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Ghana's herbal market

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ABSTRACT

Ethnopharmacological relevance: Medicinal plant markets not only provide a snapshot of a country's medicinal flora, they also reflect local health concerns and the importance of traditional medicine among its inhabitants. This study aimed to describe and quantify the Ghanaian market in herbal medicine, and the diversity of the species traded, in order to evaluate their economic value.

Materials and methods: Initial visual surveys on the markets were followed by a detailed quantitative survey of 27 stalls in August 2010. Market samples were processed into herbarium vouchers and when possible matched with fertile vouchers from the field.

Results: We encountered 244 medicinal plant products, representing 186–209 species. Fourteen species were sold at more than 25% of the market stalls. Seeds and fruits that doubled as spice and medicine (*Xylopia aethiopica*, *Monodora myristica*, *Aframomum melegueta*) were in highest demand, followed by the medicinal barks of *Khaya senegalensis* and *Pteleopsis suberosa*. Plants sold at the market were mostly used for women's health, in rituals, as aphrodisiacs and against sexually transmitted diseases. An estimated 951 tons of crude herbal medicine were sold at Ghana's herbal markets in 2010, with a total value of around US\$ 7.8 million. Between 20 and 30% of the Ghanaian medicinal flora was encountered during this survey. Roots were less dominant at the market than in dryer parts of Africa. Tons of *Griffonia simplicifolia* and *Voacanga africana* seeds and *Fadogia agrestis* bark are exported annually, but data on revenues are scanty. None of these species were sold on the domestic market.

Conclusion: Our quantitative market survey reveals that the trade in Ghanaian herbal medicine is of considerable economic importance. Regarding the specific demand, it seems that medicinal plants are used to complement or substitute Western medicine. Further research is needed on the ecological impact of medicinal plant extraction.

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1. Introduction

West Africa has a historically high human population density, concentrated settlements, and a history of well-developed long-distance trade. Medicinal plants are in high demand as trade goods, since their small size makes them easy to transport in countries with a defective transport system (Van der Geest and Reynolds Whyte, 1989). High levels of unemployment, rapid urbanization and low levels of formal education among rural to urban migrants are other reasons behind the increasing trade in herbal medicine in West Africa. This trade has a significant socio-economic importance as it allows millions of people, especially women, to generate

an income by plant collection and marketing (Cunningham, 2001; Sunderland and Ndoye, 2004; Williams, 2007).

Medicinal plant markets not only provide a snapshot of a country's medicinal flora, but they also reflect the concerns about health and illness and the importance of traditional medicine among its inhabitants. Between 60 and 95% of the Africans are said to depend on traditional medicine for their primary health care needs (Anyinam, 1995; WHO, 2000; Cunningham, 2001). There exists a general concern that the trade in herbal medicine threatens the wild populations of popular West African plant medicines (Cunningham, 1993; Blay, 2004; Ndam and Marcelin, 2004), which can in turn affect their availability for primary health care (Grifo and Rosenthal, 1997; Hamilton, 2004). Overexploitation is a growing problem for many West African medicinal species in areas where population growth, lack of access to western medicine, poverty, and growing markets fuel unsustainable harvesting practices (Osemeobo, 1992; Cunningham, 1993; Hamilton, 2004; Boon and Ahenkan, 2008). Market surveys remain indispensable for sound conservation and development planning. Learning which

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species are sold, their prices, and the volumes marketed are the first steps in identifying species with conservation or resource management priorities. Wild species that are sold frequently and in high quantities are at greater risk of overharvesting (Cunningham, 1993; Williams, 2007). On the other hand, Padoch (1992) argues that knowledge on the commercialization of plant products can also increase the value of forest products, stimulate conservation efforts and enhance the income of rural people.

The marketing of medicinal plants is an important, but neglected area of research. Reliable official statistics are often limited to export figures, while the bulk of the plant material is sold locally (Padoch, 1992). People who harvest or sell medicinal plants are generally self-employed and form part of a 'hidden economy', and thus remain unrecognized in government figures (Cunningham, 2001). As most transactions are only marginally legal and competition is high, vendors are reluctant to be questioned, and middlemen are notoriously difficult to interview (Padoch, 1992; Olowokudejo et al., 2008; Kadiri, 2009). Merchants of different ethnicities are present on the market, so products derived from a single botanical species may be sold under a variety of vernacular names (McMillen, 2008). Finally, when plants are sold in the form of roots, bark, wood or shredded leaves, botanical identification can be very difficult (Johnson & Johnson, 1976; McMillen, 2008; Mati and de Boer, 2010).

Few quantitative market surveys have been carried out in West Africa. The trade in herbal medicine has been studied in Benin (CENPREBAF, 1999; Vodouhê et al., 2008), Cameroon (Betti, 2002), Nigeria (Johnson and Johnson, 1976; Olowokudejo et al., 2008; Sonibare and Gbile, 2008; Kadiri, 2009), and Ghana (Falconer, 1994; Blay, 2004; Obiri and Addai, 2007). Although these researchers have interviewed vendors and listed (part of) the marketed species, none of them has estimated the frequency, volumes or value of the herbal medicine offered for sale, like it has been so thoroughly done for South Africa (Williams, 2007; Williams et al., 2005, 2007) and Tanzania (McMillen, 2008).

This paper presents the results of a quantitative market survey conducted in Ghana in 2010. With an economic growth of about 20% for 2011, Ghana was listed as the world's fastest growing economy (Economy Watch, 2011). The country has 24.7 million inhabitants, and its capital Accra, with an annual growth rate of 3.4%, is one of Africa's most populated and fastest-growing cities today (CIA, 2011). Almost half of Accra's residents are migrants: either from the countryside or from neighboring states. The country has three distinct ecological zones: closed canopy forest, a forest-savanna zone and dry savanna. As a result of population growth, logging and land clearing for cash crop agriculture, Ghana has lost one third of its forest cover between 1990 and 2010. The rain forest area in southern Ghana is now less than 25% of its original size (Repetto, 1990). Savanna trees are disappearing due to bush fires and the expansion of agricultural practices (Gyasi et al., 1995). At the same time, some 80% of the rural villagers in southern Ghana rely on wild plants as their main medicinal source (Falconer, 1994). Access to primary health care has a strong urban bias: the number of patients per public doctor varies between 6200 in Accra to 42,200 in remote rural areas (Van den Boom et al., 2008). As a rapidly urbanizing region with a high level of endemic plant taxa, and a population that heavily depends on herbal medicine, Cunningham (1993) has indicated Ghana has as a priority area for cooperative action between healthcare professionals and conservationists.

