, abdominal pain, bleeding, bloating, colic, dermatophilosis, external parasites, ringworms, streptothricosis, wound treatment) ^{97,80,100–102,83,129,104,121,86,127,88,51,130,91,132,133}	1. Antiplasmodial ^{134–140} 2. Antibacterial ^{141–146,108,147–151} 3. Anti-inflammatory ^{152,153} 4. Antifungal ^{154,108,150,155} 5. Anticonvulsant and sedative ¹²³ 6. Antidiabetic ¹⁵⁶ 7. Antidiarrheal ¹⁵⁷ 8. Antiulcer ¹⁵⁸ 9. Diuretic ¹⁵⁹ 10. Larvicidal ¹⁶⁰ 11. Antileishmanial ¹⁶¹ 12. Anthelmintic ^{162,163}
<i>Ficus natalensis</i>	Bark, Leaves Leaves mixed with roots of other trees, then with the mother elephant's milk	62.5%	1. Digestive disorders (diarrhea, dysentery, stomach complaints) ¹⁶⁴ 2. Wound treatment and healing ^{164,95} 3. Infectious diseases (mumps, jaundice, colds, cough, sore throats, acne, deworming, cholera, septic ears) ^{164,166,95} 4. Inflammation (stomach ulcers) ⁹⁵ 5. Reproductive health (promoting labor, retained placenta) ¹⁶⁶ 6. Other disorders (cataract, hiccup, snakebite) ¹⁶⁶	1. Antimicrobial activity (growth inhibition and anti-biofilm) ^{167–170} 2. Antioxidant and anti-inflammatory effects ^{171–174,169} 3. Reproductive health (improves sperm count/motility, restores testosterone and steroidogenic gene expression) ¹⁷³
<i>Afrocarpus falcatus</i>	Bark, Seeds	50.0%	1. Digestive disorders (abdominal pain) ¹⁷⁵ 2. Bone fractures ¹⁷⁵ 3. Inflammation (asthma) ¹⁷⁵ 4. Liver disorders (jaundice) ^{176,177} 5. Inflammation (gastritis) ¹⁷⁷ 6. Infectious diseases (amebiasis, intestinal parasites) ^{178,177}	1. Diuretic and renal effects ¹⁷⁹ 2. Antioxidant and anti-inflammatory effects ¹⁸⁰ 3. Antiproliferative activity ¹⁸¹ 4. Antimutagenic effects ¹⁸²
<i>Dombeya burgessiae</i>	Cambium (“slippery substance”) between the bark and stem	50.0%	1. Infectious diseases (malaria, leprosy) ¹⁸³ 2. Digestive disorders (stomachache) ¹⁸³ 3. Diabetes ¹⁸⁴	1. Antioxidant ¹⁸⁴ 2. Antidiabetic ¹⁸⁴ 3. Antibacterial effects ¹⁸⁵ 4. Anti-inflammatory effects ¹⁸⁵
<i>Dombeya rotundifolia</i>	Cambium (“slippery substance”) between the bark and stem	50.0%	Used as traditional medicine in over 60% of the countries where it is native in tropical Africa, highlighting its cultural and medicinal importance ¹⁸⁶ 1. Digestive disorders (diarrhea, ulcers, dyspepsia, constipation) ^{187–192,186,193–201,245} 2. Reproductive health (induce or hasten labor, infertility, pregnancy nausea) ^{187–189,191,192,186,195,201,50,245} 3. Cardiovascular disorders (heart problems, palpitations, hypertension) ^{204,186,205,195,196,206,207,200,245} 4. Respiratory issues (chest complaints, pneumonia) ^{208,186,195,196,200,245} 5. Parasite infections (malaria, parasitic worms) ^{192,186,209}	1. Anti-inflammatory ^{210,211,186,195} 2. Antimicrobial ^{212,211} 3. Antioxidant (purely chemical assay with no pharmacological relevance) ^{212,186,213,195} 4. Anti-hypertensive ^{186,195} 5. Acetylcholinesterase inhibition ^{214,186,195} 6. Antibacterial ¹⁹⁵
<i>Dombeya torrida</i> subsp. <i>torrida</i>	Cambium (“slippery substance”) between the bark and stem	50.0%	1. Digestive disorders (indigestion) ^{215,190,216,217} 2. Respiratory issues (chest pain, colds) ^{215,218,216}	1. Antibacterial ^{216,219} 2. Antifungal ²¹⁶
<i>Podocarpus latifolius</i>	Bark, Seeds	37.5%	1. Respiratory disorders (asthma, cough, chest pain) ^{180,220,221,189,222,201} 2. Inflammatory disorders (fevers, asthma, arthritis, rheumatism, pain) ^{180,220,182,221,223} 3. Digestive disorders (stomachache) ²²⁰ 4. Parasite infections (deworming) ^{220,182,224} 5. Bacterial and fungal infections (e.g., cholera) ^{225,180,220,221} 6. Birth (womb cleansing / afterbirth) ⁵¹ 7. Veterinary uses (distemper in dogs, gall sickness in cattle) ²²⁰	1. Antibacterial and antifungal (against bacterial pathogens, including those linked to rheumatoid arthritis and ankylosing spondylitis, and <i>Candida albicans</i>) ^{225,220,226,227} 2. Anti-inflammatory and antioxidant ^{180,220,182,221} 3. Anthelmintic ^{220,221} 4. Anti-tyrosinase ^{180,220,221} 5. Anti-cancer/anti-proliferative ^{220,227} 6. Cytotoxicity ^{182,227} 7. Anti-HIV ²²⁰
<i>Olea welwitschii</i>	Bark	37.5%	No recorded ethnomedicinal uses	No direct evidence of pharmacological effects

