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An ethnobotanical survey of plants used for the treatment and management of cancer in Embu County, Kenya

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Abstract

Documentation of anticancer plants is not exhaustive in Kenya. The current study therefore was carried out to identify the plants used for treatment and management of cancer in Embu County. This is part of the mapping requirements of the laws of Kenya to promote complementary medicine. Analytical cross-sectional ethnobotanical study was conducted in Embu County, sixteen key informants were recruited and provided information about the names of plants, the parts of plant and methods of preparation of the medicines used to manage cancer. The plants were collected from their natural habitat and identified. Nine plants were recorded to manage cancers of the breast, prostate and throat. *Fagaropsis angolensis*, *Hydnora abyssinica* and *Indigofera swaziensis* were recorded for management of cancer for the first time in this study. It was concluded that traditional medical practitioners of Embu County use plant extracts to manage and treat cancers of the breast, prostate and throat.

Keywords: Ethnobotany, indigenous plants, Kenya, traditional knowledge, traditional medical practitioners

Introduction

There is great interest on traditional medicine systems for search of drugs meant to treat incurable illnesses, which include cancer, diabetes, arthritis, evil eyes, asthma and HIV/AIDS (Gupta *et al.*, 2014; Harish *et al.*, 2012) [24, 25]. The use of medicinal plants for such illnesses has become popular in developed countries. However, the documentation of anticancer plants remain unexhaustive due to poor description of cancer in traditional medicine and also incompetent intellectual property rights protection associated with cultural heritage (Cragg & Newman, 2004) [15]. The facts that plants like *Catharanthus roseus*, *Taxus brevifolia*, *Podophyllum peltatum*, *Camptotheca acuminata*, *Cephalotaxus harringtonia* and *Bleekeria vitiensis* have had significant contribution to the development of clinical anticancer drug (Harris, 2003) [26]. There is still need for continuous research on anticancer agents of natural origin with an intention of discovering potent, affordable and safe anticancer compounds.

While there are over 500 000 plants worldwide, in Kenya there are about 2000 plant species of higher plants and approximately 1,200 species have been identified to be used in primary health care (Misonge *et al.*, 2016) [51]. Over sixty-five species of the Kenya medicinal plant species have folkloric use in the treatment and management of cancer (Ochwang'i *et al.*, 2014) [61]. However, about 60% of these plants have demonstrated evidence of use scientifically (Tariq *et al.*, 2017) [79]. Many studies related to the documentation of medicinal plants in Kenya with anticancer activities (Ochwang'i *et al.*, 2014) [61]. The objective of this study was to document medicinal plants used by traditional medicine practitioners in Embu County. The findings from this study form a basis for further pharmacological and phytochemical studies on these plants to provide correct information about their use in management of cancer in Kenya.

Materials and Methods

Study design and site

Analytical cross-sectional ethnobotanical study was conducted in the four constituencies of Embu County, Manyatta, Runyenjes, Mbeere North and Mbeere South (Figure. 1). The county is situated approximately between latitude 0° 8' and 0° 50' South and longitude 37° 3' and 37° 9'

East. It is characterized by highlands, lowlands and slopes from North-West towards East and South-East with a few isolated hills such as Kiambere and Kiangombe. It rises from about 515 m above sea level at the River Tana Basin in the East to 5,199 m at the top of Mount Kenya in the North West.

The Southern part of the county is covered by Mwea plains which rise northwards, ending in hills and valleys to the Northern and Eastern parts of the county (County Government of Embu, 2013)^[14].



Fig 1: Map of Embu county administrative units (ECIDP, 2013)

Documentation of ethnobotanical information

A guided reconnaissance was conducted between August 2017 to map out the key informant herbalists that were used to provide data for this study. The actual study was carried out between December 2017 to September 2018. A total of 16 key informants were recruited (four from each constituency) for the study with the assistance of the chairperson of the association of herbalists and the administrative officers in the Ministry of Gender, Sports, Culture and Social Service. The key informants were sampled purposively and data was collected using community participatory appraisal method. A workshop of sixteen key informants was held at Embu social hall where interviews, questionnaires, face to face consultations techniques were used to document names of plants used to manage cancer, the parts of plant used and methods of preparation of the medicines. Later on, the key informants were visited at their clinics for informal discussions, participant observations and confirmation of the information gathered during the interviews.