While the aim of the British colonial government was still to 'liquidate native practices of traditional medicine' (Twumasi and Warren, 1986), these practices were embraced as part of the national identity after independence in 1957 (Brown, 1995). From then onwards, Ghana's medicinal flora has been well documented (Irvine, 1961; Ayensu, 1978; Abbiw, 1990; Brown, 1995; Mshana et al., 2000; Asase et al., 2005). Much research has been devoted to traditional healers and their possible cooperation with

western-trained health personnel (e.g., Warren et al., 1982; Fink, 1990; Ventevogel, 1996). In 1974, the Center for Scientific Research into Plant Medicine was established to study the efficacy of local herbs, carry out domestication trials and serve as a traditional health clinic (www.csrpm.org, assessed 26 September 2011; Boon and Ahenkan, 2008). If Ghana wants to guarantee its residents their access to herbal medicine in the future, it needs to conserve the medicinal plants that are so critical for their health. However, before vulnerable species for conservation or management can be prioritized, it is necessary to know which species are sold and in what quantities. Apart from the domestic market in chewing sticks in Kumasi (Blay, 2004), an overview of forest products sold around Kumasi (Falconer, 1994) and the export of *Griffonia simplicifolia* and *Voacanga africana* seeds (Arthur, 2010; Gbewonyo, 2002), no quantitative figures exist on the export or domestic market of medicinal plants from Ghana.

Our main objectives were to describe and quantify the Ghanaian market in herbal medicine, and the diversity of the species traded, in order to evaluate their economic importance. Additionally, we would like to answer the following questions: Which species are in highest demand? What role do these plants play in local health care? What percentage of Ghana's medicinal flora is being commercialized? The outcomes of this market survey can be used to identify species most susceptible to overharvesting due to their high demand in the (inter-) national trade. Data on the conservation priorities for Ghanaian species in trade will be published elsewhere.

2. Materials and methods

2.1. Market survey

This study formed part of the research project "Plant Use of the Motherland: Linking Afro-Caribbean and West African Ethnobotany", carried out by the Netherlands Center for Biodiversity Naturalis, in collaboration with the University of Ghana. Fieldwork was conducted in Ghana from 21 June till 7 September 2010 (in the rainy season), during which we regularly visited the five largest markets in the capital Accra. We counted the number of market stalls on both quiet and busy days. From the first visit on, we bought fresh medicinal plants when they were available, processed them into herbarium vouchers and collected information on vernacular names, processing methods, uses and prices. Living rhizomes and bulbs were propagated to produce leaves, after which they were pressed and dried into herbarium vouchers. After becoming familiar with most of the commercial species, we conducted a systematic quantitative survey in August 2010 of in total 27 market stalls in the country's largest cities: Accra (pop. 3.9 million), Kumasi (pop. 1.6 million), and Tamale (pop. 390,730), and in Cape Coast (pop. 154,204), the 8th largest town (www.world-gazetteer.com, assessed 12 December 2011). Additionally, we surveyed a village market in Akoase (pop. ca. 3000), near Nkawkaw (see Fig. 1), an area where commercial extraction takes place.

Per stall, we counted all plant products offered for sale, the amount of sales units (bundles, bags, bottles or loose plant parts) per species, we observed whether material was sold fresh or dried, and estimated the volume of additional stock packed in bags behind the stalls. Additionally, we recorded the ethnicity and gender of the vendors and asked them to estimate their weekly sales of plant material and indicate species that were becoming expensive or increasingly difficult to obtain. Chewing sticks that were sold on medicinal plant stalls were included in our survey, but we excluded stalls selling only chewing sticks, since the marketing of this product was adequately described by Blay (2004). Unknown herbs and leafy twigs were purchased and pressed as herbarium specimens;



Fig. 1. Map of Ghana.

Source: www.mapsofworld.com.

pieces of wood, bark and root were numbered and dried as well. We weighed the sales units of all purchased plant parts (153 products, 63% of the total diversity), using a portable digital scale accurate to 1 g, for later conversion to a price/kg basis. For those 91 plant products that were not purchased (37%), we estimated their volumes by using the average weight for a bundle of herbs (105.4 g), piece of bark (45.2 g), wood (152.8 g) or a root (49.0 g). From these data, we calculated the volumes of plant material offered for sale per market stall, the percentage of stalls selling the individual species and subsequently estimated the total annual sales per market. The weighted average price/kg of herbal medicine was calculated by dividing the total volume recorded per species by the total volume at all sampled stalls, multiplying this figure by its price/kg and sum these figures for all species encountered during the quantitative survey. The above-mentioned methods were adapted from an earlier market survey in Suriname (Van Andel et al., 2007) and from the guidelines for ethnobotanical market inventories designed by Cunningham (2001).

As the market survey was part of a larger ethnobotanical project that also included interviews with rural plant collectors (Myren, 2011; Van Onselen, 2011), we tried to match the market products with fertile herbarium vouchers in the field. A complete set of voucher specimens, including wood, bark, seed and root specimens, was deposited at the Ghana Herbarium (GC) at Legon and at the Wageningen branch of the National Herbarium of the Netherlands (WAG) for taxonomic identification. Scientific and author names were checked for accuracy with the Plant List (www.theplantlist.org, assessed 26 September 2011). Medicinal products for which we could not collect sample material that allowed for identification (e.g., finely shredded leaves or roots), were 'identified' by matching their local names with literature (Irvine, 1961; Etkin, 1981; Mshana et al., 2000; Burkill, 2004; Blench and Dendo, 2007). Finally, we interviewed the director of a commercial processing company of herbal medicine to get an idea about the volumes of plant material used in the manufacture and export of pre-packed herbal medicine.