Continued

Plant species	Plant part cited	RFC	Traditional uses	Pharmacological effects
<i>Vachellia seyal</i>	Leaves, Bark, Roots	37.5%	1. Wound treatment¹⁷⁵ 2. Liver disorders (jaundice)²²⁸ 3. Infectious diseases (malaria, typhoid fever)²²⁹ 4. Inflammation (menstrual pain, fever)²²⁹ 5. Digestive disorders (stomachache)^{229,230} 6. Other medical disorders (preventing blood loss, skin diseases, ear diseases, boosting immunity, general tonic)^{229,230}	1. Antifungal against <i>Phytophthora infestans</i>²³¹ 2. Antioxidant^{232–234} 3. Antibacterial²³² 4. Anti-inflammatory²³³ 5. Quorum sensing and biofilm formation inhibition²³⁵
<i>Warburgia ugandensis</i>	Young leaves, Leaves, Bark	37.5%	1. Parasite infections (malaria)^{236–238,75} 2. Inflammatory disorders (pain, chest pain, fever, redness, swelling, headache, toothache)^{239,119,51,240,75} 3. Skin disorders (wound treatment)⁷⁵ 4. General infections (sore throat, cough, nasal congestion)^{240,75} 5. STIs⁷⁵ 6. Infectious diseases (tuberculosis, pneumonia, measles, HIV/AIDS, candidiasis, influenza)^{236,237,119,51,75} 7. Cancer (leukemia, breast cancer, cervical cancer, intestinal cancer, prostate cancer, skin cancer, throat cancer)⁷⁵ 8. Digestive disorders (diarrhea, stomachache, constipation)^{236–238} 9. Other medical disorders (anemia, aphrodisiac, brain disorders, fallopian tube blockage, kidney failure, hypertension, miscarriage, nose bleeding, ulcers)⁷⁵	1. Anti-inflammatory^{242,58,243} 2. Antioxidant^{242,58} 3. Antiplasmodial^{241,244,247} 4. Antibacterial, e.g., against multidrug-resistant clinical isolates of ESPAPE pathogens, mycobacteria and listeria^{119,246,74,242,18} 5. Quorum sensing inhibition in MRSA⁷⁴ 6. Cytotoxicity, e.g., against MRC-5S_{v2} lung fibroblasts^{248–250,241} 7. Antiproliferative effects²⁴³ 8. Antifungal effects²⁴⁶ 9. Biofilm formation inhibition²⁵¹ 10. Antileishmanial effects²⁵² 11. Anthelmintic effects²⁵³

Table 6. Ethnomedicinal uses and pharmacological properties found in the literature for the species cited by > 25% participants. NB: Overlaps in plant parts or therapeutic indications between our original field data and the existing literature are highlighted in bold.

