

Ethnobotanical Study of Plants Used in Control of Ectoparasites in Murang'a County, Kenya

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Abstract: Herbal medicine has been practiced in the world since ancient times, yet limited research data has been documented on their use in Murang'a County, Kenya. The aim of this study was to identify different herbs of medicinal value in Murang'a County, their uses, and effect on ectoparasites with emphasis on fleas and jiggers control. A cross-sectional study was carried out using a questionnaire and a total of 28 herbalists were interviewed. The herbalists identified 122 herbs which were used for the treatment of various illnesses and ectoparasites. A total of 18 plants were used to control jiggers and fleas and *Solanum campylacanthum* was the most commonly used plant. Despite the common use of *Solanum campylacanthum* in the control of jiggers and fleas, there is still a high burden of jiggers in Murang'a County and hence there is a need to evaluate other plants, which grow in large numbers in the County where their use have been documented in other areas. In this study *Tithonia diversifolia* and *Senna didymobotyra* were studied. The two plants were found to be moderately safe with LD₅₀ of above 2000 mg/kg.

Keywords: Herbal medicines, control, pests and jiggers.

Date of Submission: 10-07-2018

Date of acceptance: 27-07-2018

I. Introduction

Plants have been used by human beings for maintenance of life and as sources of shelter, clothing, food, and medicine for man and livestock. Studies on medicinal use of plants by different communities in various cultural set-ups are reliable sources of knowledge for sustainable use and conservation of plants. WHO (1993) stipulated guidelines on the conservation of medicinal plants and documentation is an impressive key to providing basis for decision making and policy design on conservation of the plants. Like the rest of the world, various communities in Kenya have encouraged ethno-pharmacological documentation.

Fleas are the most predominant ectoparasites of domesticated animals and pets especially dogs and cats throughout the world [1]. They feed on blood by sucking through the skin of their hosts and these pests are not restricted to animals only.

Jigger (*Tunga penetrans*) is a small flea that inhabits sandy beaches and soil and is commonly found in human dwellings. According to the Ministry of Health [2], an estimated 1.4million Kenyans or 4% of the population was infested by jiggers. Jigger infestation cause morbidity and inability of victims to work and leads to low productivity and is a burden to both economy and families. A study carried out in Murarandia area of Murang'a County indicated that there was a significant reduction in agricultural productivity when people infested by jiggers were used as labourers, as compared to labourers who were free of jigger infestation [3]. Another study carried out among primary school pupils in Murang'a County revealed that the prevalence of jigger infestation was as high as 21.5% across all age-groups, with the most common method of control being mechanical removal of jiggers using sharp objects [4]. This not only creates a multiplicity of risks in terms of spread of other infectious diseases amongst the population, but also increases chances of infection through broken skin and may lead to painful and septic wounds, eventually limiting the victims' mobility. This therefore calls for alternative methods of treating and preventing jigger and flea infestation.

The Kenyan Ministry of Health in its National Policy Guidelines for Prevention Control of Jiggers [2] acknowledges that use of chemicals such as pyrethrins and pyrethroids, organophosphates, carbamates, and fumigants to control jiggers exhibit varying levels of efficacy, and safety to humans, environment and non-target organisms such as pets. In addition, usage of chemical control requires technical understanding of usage, precautions and disposal of empty containers, which is a challenge to semi-literate and illiterate household heads. Availability and accessibility of the chemical compounds and implementation therefore is very challenging.

In addition, common control of jiggers using potassium permanganate and hydrogen peroxide which are used commonly is not sustainable. These popular chemicals lack sufficient supportive research on efficacy and safety of their supply may not be guaranteed. Potassium permanganate is listed by the United States and the International Narcotics Control Board as a controlled precursor chemical used in the production of cocaine. More Countries are doing extensive monitoring of supply of these chemical and this lead to their unavailability for control of jiggers. Murang'a County is ranked among the Counties which are worst hit by the jigger menace, together with Kiambu, Kilifi, Nyeri, Kwale, Baringo, Busia, Kakamega, Siaya, and Marsabit Counties. Jigger infestation is associated with low socio-economic status amongst the fifteen affected Counties. The children and the elderly are among the worst affected by jiggers, with infestations occurring in Schools, homes and other Public places. Kenya has over 1.8million children affected by Jiggers. Over 10% of the children with the jigger infestation drop out of school, and they are unable to concentrate in education and work due to feet infestation. There is also a decreased agricultural productivity of infested adults and loss of social capital due to stigma associated with this problem. The major contributor of the stigma is the lack of the political will to fight the menace by the politicians. Among projects identified by the Murang'a County Government in the Strategic Planning for 2013-2017 was public participation in establishing a treatment Centre for Jiggers

The naming of plants has been documented in Central region of Kenya [5]. Gachathi developed a guide to plant names, their uses and cultural values in the Kikuyu community. The current study was conducted in order to document medicinal plants used to control fleas and jiggers in Murang'a County.