2.2. Sample selection and size

Since we depended on the vendors' willingness to participate, we could not draw a random sample of market stalls. We made a distinction between large herb stalls (that sold more than 1 m³ of herbs), small herb stalls (<1 m³) and spice stalls, selling only seeds and spices. After counting these stalls, we randomly asked vendors in each category whether they wanted to participate in our survey. Stalls were only surveyed after we had clearly explained the purpose of our research (sometimes with the help of a Twi-speaking translator) and the vendors had agreed to participate. Depending on their stock size and the amount of samples purchased, the vendors received between US\$ 10 and US\$ 15 for their participation. People that refused to participate gave the following reasons: no time, stall owner not present, not able to speak English or Twi, not interested. As their wares were displayed in full view of the researchers, we did not observe differences in stall size or products between them and vendors that did agree to participate in this survey. Therefore, we are confident that the participants' stalls and wares sufficiently represent the herbal stands found in the Ghanaian markets at the time of our survey.

Similar to Williams et al. (2005), we produced a species-accumulation curve to ensure an adequate sampling effort, with the number of plant products and species recorded as a function of the amount of market stalls sampled (Fig. 2). After sampling 27 stalls, we found 94% (230 out of 244) of the total plant products and 95% of the existing botanical variation (199 out of 209 species, including ethnospecies). Plant mixtures were excluded from this calculation. Although our sample represented less than 5% of the

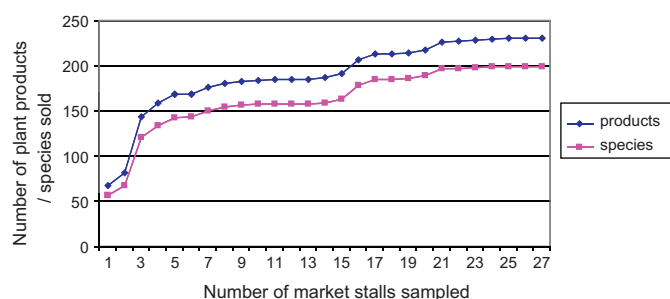


Fig. 2. Cumulative number of medicinal plant products and species sold on the 27 stalls sampled.

total number of medicine stalls, our survey covered a high proportion of the total floristic and product diversity on the market. The fact that our accumulation curves level off almost completely suggests that our sample size was adequate to give a representative overview of the diversity of herbal medicine sold on the Ghanaian market in 2010.

3. Results

3.1. Market characteristics

Accra has five markets where substantial amounts of medicinal plants are sold: Timber, Nima, Makola, Art Center and Kaneshie. Timber market is the main place to buy fetish animals, while Nima is the commercial area for Muslim migrants from the north that live in the capital. Makola and Kaneshie are the main places to buy kitchenware. Art Center, located behind the country's largest craft market, doubles as a bulking centre for (inter-) national trade. Large bags of fresh bark are trucked in from the countryside, opened and left to dry in the sun. Kejetia market in Kumasi is said to be the largest open-air market in West Africa and has some 10,000 traders spread over 12 ha. Using the market classification of Skinner (1964), all markets in our survey were regional (covering a large area, supporting several market places), except for the intermediate markets of Salaga market and Cape Coast, which fell in between the flow of goods downward for local use and upwards to regional markets, and the small village market of Akoase, which was an end point for imported items and starting point for agricultural produce to larger cities (Table 1). The only herbal medicine vendor at Akoase bought her goods in Kumasi, even though all her stock was available in the forest and fields surrounding her village. Despite the fact that some smaller cities and many smaller herb stalls spread over the large cities have been left out of our survey, we are confident that we have covered the main medicinal plant markets of Ghana.

Women dominate the trade in herbal medicine in Ghana, even at 'Muslim markets' like Nima, Salaga and Tamale. The few male vendors we observed were specialized in fetish animals or in pre-packed wood and bark chips used to compose aphrodisiacs. Fifteen percent of the vendors we interviewed were men. Herb sellers came from different ethnic backgrounds, often resulting in a variety of local names for products of the same species. Several Beninese Fon vendors were selling herbal medicine in Accra, but the main ethnicities on the markets were Akan and Hausa, the latter being traders of the Sahel zone. Traditional healers purchased their goods at the market or sent their clients with shopping lists. Vendors also advised and acted as traditional healers, although they did not identify themselves as such.



Fig. 3. Herbal medicine stall at Timber market, Accra. Picture by Christiaan van der Hoeven.

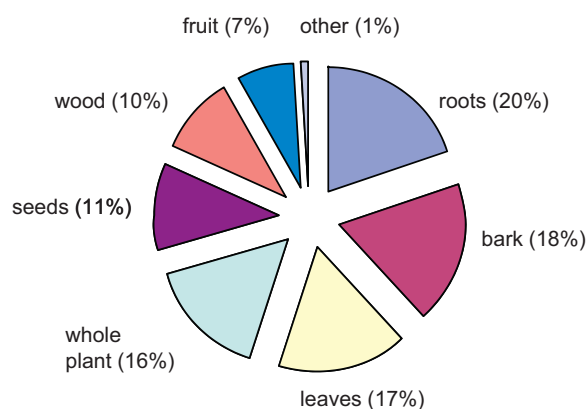
3.2. Floristic diversity

Markets stalls could generally be divided into large ones, selling substantial amounts of herbs, barks, roots, pottery and animal products (Fig. 3), small ones selling less than 1 m³ of plants, and spice stalls, specialized in a few seeds (*Monodora myristica*, *Piper guineensis* and *Xylopia aethiopica*) used both as spice and medicine (Table 1). In total, we recorded 244 medicinal products belonging to a single

plant species, of which 206 could be identified to species level, 13 only to genus level and two only to family level (see Appendix). Another 23 products, mostly bark and roots, could not be identified to family level due to insufficient sample material, but are considered as 'ethnospecies' (McMillen, 2008). We made vouchers from 107 market species, and collected another 45 vouchers with more representative characters (leaves, flowers) in the field to match the market samples. The total number of plant species encountered

Table 1
Characteristics of markets studied in Ghana, July–August 2010.