Discussion

Our study presents firsthand accounts from local experts on Mount Elgon, documenting their observations of elephants selectively exploiting certain plant species with local ethnomedicinal uses to medicate themselves or others. Across all interviews, experienced informants indicated their belief that elephants can intentionally seek out medicinal resources when sick with certain conditions, indicating a targeted, rather than random, foraging behavior. This study therefore provides the first indications of Mode 4 self-medication and allo-medication in African elephants, and raises important questions about how these medicinal behaviors are acquired.

We highlight here the eight resources classified as involved in **Mode 4** medication behaviors (Table 5; highlighted in dark green). For each of these resources, informants were able to describe specific anecdotes in which they observed elephants feeding on plants for a perceived medicinal purpose or administering this resource to their offspring as a medicine. One of these resources is *A. arborescens*, which female elephants have been observed feeding to calves to increase their appetite. Elephants have also been observed mixing *C. barbatus*, *F. natalensis*, and *B. abyssinica* with their milk to feed to their calves. Participants stated that this behavior functions as an immunization for their offspring. Participants also reported elephants using three species from the genus *Dombeya* (specifically *D. burgessiae*, *D. rotundifolia*, and *D. torrida* subsp. *torrida*) to aid in digestion and soften their droppings. Finally, informants mentioned that *K. usambarensis* is used by elephants showing visible sickness behaviors (e.g., lethargy and lack of movement).

Learning from elephants

Several informants suggested that local people have acquired medicinal or nutritional knowledge by observing the medicinal behaviors of elephants (specifically for the species *O. welwitschii* and *Ipomoea batatas*). Most participants also referenced the shared local belief that the plants elephants consume are also good for people. One informant stated, “The grandfathers used to tell us that whatever works for elephants also works for us and so we can follow what they eat” (Interviewee 5, Supplementary Material S5). Another said, “People here will follow elephants and try to eat what they eat as they believe it will also be good for them” (Interviewee 1, Supplementary Material S1). However, two interviewees noted that this is not always the case, as some plants eaten by elephants are poisonous for people (Interviewee 4, Supplementary Material S4). Consistent with past research on elephant zoopharmacognosy³⁵, informants conveyed the belief that humans and elephants engage in multidirectional, interspecies knowledge transmission. One participant described how an elephant observed his own medicinal use of the species *Rhamnus prinoides*, finding the next day that “the elephants had consumed the plant as well” (Interviewee 4, Supplementary Material S4).

Ethnomedicinal overlap

Literature reviews were conducted for 10 plant species that were cited by >25% of the study participants to evaluate their ethnomedicinal/ethnoveterinary uses and pharmacological properties. Through this review, we identified a significant overlap in the species and plant parts used by elephants for putative therapeutic behaviors and those cited in the existing literature as having established uses and/or pharmacological activity. Specifically, nine species in the Mount Elgon elephant diet with an RFC value above 25% have previously documented ethnomedicinal uses. Similarly, the same nine species in the Mount Elgon elephant diet with an RFC value above 25% have previously identified pharmacological properties. These findings highlight the prevalence of known

medicinal resources in the diets of Mount Elgon elephants, which may intentionally or unintentionally provide them with chemical defenses against harmful pathogens or therapeutic mechanisms for medical disorders.

As interpreting medication behaviors in wild animals is inherently challenging, participants in this study relied both on direct observation and on their familiarity with medicinal plant use within local cultural and medical knowledge systems. Many interviewees were familiar with the medicinal uses of plants consumed by local elephants in human traditional medicine. At times, they also referred to modern biomedical concepts, such as immunity and digestion. This knowledge may have helped informants recognize unusual feeding events and interpret selective feeding behavior. Consequently, some therapeutic explanations may result from an interpretive process in which observed elephant behaviors are contextualized through existing medical knowledge. While this dynamic can help identify potential self-medication behaviors, it may also influence how informants perceive and explain the function of those behaviors.