Collection of plant specimens and identifications

The anticancer plants were identified and harvested from their

wild habitat where they grew naturally with the assistance of herbalists. A taxonomist from East African Herbarium assisted in the collection, identified and authentication of the plant samples. Voucher specimens were prepared in duplicate and deposited at the East African Herbarium at the National Museums of Kenya and the duplicates were deposited at Mount Kenya University Herbarium at the school of pharmacy.

Ethical clearance

Permission to carry out the study was sought from relevant authorities including the minister for culture and social services in Embu County, Kenya National Council of Science and Technology (NACOSTI), Mount Kenya University (MKU) and Kenya Medical Research Institute (KEMRI) Ethical Clearance and Review Committee (ECRC).

Data analysis

Ethnobotanical data was analyzed by computation of the ratio of a number of times a given plant species was mentioned as anticancer medicine to the total number of the traditional medicine practitioners who were interviewed in the

study. The ratio is known as familiarity index (F_i) and calculated using the formula:

$$F_i = \frac{N_a}{N_b} \times 100 \quad (\text{Tabuti, et al., 2004; Tabuti, et al., 2010})^{[77, 78]}$$

Where N_a was the number of traditional medicine practitioners who mentioned the plant as being used for treatment of cancer while N_b was the total number of traditional medicine practitioners who were interviewed (16).

Results and Discussion

Ethnobotanical documentation of anticancer plants

Nine plants, each from a different family were reported by traditional medicine practitioners for the treatment and management of cancer (Table 1). It was reported in this study that the plants were responsible for treating or managing breast, prostate or throat cancers. Eight of the plants were reported for the treatment and management of breast cancer. Namely, *Fagaropsis angolensis* stem bark, *Hydnora*

abyssinica rhizome, *Launaea cornuta* aerial parts, *Vitex keniensis* leaves, *Maytenus obscura* root, *Flueggea virosa* root, *Grewia villosa* root and *Prunus africana* stem bark. On the other hand, *Fagaropsis angolensis* stem bark, *Hydnora abyssinica* rhizome and *Prunus africana* stem bark were found to manage both prostate cancer and breast cancer either as combined or even as single plant preparations. *Indigofera swaziensis* root was recorded to treat and manage throat cancer.

Fagaropsis angolensis, *Hydnora abyssinica* and *Prunus africana* had the highest familiarity index, indicating that these plants were most popularly used by traditional medicine practitioners in Embu County. While *Prunus africana* bark has been listed by other researchers for the treatment of prostate and breast (Ochwang'i et al., 2014)^[61], The use of decoctions from *Fagaropsis angolensis* bark and *Hydnora abyssinica* rhizome were recorded for the management of both breast and prostate cancer was recorded for the first time in this study.

Table 1: Plants used for management of cancer collected from Embu County

Family	Scientific name of plant, synonym, local name in Embu dialect	Life form	Voucher number	GPS of collection site and elevation (Locality)	Type of cancer treated	Part used and method of preparation and administration	Familiarity index
Euphorbiaceae	<i>Flueggea virosa</i> (Willd.) Voigt (Mukuru)	Shrub	JMO-1-2017	0 31.545S; 037 27.112E (1410 m) at Embu Cultural Centre	Breast cancer	The roots are boiled and decoction drunk	67
Tiliaceae	<i>Grewia villosa</i> Willd. (Mubuu)	Shrub	JMO-2-2017	*NR	Breast cancer	The roots are boiled and decoction drunk	56
Celastraceae	<i>Maytenus obscura</i> (A. Rich.) Cuf. (Muraga)	Shrub	JMO-3-2017	*NR	Breast cancer	The roots are boiled and decoction drunk	44
Rutaceae	<i>Fagaropsis angolensis</i> (Engl.) Dale (Mukuria Hungu)	Tree	JMO-3-2015	0 31.545S; 037 27.112E (1410 m) at Embu Cultural Centre	Breast and prostate cancers	The stem bark is boiled and decoction drunk	100
Rosaceae	<i>Prunus africana</i> Hook. F. (Mwiria)	Tree	JMO-3-2014	*NR	Breast and prostate cancers	The stem bark is boiled and the decoction drunk with soup	100
Hydnoraceae	<i>Hydnora abyssinica</i> Schwein f. (Synonym: <i>H. johannis</i> Becc. Nouv. And <i>H. solmsiana</i> Dinter.) (Ndonga or Mutumurathi)	Herb	JMO-2-2014	0 27.670S; 037 46.814E (854 m) at Kangai, Ishihara	Breast and prostate cancers	The whole rhizome is boiled and the decoction drunk with soup	100
Verbenaceae	<i>Vitex doniana</i> Sweet (Mubiru)	Tree	JMO-4-2017	*NR	Breast cancer	Leaves are boiled and the decoction is drunk	50
Papilionaceae	<i>Indigofera swaziensis</i> Bolus (Unknown)	Shrub	JMO-5-2017	0 28.975S; 037 25.750E (152 m) at Gatunduri Village in Embu	Throat cancer	Roots are boiled and the decoction is drunk	6
Asteraceae	<i>Launaea cornuta</i> (Hochst. ex Oliv. & Hiern) C. Jeffrey (Muthunga)	Herb	JMO-1-2014	0 28.977S; 037 25.750E (1521 m) at Gatunduri Village, Embu	Breast cancer	Aerial parts (leaves and stems) are boiled and the vapor inhaled	63