II. Materials And Methods

Study design

A cross-sectional survey using semi structured questionnaires was carried out in order to study the herbal medicines used by traditional medicine practitioners in order to manage jiggers, fleas and ticks, as well as other disease conditions in Murang'a County

Study Area

The study was carried out in Murang'a County, which lies in Central region of Kenya. Murang'a County occupies a total area of 2,558.8 Km² of which 11.2 km² is a water mass and the remaining land of 2,135km² is arable. The County lies between 914m above the sea level in the East and 3,353 m above the sea level along the slopes of Aberdare ranges in the West. The County lies between latitudes 0⁰ 34' South 1⁰ 7' South and longitudes 36⁰ East and 37⁰ 27' East. Long rain falls between March and May, with April recording the highest rainfall and short rains are received in October and November.

The County had a total population 936,228 persons who consist of 451,751 males and 484,477 females, and a growth rate of 0.4 % per annum as reported in 2009 Census. The rate of unemployment in the County was about 17.67%, which translates to 93,241 persons, while 36.3 % of the County population lives in abject poverty. A total of 40% of the population live in stone/brick walled houses, 24.3% mud and wood houses and 2.19% live in grass, straw and tin walled houses. Most of the houses in the County are roofed with corrugated iron sheets (94.38%); while makuti and grass roofed houses constitute 0.18%. Most of the houses (60.04%) have earth floor.

Plant collection and Identification

Selection and recruitment of herbalists

A reconnaissance study was done in January 2016 and thereafter it was followed by actual studies between May and December 2016. Simple sampling of the herbalists that were recognized by the Ministry of culture and social services in Murang'a County was done. Herbalists who were willing to participate in the study were recruited and interviewed using a semi structured questionnaire.

Ethno-botanical Study

A total of twenty-eight herbalists were interviewed in consultative meetings which were held at Maragua Jua Kali herbalists' social hall. Field collection of plant specimens was done with the help of the herbalists and voucher specimens were prepared, and authenticated by a Botanist from the East Africa herbarium, of the National Museum of Kenya where they were deposited. The data collected included the respondents' demographics, names of plants and the parts of the plants used, methods of preparation and administration of the extracts.

Analysis of data

The data collected was analyzed descriptively using Student's t-test, R version 3.4.3 and presented using tables and familiarity indices. Familiarity index was used as an indicator of popularity of a plant species and was determined using a method reported previously [7].

III. Results

Demographic data of the herbalists

Demographic data of 28 herbalists is given below. Majority of the herbalists (86%) are males, and majority (89.3%) were married, 7.1% are divorced and 3.6% are widowed. Majority of herbalists (50%) had attained Primary level of education, 32.1% Secondary level and only 17.9% had Post-Secondary level of education. All the herbalists in the study are religious, majority (89.3%) being Protestants, and (7.1%) being Catholics. Majority (64.3%) of the herbalists treated humans only and 25% of herbalists treated animals as well. The demographic data of the herbalists is shown in Tables 1.

Table 1: Demographic data of Murang'a herbalists

Variables		No of herbalists	Percentage
Age	31-40	2	7.1
	41-50	3	10.7
	51-60	5	17.9
	61-70	10	35.7
	71-80	6	21.4
	81-90	2	7.1
Gender	Males	24	86
	Females	4	14
Occupation	Full time herbalists	9	33.3
	Farmers	17	63.0
	Employed	1	3.7
Source of knowledge	Hereditary	12	42.9
	Observation	8	28.6
	Seminars and internet	11	39.3
Level of Education	Primary school	14	50
	Secondary school	9	32.1
	Post-secondary	5	17.9
Religion	Catholics	2	7.1
	Protestants	25	89.3
	Other religions	1	3.6
Marital status	Married	25	89.3
	Divorced	2	7.1
	Widowed	1	3.6

NB: N=28

Monthly workload, sources of clients, feedback methods and nature of practice of the herbalists are given in Table 2.