The function of geophagy at Mount Elgon: clay and soil consumption

Despite existing literature on the medicinal function of clay and soil consumption in elephants, in this study informants did not identify any ingested substrate as medicinal. Rather, the function of these behaviors was attributed to mineral acquisition (for salt and iron) and to the perceived enjoyment that elephants gain from engaging in geophagy. One participant mentioned the use of red soil as potentially important for female elephants' reproductive cycles, but no further information was given.

Future directions

The relative lack of comprehensive research on elephant medication has thus far left key questions unanswered, particularly regarding which plants African elephants may target when sick or injured, and how medicinal knowledge is acquired (e.g., innate, instinctive, learned from more experienced individuals such as mothers or elders within the herd, or a combination of these). Understanding these processes could provide deeper insights into the cognitive, cultural, and social aspects of elephant behavior.

To build on the outcomes of this study, several research avenues should be pursued. First, pharmacological testing of plants frequently consumed by elephants in specific health-related contexts is necessary to determine their medicinal properties, active ingredients, mechanisms of action, and potential physiological effects. Subsequently, long-term behavioral studies tracking individual elephants could yield critical data on patterns of plant selection, social learning mechanisms, and the recurrence of specific foraging behaviors (and even human crop raiding behaviors³⁹) during periods of illness. Furthermore, research should aim to establish clearer connections between observed plant consumption and the ailments these behaviors may be addressing. Ultimately, expanding this field of study could offer not only a better understanding of elephant zoopharmacognosy but also valuable insights for conservation, wildlife health management, and even potential applications for human medicine.

Conclusions

The results of this study have wide-ranging implications—from advancing our understanding of elephant behavior and informing conservation strategies to providing profound insights for pharmaceutical research. Despite growing interest in animal self-medication, little is known about the medicinal behaviors of elephants. By reporting 35 plant species identified as putatively medicinal for elephants by local experts, this study provides a foundation for further research into the ways elephants interact with their environment for health-related purposes.

Today, the African elephant is classified as an endangered species by the International Union for Conservation of Nature (IUCN), noting that these animals face threats from habitat loss, poaching, and human-wildlife conflict. Therefore, a deeper understanding of elephant medication behaviors may not only illuminate their cognitive abilities and ecological intelligence but also reinforces the urgency of conserving their habitats. As habitat destruction may limit their access to critical medicinal resources, protecting these ecosystems is essential for both elephant welfare and broader biodiversity conservation.

Additionally, insights from elephant medication may also inspire new approaches to human medicine, offering potential leads for pharmaceutical research rooted in nature's own remedies. This underscores the interconnectedness of species and ecosystems, emphasizing that conserving elephants is not just about protecting a single species, but about preserving the delicate balance of the natural world. Recognizing the complexity of elephant healthcare behaviors and their deep environmental ties serves as a powerful reminder of the importance of safeguarding global biodiversity for future generations.

Data availability

All data analyzed during this study are included in this published article and its Supplementary Information files, including the non-edited interview transcriptions.

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Conceptualization: FS, EF, CP. Formal Investigation – Interviews: TOC, CP, RNK. Formal Investigation – Plant Collection and Taxonomic Identification: RNK. Formal Analysis – Data analysis: FS, KB, EF, RNK. Writing – Original Draft Preparation: FS, EF, KB, AJMC, CP, RNK. Writing – Review and Editing: FS, EF, AJMC, KB. Funding Acquisition: FS, LAG. Supervision: FS, CP, LAG, EN. Resources: LAG, EN, FS.

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Declarations

Competing interests

The authors declare no competing interests.

Ethical approval

Our study was exclusively observational and non-invasive, and it was conducted in accordance with the national and international regulations of the Nagoya Protocol and local district authorities. The research was approved by the National Commission for Science, Technology and Innovation of Kenya (Permit No. 123296).

Informed consent

Written informed consent was acquired from all interviewees, including permission to publish photographic material.

Additional information

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