Market (city)	Market type ^a	Main products	Frequency	Herb stalls > 1 m ³	Herb stalls < 1 m ³	Spice stalls	No. stalls sampled [%]	No. of medicinal plant products sold [%] ^b	Total daily stock (kg)
Timber (Accra)	Regional	Wood, herbs, ironware, animal/fetish	Every day except Sunday	24–40	5	0	4 [9–14%]	138 [66%]	4767–7886
Nima (Accra)	Regional	Vegetables, fish, textile, grains, meat, herbs, spices	Every day Wednesday peak day	16–65	7–35	37–211	9 [3–15%]	60 [29%]	5782–31,203
Makola (Accra)	Regional	Food, meat household products	Every day	10	43	0	1 [2%]	14 [7%]	1438
Kaneshie (Accra)	Regional	Food, clothes, textile household products	Every day	2	2	81	4 [5%]	51 [24%]	2997
Art Center (Accra)	Regional	Tourist crafts, textile, barks	Every day	17	0	0	2 [12%]	33 [16%]	23,630
Salaga (Accra)	Intermediate Regional	Fish, meat, herbs	6 days/week	9	0	0	0 [0%]	No data	No data
Kejetia (Kumasi)	Regional	Food, shoes, clothes, fetish, household and 2nd hand goods	Every day	71	34	72	5 [3%]	83 [40%]	15,919
Central market (Tamale)	Regional	Food, textile, animal/fetish	Every day	9	0	10	1 [11%]	7 [3%]	944
Central market (Cape Coast)	Intermediate	Food, fish	Every day	0	4	0	1 [25%]	12 [6%]	17
Market (Akoase)	Standard	Household products, clothes, food	Wednesday only	0	1	0	1 [100%]	7 [3%]	0.9
Total				158–223	96–124	200–374	27 [4–6%]	244 [100%]	55,495–84,035

^a Classification of Skinner (1964).^b Percentage of the total number of species (n = 209) encountered before and during the quantitative survey.**Fig. 4.** Plant parts sold on the Ghana market as percentage of the total number of species (n = 209).

during our market survey lies between 186 and 209 species. The number of products is much higher than the number of individual species, as some trees (e.g., *Morinda lucida*) yielded several different medicinal parts (leaves, bark, wood and roots) that were sold separately. Of some species several different cultivars were marketed, such as the variously shaped dry fruits of the bottle gourd (*Lagenaria siceraria*).

Apart from products derived from a single species, several medicinal mixtures were offered for sale. These varied from 'kebiwi' (Twi), bullet-shaped lumps of finely ground and pressed medicinal leaf mixtures, to hollowed-out palm seeds filled with charred plant remains used to rub into skin incisions. 'Bitters' were also popular: bottles with several types of chipped bark, roots and wood, to be soaked in alcohol and drunk as an aphrodisiac, against stomach ache or piles. Most herb stalls also sold a variety of animal parts (hides, skulls, claws, dried birds, living and dried chameleons), as well as minerals (sulfur, clay, and potash) and earthenware pots for offerings. The highest floristic diversity was found on Accra's Timber market (66% of the total number of species), followed by Kejetia (40%) and Nima market (29%). The most diverse family on the market was the Fabaceae (28 species), followed by Euphorbiaceae and Apocynaceae (each 10 spp.), Malvaceae (9), Annonaceae (8), Asteraceae (7), Meliaceae (6) and Rutaceae, Rubiaceae, Poaceae, and Cucurbitaceae (each with 5 spp.). Most species were represented on the market by their roots (Fig. 4), closely followed by bark, leaves or the entire plant.

3.3. Frequency, prices and volumes

Species that were in high demand were generally present on many markets stands. Table 2 lists the species with the highest frequency (sold by more than 25% of the vendors), together with their total volume on the 27 sampled stalls and main uses. Folded bark strips of the small savanna tree *Pteleopsis suberosa* were the most frequently sold medicinal product, present on almost half of the stalls (Table 2).

Plants that were seen frequently on the market were often also sold in large quantities, but this was not always the case. Species that were sold in the greatest bulk are listed in Table 3. Again, species that function both as spice and medicine were sold massively (e.g., *Xylopia aethiopica*, *Monodora myristica*, *Aframomum melegueta*, *Piper guineense*), but bark and wood of primary rainforest trees like *Pericopsis elata* and *Daniela ogea* were also commercialized in large quantities. The shredded roots of *Securidaca longipedunculata*, a shrub from the Northern Volta region, were said to become increasingly scarce and expensive.

Table 2
Most frequently sold species at the Ghanaian markets in 2010.

Species	Frequency [%]	Total volume on 27 stalls [kg]	Main uses	Domestication
<i>Pteleopsis suberosa</i>	44	49.5	Clean uterus, STDs	Wild
<i>Xylopia aethiopica</i>	41	186.8	Laxative, ritual, spice	Wild and cultivated
<i>Monodora myristica</i>	37	45.2	Spice, induce menstruation	Wild and cultivated
<i>Khaya senegalensis</i>	37	88.0	Blood tonic, aphrodisiac, fever	Wild and cultivated
<i>Okoubaka aubrevillei</i>	37	14.5	Ritual, convulsions, prevent miscarriage	Wild
<i>Aframomum melegueta</i>	33	4.1	Ritual, aphrodisiac, spice	Domesticated
<i>Sorghum bicolor</i>	30	15.0	Strengthen pregnant women, anemia	Domesticated
<i>Afrotyrax lepidophyllus</i>	30	3.4	Convulsions	Wild
<i>Morinda lucida</i>	26	74.3	Aphrodisiac, puerperal fever, phlegms, malaria	Wild and cultivated
<i>Momordica charantia</i>	26	11.40	Ritual, fever, measles, abortion	Wild
<i>Sphenocentrum jollyanum</i>	26	10.10	Aphrodisiac	Wild
<i>Mucuna sloanei</i>	26	6.50	Ritual	Wild
<i>Strophanthus hispidus</i>	26	5.9	STDs, fever during pregnancy, body pain	Wild
<i>Ocimum americanum</i>	26	3.61	Ritual	Cultivated

Table 3
Species sold in the greatest bulk, summed for all Ghanaian markets.