*NR, Not recorded

Table 2: Cross-reference of plants used for management of cancer collected from Embu County with published literature

Botanical name	Ethnomedicinal uses	Biological activity and chemical constituents
<i>Flueggea virosa</i>	Root decoction drunk is used to heal breast and prostate cancers, pneumonia, liver and kidney problems, testicular inflammation, frigidity, sterility, menorrhagia, rheumatism, arthritis, epilepsy, convulsions, mental diseases, uterine and rectal prolapse, infectious diseases including tuberculosis, venereal diseases, urinary tract infections, dysentery, intestinal helminthiasis, malaria, ear aches, HIV related infections, lactation disorders and also is used as a contraceptive during sexual intercourse. Dried root powder is applied to snake-bitten part as an antidote and to enhance general wound healing. Decoction of the leaves are used as the root in addition to treating conjunctivitis, headaches, jaundice, fever, oedema, diabetes, vertigo, sickle cell anaemia and coughs. The fruits treat snake bites, lactation and parturition disorders (Kareru et al. 2007; Maroyi, 2011; Renu et al. 2018; Tabuti, 2007; Tabuti, 2008) ^[37, 49, 67, 75, 76]	Cytotoxicity, antimicrobial, antioxidant, antidiabetic, aphrodisiac, laxative, analgesic, anti-inflammatory, antimalarial, anti-HIV, anti-Hepatitis C, antiarrhythmic, antidiarrheal, sedative activities (Renu et al. 2018; Tabuti, 2008) ^[67, 76] and trypanocidal activities (Nyasse et al. 2004) ^[60] . Chemical composition includes alkaloids, isocoumarins, steroids and phenolics (Renu et al. 2018) ^[67] .