Table 2: A Summary of the Murang'a herbalists' activities

Variables		No of herbalists	Percentage
Monthly workload	Less 10 clients	7	25
	Between 10 and 20	14	50
	More than 20	7	25
Source of clients	Inter-herbalist referral	7	26.9
	Market day promotions	11	42.3
	Hospitals	8	30.8
Clients reason for visit	Failure of hospital drugs	20	71.4
	Side of hospital medicines	3	10.7
	Cost of hospital medicine	2	7.1
	Other reasons	3	10.8
Clients feedback	Patients come for review	13	46.4
	Patients not coming	10	35.7

Nature of practice	back			
	Patients	laboratory	2	7.1
	results			
	Other feedbacks		3	10.8
	Treats humans only		21	75
	Treats human and animals		7	25

NB: N=28

Medicinal plants use

A summary of medicinal plants used in Murang'a County is given in Tables 8.

Table 8: Plants used for the management of jiggers and fleas in Murang'a County

Botanical names	Types of plants	Part of plants used	Familiarity Index	Other major medicinal use of the plants
<i>Solanum campylancanthum</i> ^{a,b}	Shrub	Fruits, roots	0.75	Colds, stomachache and treatment of anthrax in sheep [5]
<i>Vernonia lasiopos</i>	Shrub	Leaves, stems	0.11	Antitrypanosomal, antihelmintic, venereal and skin diseases, [5],[6],[7]aphrodisiac
<i>Caesalpinia volkensii</i> ^b	Climber / Liana	Leaves, seeds	0.14	Antibioterial, antifungal,pesticidal, malaria, venereal diseases, aphrodisiac[5,8]
<i>Azadirachta indica</i> ^{a,b}	Tree	Leaves	0.29	Antifungal, antimalarial, analgesic, antiviral, antibacterial, antipyretic, hypoglycaemic, contraceptive, antitumor, anthelmintic [9]
<i>Tagetes minuta</i> ^{a,b,c}	Herb	Leaves	0.21	Antifungal, antibacterial, allopathic and insecticide[8]
<i>Aloe vera</i> ^{a,b}	Shrub	Stems, and leaves	0.11	Laxative, anti-malaria, ECF in animals,[5],[8],[11] antioxidant,antimicrobial,immunomoderator,hypoglycemic, wounds[10]
<i>Nicotiana tabacum</i> ^{b,c}	Shrub	Leaves		Hypoglycemic, antifungal, antibacterial, insecticidal [11]
<i>Senna didymobotrya</i> ^{a,b}	Shrub	Leaves, roots	0.14	Antimicrobial, antifungal, pesticide [12]
<i>Trichilia emetica</i> ^a	Tree	Flowers	0.04	Stomachache , leprosy, pneumonia,[5,8]
<i>Albizia antihelminthica</i> ^b	Tree	Leaves	0.04	antioxidant, antihelminic, Anti-inflammatory, analgesic.[13]
<i>Tithonia diversifolia</i>	Shrub	Leaves	0.32	Analgesic, anti-inflammatory, anti-malarial, antiviral , antiplasmodic, hypogycemic, antimicrobial, cancer chemopreventive, biopesticide[14]
<i>Dicrostachys cineria</i>	Shrub	Leaves , stem and barks	0.04	
<i>Xanthoxylum gillettii</i> ^a	Tree	Barks of stem and roots	0.04	Antimicrobial, cytotoxic and analgesic, antiplasmosis in cattle, coughs and cold [5],[15]
<i>Solanum aculeastrum</i> ^{a,b}	Shrub	Leaf Berries Roots.	0.07	Bronchitis, gonorrhoea, antioxidant, antibacterial, [8,16]
<i>Jacaranda mimosifolia</i>	Tree	Barks of stems-Leaf.	0.04	Venereal diseases,Molluscicidal,tripanocidal, hypoglycemic, anti-inflammatory, immuno-stimulant, anti-snake venom, anti-cancer [17],[18]
<i>Jatropha curcas</i>	Shrub	leaves and stalk	0.04	Analgesic, Antibacterial, antioxidant, antifungal, antiinflammatory[18]

Key: a (Jiggers), **b** (fleas)

III. Discussion

The findings of the study show that males 89.3%dominates the practice of herbal medicine. The findings are similar to those reported [20]. Majority (82.9%) of the herbalists are above50 years. These findings concur with a study done in Lebanon [21], and unlike the findings of the study [20] in which 66 % of herbalists were younger and were aged between 26 and 45 years. The findings also show that majority of the herbalists are semi-literate, with 17.9% having tertiary level education, 32.1% Secondary level and 50% with primary school

level of education. The findings are in agreement with results [21]. Majority (89.3%) of the herbalists are married, and are mainly (64.3%) part time herbal practitioners. Most of the herbalists (89.1 %) were Protestants and were either peasant farmers or retirees.