Species	Daily market stock (kg) ^a	Domestication	Growth form	Product	Main uses
<i>Xylopia aethiopica</i>	19,936	Wild and cultivated	Tree	Fruit	Laxative, ritual, spice
<i>Monodora myristica</i>	10,497	Wild and cultivated	Tree	Seed	Spice, induce menstruation
<i>Aframomum melegueta</i>	1959	Domesticated	Herb	Seed	Ritual, aphrodisiac, spice
<i>Khaya senegalensis</i>	788	Wild and cultivated	Tree	Bark	Blood tonic, aphrodisiac, fever
<i>Pteleopsis suberosa</i>	719	Wild	Tree	Bark	Clean uterus, STDs
<i>Pericopsis elata</i>	638	Wild	Tree	Wood	Ritual
<i>Piper guineense</i>	625	Wild	Liana	Seed	Spice, asthma, convulsions
<i>Caesalpinia bonduc</i>	601	Cultivated	Liana	Seed	Skin rash (baby)
<i>Zanthoxylum zanthoxyloides</i>	574	Wild	Tree	Root	Strengthen pregnant women, aphrodisiac
<i>Daniela ogea</i>	565	Wild	Tree	Bark, resin	Ritual
<i>Securidaca longipedunculata</i>	561	Wild	Shrub	Root	Aphrodisiac, phlegms
<i>Morinda lucida</i>	541	Wild and cultivated	Tree	Wood, root	Aphrodisiac, puerperal fever
<i>Dichrostachys cinerea</i>	538	Wild	Shrub	Wood, root	Headache, STDs, anticonception
<i>Vitellaria paradoxa</i>	450	Wild and cultivated	Tree	Seed (fat)	Skin boils, cosmetics, baby care
<i>Rauvolfia vomitoria</i>	441	Wild	Tree	Root	Mental problems, aphrodisiac

^a On busy market days.

Although 30% of the botanical diversity was represented on the market in the form of roots (Fig. 4), the bulk of the plant material sold consisted of fruits and seeds (Fig. 5). This was caused by the large quantities of fruits of *Xylopia aethiopica* and seeds of *Monodora myristica*, *Aframomum melegueta* and *Piper guineense* that were commercialized.

We estimate the amount of herbal medicine offered for sale at all Ghanaian markets sampled together at 55,495 kg (on quiet days) to 84,035 kg (on busy days). The largest volumes were present on Wednesdays at Nima market (more than 30,000 kg of herbal medicine), followed by Art center, Kumasi and Timber market (Table 1). Much of the Nima stock, however, was represented by

products that double as medicine and spice (e.g., *Xylopia aethiopica*), so the largest volume of pure medicinal products was encountered at Art Center (almost 24,000 kg in stock, mostly bark). Since we only included the largest markets, left out several smaller cities and did not cover every single herb vendor in the Accra or Kumasi, the total amount of herbal medicine offered for sale in all Ghanaian cities together must be higher. For example, the red *Sorghum bicolor* stalks were sold on medicinal plant stalls as a remedy against anemia (and thus included in our survey), but they were also commercialized in large heaps (probably several m³) along the Nima road as a food colorant for the red rice-and-beans dish called 'wakye', Ghana's most popular breakfast. These outlets of *Sorghum* leaves were not included in our study.

The average bundle of fresh herbs weighed 105 g and was sold for ca. US\$ 0.38 (GH¢ 0.5); the average piece of root (49 g) or bark (45 g) had the same price, while the average piece of wood (153 g) was sold at US\$ 0.76. Prices/kg for individual taxa varied considerably (from US\$ 0.50/kg to almost US\$ 220/kg), and are listed per medicinal product in Appendix. The most expensive plant products were ritual items sold in very small volumes, such as the strings of seeds from *Operculina macrocarpa* or the unidentified seeds of TVA 6074 ('akukunini', Hausa). The strings (about 1 g each) were used by fetish priests to communicate with the spirits of twin children. Prices for such magic objects ranged from US\$ 34 to US\$ 219.7/kg. The same accounted for the magic seeds of *Antrocaryon micraster* (US\$ 51/kg) and *Mucuna sloanei* (US\$ 59/kg). Products that required labor-intensive processing methods were also expensive, like the small lumps of 'tum' (Twi), a red face paint made from finely shredded and pressed roots of *Baphia nitida* (US\$ 86.9/kg). Finally, products that were said to be rare or had to be transported from large distances were quite expensive, such as

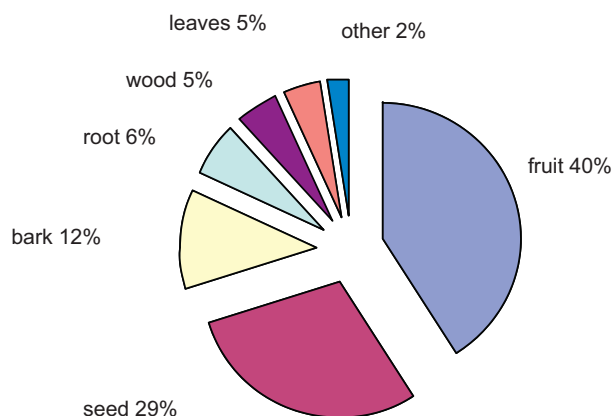


Fig. 5. Plant parts as percentage of the daily stock present on all Ghanaian markets sampled (stock packed in bags behind the stalls was excluded).

Securidaca longipedunculata roots (US\$ 47.8/kg) and fresh bulbs of *Gladiolus dalenii* ssp. *dalenii* (US\$ 167.2/kg).