<i>Grewia villosa</i>	A concoction of roots is used as part of mixtures for treatment of syphilis, tuberculosis, smallpox, dysentery (Dev <i>et al.</i> 2017) [16]. Roots decoction is used for management of breast prostate gland cancers (Kareru <i>et al.</i> , 2007; Musa <i>et al.</i> , 2011) [37, 55]. Stem bark infusion is used to treat boils, abscesses and swellings (Teklehaymanot and Giday, 2010) [80]. Fruits are eaten to suppress appetite in obese patients and also by lactating mothers to improve their health and lactating abilities (Elhassan and Yagi, 2010; Pare <i>et al.</i> 2016; Sati and Fatima, 2018) [17, 66, 70].	Anticancer, antioxidant, antibacterial and analgesic activities. Triterpenes, steroids, flavones, glycosides, lignanes, phenolics, alkaloids and lactones (Bashir <i>et al.</i> 1987, 1982; Bashir <i>et al.</i> 1982; Goyal, 2012) [8, 9, 22].
<i>Maytenus obscura</i>	Root and leaf decoction is used for management of breast prostate gland cancers (Chhabra <i>et al.</i> , 1991; Kareru <i>et al.</i> 2007; Kokwaro, 2009) [13, 37, 43].	Anti-inflammatory, antinociceptive (Alajmi and Alam, 2014; Maina <i>et al.</i> , 2015) [2, 47].
<i>Fagaropsis angolensis</i>	Leave and root decoction used to treat back-ache and joint-aches, malaria, male sterility and cancer (Jeruto <i>et al.</i> , 2011; Jeruto <i>et al.</i> , 2010; Kareru <i>et al.</i> , 2007; Lemmens, 2008; Njoroge and Bussmann, 2006) [31, 32, 37, 46, 12]. Seeds are also chewed for malaria (Asnake <i>et al.</i> , 2016) [4]. The bark is used for human chest and gut ailments including pneumonia, amoebiasis and diarrhoea (Kuglerova <i>et al.</i> , 2011; Shiracko <i>et al.</i> , 2016) [45, 72]. It is an important plant in veterinary medicine also, the leaves are useful for treating diarrhea and wounds in cattle, bark infusion treats bovine pleuropneumonia, babesiosis and anaplasmosis in cattle (Eshete <i>et al.</i> 2016; Fenetahun and Eshetu, 2017; Gradé <i>et al.</i> 2009; Kuglerova <i>et al.</i> 2011) [18, 19, 23, 45].	<i>In vitro</i> antimicrobial and antioxidant (Kimutai <i>et al.</i> , 2016; Kuglerova <i>et al.</i> , 2011) [41, 45]. larvicidal (Mudalungu <i>et al.</i> 2013) [53], Antiplasmodial and cytotoxic (Kirira <i>et al.</i> , 2006) [42], anticancer activities (Onyancha <i>et al.</i> , 2018) [64]. Alkaloids and limonoids (Khalid and Waterman, 1985; Waterman and Khalid, 1991) [39, 86], fatty acids and essential oils (Mudalungu, 2013) [54].
<i>Prunus africana</i>	Bark decoction is used for treating fevers, constipation meal allergy, gonorrhoea, stomach pain (Glover <i>et al.</i> , 1966; Kokwaro, 2009) [21, 43]. On the other hand, bark and leave decoctions are used for managing inflammatory conditions, kidney disease, urinary tract complaints, prostate cancer, malaria, wound dressing and appetite stimulation (Gachathi, 2007; Kokwaro, 2009) [20, 43].	Phytosterols (Bassi <i>et al.</i> 1987) [10]. Pentacyclic triterpenes, Ferulic esters, fatty acids and phenols (Awang, 1997; Bombardelli and Morazzoni, 1997; Komakech <i>et al.</i> 2017) [5, 11, 44]. Anti-prostate cancer activity (Shenouda <i>et al.</i> 2007) [71] and antimicrobial activities (Mwitari <i>et al.</i> 2013) [57].
<i>Hydnora abyssinica</i>	Infusions and decoctions of the rhizome is used to treat evil eyes, cholera, sore throat, oral thrush, amoebic dysentery, diarrhea, stomachache, pneumonia, typhoid, East coast fever, anthrax, cancer, and wounds (Ibrahim, <i>et al.</i> , 1998; Musa <i>et al.</i> , 2011; Ndwigah <i>et al.</i> , 2014; Ruffo, 2002; Wanzala <i>et al.</i> , 2016) [29, 55, 58, 68, 85]. It is also useful in management of female conditions like retained afterbirth, postpartum haemorrhage, uterine problems and breast cancer (Gachathi, 2007; Kaingu <i>et al.</i> , 2011; Kamau <i>et al.</i> , 2016; Kokwaro, 2009) [20, 33, 34, 43].	<i>In vitro</i> antimicrobial, antioxidant (Ayoub, 2014; Ndwigah <i>et al.</i> 2014; Onyancha <i>et al.</i> , 2015; Saadabi and Ayoub, 2009; Yagi <i>et al.</i> 2012) [6, 58, 63, 69, 87]. <i>In vitro</i> anticancer activities (Onyancha <i>et al.</i> , 2018; Waleed <i>et al.</i> , 2009) [64, 82]. Catechin, trans 3'-5'-dihydroxy-4'-7 dimethyl dihydroflavonol, myristic acid, palmitic acid, oleic acid, vanillin, protocatechuic acid, and stigmasterol, tetradecanoic acid, tyrosol, circilio and benzoic acid (Koko <i>et al.</i> , 2015; Waleed <i>et al.</i> , 2009; Yagi <i>et al.</i> , 2012) [82, 87].