The main source of herbal medicine knowledge is hereditary as 42.9% of herbalists acquired their knowledge from their grandparents, parents or elder relatives, 28.6% of the herbalists learned practice by observing other experienced herbalists while 39.3% of the herbalists searched the internet in order to get the knowledge. Majority (42.9%) of the herbalists attended between 10 and 20 clients per month, while only 28% of the herbalists attended more than 20 clients which is not in line with other findings [22]. The major source of herbalists' clients was from promotions on market days which attracted 39.3% of the patients, who were eager to have their problems solved especially when the herbalists were available to attend them as they went about their usual daily activities. Patients' self-referral from the hospitals constituted 28.6%, of a group of patients who have lost hope due to their low socioeconomic status, making conventional medicine out of reach, had advanced stages of diseases or had chronic illnesses which they thought modern medicine was taking too long to cure, and hoped herbalists would offer a quicker and safer options which is in line with earlier [23] findings. The inter-herbalists referrals made up 25% of the clients being attended.

The herbalists used one plant to treat more than one condition, and used a combination of many plants to treat a specific condition. In most cases, liquid preparations were obtained by boiling the plants in water and the findings are in line with findings of [20]. The findings have shown that there is a high risk of completely losing the practice of herbal medicine, as majority of practitioners are aged, and are not documenting their work due to their low levels of literacy. The younger generation who are educated and well versed with technology need to be inspired in to Ethno Pharmacology, in order to promote integration of herbal medicine with modern science, medicine and technology, leading to more research and documentation, encouraging more young people to practice herbal medicine openly as well as raising the societal confidence in seeking herbal treatment.

Modernization of the herbal medicine would increase the practitioners' income, and also make practice a full time job, since many modern citizens will embrace it. This can lead to the conservation of biodiversity as it can be a source of raw materials for medicines. Better research and with integration of modern science will encourage well educated persons to take up the practice with better understanding of science behind it, human Physiology, Biochemistry, and diseases conditions, as well as effects of the herbal medicine on the human body and possible interactions with the conventional drugs. The Science and Technology will also encourage gender equity in the practice.

Fleas host many vector- borne pathogens and their diseases [24]. Among the many diseases causing bacteria hosted by fleas is *Yersinia pestis* which causes plague in man. Fleas and ticks have economical and health effects on humans. Both Human (*P. irritans*) and cat (*C. felis*) fleas are associated with plague transmission from human to human, and *C. felis* is also associated with the outbreaks of diseases for example fatal pneumonic plague in northwest Uganda [24]. There is a need to reduce the risks of diseases transmissions, as well as economic losses associated with fleas in domestic animals. *Tunga penetrans* fleas are associated with secondary bacterial infections lesions in the body. The Pathogenic bacteria which have been isolated from *tungiasis* lesions includes *Clostridium tetani*, *Streptococcus pyogenes*, *Staphylococcus aureus*, *Klebsiella aerogenes*, *Enterobacter agglomerans*, *Escherichia coli* as well as other enterobacteriaceae [24].

Jiggers continue to be a menace in Murang'a County, since it affects people of low socio-economic status. The ethno-medical plants in this area are growing freely on roadsides and on the uncultivated land. The medicinal plants are a possible solution for the poor to kill these parasites using the available medicinal plants. A total of 144 plants were collected from the area of study, 16 of which were mentioned by different herbalists as having been used for fleas, jiggers or ticks. There were no toxic effects reported following use of the plants in humans. *Azadirachta indica* was one of the plants used by the herbalists in the region. The plant however is not readily available in most areas of the County.

IV. Conclusions

More studies need to be conducted on the specific plants mentioned in the study and also on *Tithonia diversifolia* which is used in Kakamega region for the anti-parasitic activity especially for jiggers and fleas. There are many plants which are used by herbalists in Murang'a County to treat various ailments and parasites. There is need to do more research in order to facilitate their use.

Conflict Of Interest

The authors declare that there are no conflicts of interest.

Acknowledgements

The authors are grateful to the Murang'a County Director of social services for inviting the registered herbalists to the first meeting and also for demystifying the research objectives to them. We thank all the 28 herbalists for their positive response and willingness to assist in preservation of their herbal knowledge for posterity. We acknowledge Mr. Jared Onyancha and Mr. Mathias Mbale for identifying the plants. We also thank Murang'a County Commissioner for allowing us to conduct this study in the County.

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IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS) is UGC approved Journal with Sl. No. 5012, Journal no. 49063.

Githinji, J. M "Ethnobotanical Study Of Plants Used In The Management Of Diseases And Pests In Murang'a County, Kenya." IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS) 13.4 (2018): 56-62.