The large herb stands in Accra and Kumasi, such as the one shown in Fig. 3, were selling between one and three large bags (of 15 kg each) per week, which coincided with a weekly revenue of US\$ 273. The bark stalls at Art Center sold some 20 rice bags/week; stalls with spices or *Parkia biglobosa* reported weekly sales of 14–36 kg. Most markets were open throughout the year, except for Christmas and some public holidays. Most vendors were working 50 weeks/year, so multiplying the mean number of stalls by their weekly sales, the annual volumes of herbal medicine (including spices) commercialized at Nima were the highest (ca. 292,000 kg/year), followed by Art Center (255,000 kg), Kejetia (195,600 kg), Kaneshie (149,550 kg) and Timber market (ca. 50,000 kg). We estimate the total volume of herbal medicine sold per year on all Ghanaian medicinal plant markets sampled at 951,000 kg/year. With a weighted average price of herbal medicine of US\$ 8.2/kg, this represents an annual value of US\$ 7.8 million.

3.4. Provenance of herbal medicine

Of the 244 different plant products, about 65% was sold dry and 35% fresh, the latter mostly herbs and some barks. The fresh herbs were common weeds (e.g., *Ageratum conyzoides*) or cultivated plants (e.g., *Celosia argentea*) that were collected or grown within the city boundaries, while the fresh barks were often those supplied in large quantities from the near interior without being dried properly. Vendors at Art Center used the extensive open spaces along the beach to dry their barks to enhance their shelf life. Our research took place in the wet season, so the percentage of fresh plants might be even lower during the dry season, although vendors did not mention this to us. Most people selling herbal medicine were full-time traders who bought their wares from wholesalers and did not gather herbs themselves. As a result, they were generally unaware of the source of the plant material. Vendors at Timber and Art Center said some of their bark came from Atobiase (a village near the large Kakum Forest Reserve north of Cape Coast), Akyem (the forested region between Koforidua and Nkawka), Mampong, Akuapim (south of Koforidua) and the Volta region (Fig. 1). One saleswoman said to us: “You don’t get the bark plenty as before. Everyday the harvesters increase the price, as the forest guards catch them”. This implies that some of the bark harvesting takes place in officially protected areas. Some species, however, were said to come from far and therefore sold for a higher price than plants from the vicinity of Accra or Kumasi. *Dicoma tomentosa*, *Uria picta*, *Pteleopus suberosa*, *Mondia whitei*, *Acacia nilotica* subsp. *adstringens* and *Securidaca longipedunculata* were said to be harvested from the northern savannas or imported from Niger or Burkina Faso. The rhizomes of *Cyperus rotundus*, *Kyllinga erecta* and *Curculigo pilosa* were said to be imported from Lagos, Nigeria, while the garlic-smelling bark of *Afrostryx lepidophyllus* was brought from Abidjan, Ivory Coast.

3.5. Export of herbal medicine

No official figures are made available by the Ghanaian government on the export of herbal medicine from the country. According to Arthur (2010), the two leading medicinal plant products of export value are the seeds of *Griffonia simplicifolia* and *Voacanga africana*. Gbewonyo (2002) reported that between 300 and 500 tons of *G. simplicifolia* seeds were exported from Ghana in 1998, mainly to Europe and China. In 2008, medicinal export earnings topped US\$ 15 million, 80% of which was derived from *Griffonia* and *Voacanga* exports, which accrued to over 30,000 wild collectors, 4480 tons of seeds, 500 agents and 45 exporters (Arthur, 2010). On the Internet, *Griffonia* seeds are commercialized as a natural product to

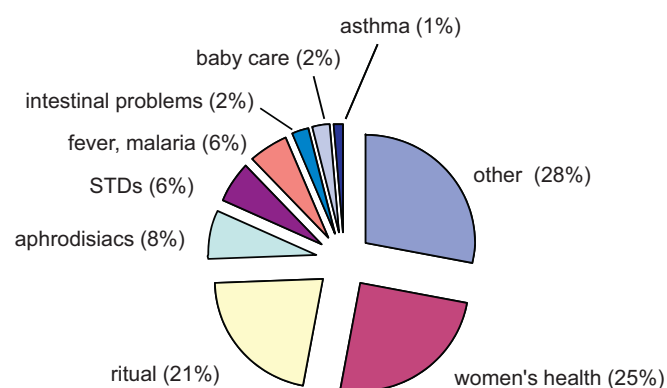


Fig. 6. Use percentages of medicinal plants traded at the Ghanaian domestic market.

overcome depression, obesity and insomnia, while *Voacanga* extracts are marketed for their hallucinogenic and aphrodisiacal properties. Neither *Griffonia* nor *Voacanga* seeds appeared on the medicinal plant stalls we surveyed in Ghana.

Corpus Herbal Medicine Company Ltd. (formerly Plant Medicine Ghana Ltd.) is a factory near Accra that processes plant parts into tea bags, capsules, creams and powders. The company's website (www.corpusherbalmedicines.com, assessed 6 October 2011) lists 287 plant species of which seeds, leaves, bark or roots can be ordered raw or powdered. About 32% (91 out of 287) of these species were also encountered during our market survey. Prof. Francis Kwabena Oppong-Boachie, director of Corpus, estimated that his company processed about 6000 kg raw plant material/year into pre-packed botanicals, sold on the domestic market. Another 4000 kg of bark (mostly *Fadogia agrestis* and *Khaya ivorensis*) was exported annually to the US, Ivory Coast, Nigeria and Burkina Faso. According to Mr. Oppong-Boachie, his US clients were interested to increase their import of *F. agrestis* bark to 1000 kg/month for the manufacture of aphrodisiac mixtures (Interview, 26 June 2010). Although Mr. Oppong-Boachie was convinced his company was the largest manufacturer and exporter of botanicals, there are many smaller enterprises exporting herbal medicine and traditional spices in Ghana. A search on the global trade website Alibaba (www.alibaba.com/countrysearch/GH/medicine-box-supplier.html, assessed 6 October 2011) resulted in 24 companies that supplied medicinal plant material to overseas clients. Abbiw (1990: 124) mentioned the export of *Marsdenia sylvestris*, *Ancistrocladus abbreviatus*, *Hunteria umbellata*, *Strophanthus gratus*, *Duparquetia orchidacea*, *Dennettia tripetala*, *Tabernaemontana psorocarpa*, *Justicia baronii*, *Centella asiatica*, *Gloriosa superba*, and *Calotropis procera*. Unfortunately, he did not reveal the source of his information. We were unable to confirm whether these species are still exported; none of them emerged from our domestic market survey.