<i>Vitex doniana</i>	Leaves are used for management of breast prostate gland cancers and fruits of are used to supplement vitamins in human (Kareru <i>et al.</i> 2007; Sofowora, 1996) [37, 74]. Stem bark decoction used in management of dysentery, rheumatism, hypertension, inflammatory disorders, postpartum bleeding, conjunctivitis, whooping cough, epilepsy, leprosy, sterility. It is also used as a stimulant (Ibui, 2007; Sofowora, 1996) [30, 74]. Roots and leaves treat epilepsy, nausea and colics while twigs are useful for tooth hygiene (Sifuma, 2011) [73]. Root decoction treat back ache in women and also as anti-snake venom (Aniama <i>et al.</i> , 2016; Sifuma, 2011) [3, 73], raw fruits used as anti-obese remedies (Pare <i>et al.</i> , 2016) [66].	Anti-inflammatory, anticonvulsant, antipyretic (Tijjani <i>et al.</i> , 2017) [81], antimicrobial (Onyema <i>et al.</i> , 2015) [65], antioxidant, antihypertensive, anti-trypanocidal, antifertility, hepatoprotective, antidiarrheal activities (Sifuma, 2011) [73]. Triterpenoids (Mohammed <i>et al.</i> , 2016), steroids (Tijjani <i>et al.</i> , 2017) [81].
<i>Indigofera swaziensis</i>	Root is used as toothbrush for dental hygiene (Bussmann <i>et al.</i> , 2006) [12]. Root decoction is used as a stimulant, aphrodisiac in men, therapy for rheumatism and bone pain (Agroforestry World Centre, 2018; Kokwaro, 2009; Mitsuo, 1987) [1, 43, 52]. The root and whole plant is also used in the management of malaria, worms, body aches and weaknesses (Ibui, 2007) [30].	Cytotoxic activity (Hostettmann <i>et al.</i> , 2000) [28].
<i>Laumaea cornuta</i>	Infusion of whole plant is used for management of ear pain, Chronic joint pain, throat cancer, prostate cancer, breast cancer, chronic wounds, impotence, sexually transmitted diseases, HIV/AIDS and diabetes (Kareru <i>et al.</i> , 2007; Kayombo, 2016; Kigen <i>et al.</i> , 2014; Maregesi and Mwakalukwa, 2015; Wambugu <i>et al.</i> , 2011) [37, 38, 40, 48, 84]. Decoction of leaves, is also used for treatment of measles, gonorrhoea, ascariasis and coccidiosis. Roots are used to cure tooth ache, stomachache, typhoid, fever, epilepsy, swollen testicles and warts (Gachathi, 2007; Herdberg <i>et al.</i> , 1982; Kokwaro, 2009) [20, 27, 43].	Alkaloid, fatty acids, fatty acid derivatives, Phytosterols, coumarin, Pentacyclic triterpenoid (Karau <i>et al.</i> , 2014) [35]. <i>In vitro</i> antimicrobial activities (Ogoti <i>et al.</i> , 2015), Cytotoxicity against brine shrimp and <i>in vivo</i> antimalarial activity (Misonge <i>et al.</i> , 2015; Musila <i>et al.</i> , 2013) [50, 56], hypoglycaemic activity and safety studies (Karau <i>et al.</i> , 2014) [35]. <i>In vitro</i> anticancer activities (Onyancha <i>et al.</i> , 2018) [64].

Conclusion and Recommendation

It was concluded that the traditional medicine practitioners in Embu County use plants in their efforts to treat and manage cancer cases. The cancers of the breast, prostate and throat

were the types of cancers that were reported to be treated by traditional medicine practitioners in Embu County. The researchers recommended evaluation of anticancer activities and phytochemical composition of *Fagaropsis angolensis*,

Hydnora abyssinica, *Launaea cornuta* and *Indigofera swaziensis*.

Author's Contribution

The conception of the study was done by Onyancha and Gikonyo. Ethnobotanical documentation was carried out by Onyancha, all authors designed the work and Onyancha wrote the manuscript which was read and primarily reviewed and corrected by all researchers.

Declaration of conflict of interest

The researchers declare that there are no competing interests in this published work

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