3.6. Most salient health issues covered by the market

We recorded a total of 339 uses for the 244 medicinal plant products sold at the Ghanaian herbal market. The most salient application for these plants (calculated as use percentage) was women's health, which included plants for strengthening pregnant women, female infertility, abortion and puerperal fever (Fig. 6). The most frequently sold medicinal product, *Pteleopsis suberosa* bark, was used to cleanse the uterus. This is a popular treatment to improve fertility, prevent puerperal fever, and induce menstruation or abortion in the first weeks of pregnancy. Ritual uses, varying from luck charms to herbal baths against witchcraft, ranked second, followed by aphrodisiac ingredients (for men only) and plants to treat sexually transmitted diseases (STDs). Apparently,

for diseases linked to sexual and reproductive health and supernatural causes, people were inclined to use (or prefer?) herbal medicine. If we derive the most important plant uses from the volumes of herbal medicine traded (Table 3), spices are followed by women's health (e.g., *Monodora myristica*, *Zanthoxylum zanthoxyloides*), aphrodisiacs (*Khaya senegalensis*, *Aframomum melegueta*) and STDs (*P. suberosa*). The demand for ritual items, however, remained important among consumers, as substantial volumes of animal products were sold for magic purposes.

4. Discussion

4.1. Economic importance

From our quantitative market survey, we estimate that 951,000 kg of crude herbal medicine was sold per year at the Ghanaian city markets sampled in 2010. At least 6000 kg, purchased directly from middlemen operating in the interior, was processed into pre-packed botanicals for the domestic market. The chewing stick trade, with an estimated value of US\$ 203,000/year in the Ashanti region alone (Blay, 2004) should be added to these figures. With an annual value on the domestic market of almost US\$ 7.8 million (excluding chewing sticks and pre-packed herbal medicine) and an export value around US\$ 15 million, the economic importance of this trade for Ghana is evident. However, these figures are still small compared to Ghana's major export commodities. In the first nine months of 2009, the country exported 710,000 tons of cocoa, worth ca. US\$ 1 billion. In the same period, timber export earnings were estimated at US\$ 168.6 million (Mhango, 2010).

Apart from Falconer (1994), who counted 260 bags and 50 baskets of herbal medicine entering Kumasi by road in 1989, the only other quantitative studies on the volume and financial value of the medicinal plant trade in the continent have been undertaken in South Africa. Williams et al. (2007) estimated the mass of plants to be sold annually at the Faraday Street market in Johannesburg (164 traders) in 2001 between 491,000 and 1,342,000 kg, with a retail value of US\$ 0.16–US\$ 0.34 million. In the South African provinces of KwaZulu-Natal and the Eastern Cape, the annual trade was valued at ca. US\$ 10 million and US\$ 4.5 million, respectively, for 4000 and 525 tons of plant material (Dold and Cocks, 2002; Mander, 1998, cited in Williams et al., 2007). According to Williams et al. (2007), there existed an inverse and disproportionate relationship between the price per kilogram and mass of the medicinal products sold in South Africa. The smaller the quantity sold, the higher the price/kg. Our results showed a similar trend: heavy plant parts like the massive tubers of *Ipomoea pes-caprae* or the large fruits of *Kigelia africana* had the lowest price/kg (ca. US\$ 0.65/kg), while small ritual objects were the most expensive.

4.2. What percentage of the Ghanaian pharmacopoeia is commercialized?

The total amount of African plant species with medicinal uses was estimated between 5400 (Neuwinger, 2000) and 5917 (Schmelzer and Gurib-Fakim, 2008). No publications exist that cover the entire medicinal flora of Ghana. Irvine reported medicinal uses for 757 woody plants, 91 of which (49%) we have encountered at the market. Abbiw (1990) recorded 587 useful species, of which 57 (31%) appeared in our market survey, while 20% (114 out of 582) of the herbs and trees listed by Mshana et al. (2000) overlapped with our findings. From the results of our market survey, it appears that only a fraction of Ghana's medicinal flora is being commercialized. We may, however, have missed some species. Markets in the northern part of the country might sell more savanna plants, but as far as we know, no surveys have been carried out in that

area. Obiri and Addai (2007) encountered 84 medicinal species on the Kumasi market, but listed only 36, of which 22 (61%) were also found by us. The lack of reliable, quantitative information on the trade in West African herbal medicine makes it difficult to put our data into perspective. With 186 to 209 commercial species, the floristic diversity on the Ghanaian herbal market is substantial, but lower than in Tanga, Tanzania (251 spp., McMillen, 2008), and Johannesburg, South Africa (470–595 spp., Williams et al., 2005, 2007).

4.3. Is Africa the root continent?

In the New World, herbal medicine is mostly sold in the form of leaves of entire herbs (Bye and Linares, 1983; Macía et al., 2005; Van Andel et al., 2007). In East and Southern Africa, bark and roots seem to dominate the medicinal plant markets, accounting for up to 50% of the plant products sold (Cunningham, 1997; Williams, 2007; McMillen, 2008). Our market survey revealed that while 20% of the floristic diversity of the Ghanaian herbal market was represented by roots, bulbs or rhizomes, just 6% of the daily volume offered for sale consisted of underground plant organs. In Abidjan (Ivory Coast), leaves represented the bulk of the species diversity on the market (Cunningham, 1997), much more than in the much drier Accra region (17%). This trend could be explained by local climate conditions: in the humid West African forest zone, leaves are abundant year round, while in dryer regions, such as East and South Africa and the Dahomey Gap (which stretches from Accra to Western Nigeria), people rely more on roots, seeds and bark. The latter have a longer shelf-life, and can be transported over longer distances without perishing. McMillen (2008) argues, however, that Tanzanians use many leaves and herbs in self-medication, but since these plants are found abundantly around consumer's homes, there is little commercial demand for them, compared to roots and bark of trees collected from remote forested areas. Besides, traditional healers often work with powdered medicine, which is easier made from dried material than from fresh leaves.

4.4. Problems with identifying market samples

In a country like Suriname, where fresh (and often flowering) herbs and twigs are the main commercial products and nearly all vendors harvest their own merchandise, identifying market samples is relatively easy (Van Andel et al., 2007). At African markets, where roots, bark and wood are much more common, and most vendors buy their (dried or chipped up) wares from middlemen, plant identification is much more cumbersome. Products need to be matched with good voucher specimens collected in the source areas, preferably in the presence of the harvesters themselves. Unfortunately, market chains are complex, and products are transported over long distances, which makes this matching quite difficult. Even when medicinal uses are mentioned on herbarium labels (in most cases they are not), the used part (root or bark) is hardly ever included in the collection. Even in the renowned wood collection of the NCB Naturalis, bark samples are a rarity. Future research should include molecular techniques, such as DNA barcoding, to allow for the identification of roots, barks, shredded or powdered material. Ethnobotanists that make herbarium vouchers of medicinal plants in the field should make an effort to collect the medicinal product (bark, root, and seed) as well.

4.5. Herbs to complement or substitute Western medicine?

The rationale given for many studies on African herbal medicine is that a large percentage of the population depends on plants for their primary health care needs. Although in rural Ghana this is certainly the case, residents of Accra and Kumasi have much better

access to modern health care (Van den Boom et al., 2008). The specific demand for herbal medicine among urban Ghanaians, as quantified in our results, seems to indicate that people are looking for plants to deal with cultural-bound health issues (e.g., witchcraft, aphrodisiacs) or to treat certain physical illnesses in a culturally more appropriate way. Many Ghanaians believe that ailments like convulsion, STDs, and infertility are caused by supernatural forces, so they prefer to treat them with herbs or visit a traditional healer (who buys his medicine at a fetish market) instead of consulting a clinic (Myren, 2011; Ventevogel, 1996). The importance of plants used for women's health suggests that either the available medicinal services are not adequate or that they do not meet the patient's specific demands (e.g., strengthen pregnant women, regulate menstruation, enhance fertility, abortion). Our market survey reflects local beliefs on health and illness that should be taken into account by medical organizations in their designs of culturally appropriate health care programs.

4.6. What we do not know

The outcomes of this study can be used to identify species most susceptible to overharvesting due to their high demand in the domestic and international trade. However, more data are needed to the domestication status of the commercialized material. What percentage of the spices comes from cultivated sources and how much is harvested from the wild? Understanding the complex trade networks is a key to appointing the major source areas in the Ghanaian interior. There are indications that many primary rainforest species (e.g., *Entandrophragma angolense* and *Daniela ogea*) are harvested from officially protected areas, but no first-hand data are available. Eleven tree species encountered in our market survey are listed as 'vulnerable' on the IUCN red list of threatened species for Ghana (www.iucnredlist.org, assessed 13 December 2011). The wood of one of these vulnerable species, *Pericopsis elata*, was even sold in great quantities (Table 3). We do not know, however, whether these trees are felled or damaged in the field to harvest their bark or wood or whether these products are collected in sawmills as a by-product of the timber industry. Species indicated as scarce by vendors and harvesters (e.g., *Securidaca longipedunculata* and *Okoubaka aubrevillei*) have not yet been the subject of population studies.

While international trade often has a greater 'visibility' than the domestic market through export figures, this is not the case for Ghana. Many small companies export herbal medicine, but little is known about their marketed volume or value. Urbanization tends to increase rather than reduce the demand for wild plant resources, resulting in a commercial trade that stimulates overexploitation (Cunningham, 2001). With the current urbanization and deforestation figures, there is a great need for further research on the effect of commercial extraction on Ghana's medicinal plant resources. Together with quantitative information on the trade, these studies can form the basis for setting conservation priorities for the Ghanaian medicinal flora.

5. Conclusions

The trade in herbal medicine is of considerable economic importance to Ghana. An estimated 951 tons of crude herbal medicine are sold annually at the herbal markets sampled in this study, with a total value of around US\$ 7.8 million. At least another 6 tons are processed into pre-packed botanicals for the domestic market. Accra, and to a lesser extent Kumasi, is the centre of this trade. Fourteen species were sold at more than 25% of the market stalls. Seeds and fruits used as spice and medicine are in highest demand (*Xylopia aethiopica*, *Monodora myristica*, *Aframomum melegueta*), followed

by medicinal barks of *Khaya senegalensis* and *Pteleopsis suberosa*. There are strong indications (but few reliable figures) that tons of herbal medicines are exported from Ghana, mainly to Europe, China and the US, with an annual value of around US\$ 15 million. The main commercial products are seeds of *Griffonia simplicifolia* and *Voacanga africana* and bark of *Fadogia agrestis*. Few of the exported species appear at the domestic market.

Less than half (probably between 20 and 30%) of the Ghanaian medicinal flora was observed at the market. Plants sold at the market are mostly used for women's health, in rituals, as aphrodisiacs and against sexually transmitted diseases. Regarding the specific demand, it seems that urban Ghanaians use medicinal plants to complement or substitute Western medicine rather than for primary health care purposes. Eleven species encountered during this survey were listed as vulnerable by the IUCN. Given the high demand for herbal medicine and the current rates of deforestation, there is an urgent need to study the ecological impact of the commercial medicinal plant extraction in Ghana.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.jep.2012.01.028](https://doi.org/10.1016/j.jep.2012.01.028).

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