

1 **Diversity, Ethnobotanical potential and sustainability assessment of plants**
2 **used by traditional healers to treat human cancer in Boyo Division, North-**
3 **West Region, Cameroon**

4 **Abstract**

5 **Aims:** Cancer is the leading cause of death in developing countries. Therefore, the
6 knowledge on medicinal plants used to cure human cancer could be of great importance for
7 their widespread use and scientific validation. The present study records information on
8 anticancer plants in Boyo Division, in the western highland of Cameroon.

9 **Methods:** Thirty traditional healers, were interviewed to document their know-how on the
10 type of human cancer cured, the plant species used as well as their use pattern. Guided field
11 walks were made to the collection sites for plant and its habitat characterization as well as
12 herbarium voucher collection. Ethnobotanical quantitative tools were used to analyze and
13 summarize collected data. Sustainability of harvest was assessed using a vulnerability index
14 based on seven parameters.

15 **Results:** A total of 25 medicinal plants cited were identified as belonging to 13 families and
16 23 genera. The most represented families were Asteraceae (28%), Lamiaceae (16%),
17 Fabaceae (12%) and Acanthaceae (8%). Out of the seven categories of cancer diseases
18 reported, the highest number of plants species were reported to treat stomach, pancreas,
19 liver, skin and breast cancers, with informant consensus factor (ICF) ranging from 0.79 to
20 0.82. Leaves (60%) and bark (20%) were the major plant parts used mostly in form of
21 decoction (45.45%) and concoction (38.18%). The result of Relative frequency citations
22 (RFCs) revealed that 9 of the 25 plants species cited were the most frequently used with
23 fidelity levels ranging from 92% (*Geniosporum rotundifolium* and *Ocimum* sp *Aframomum* sp.
24 and *Entada abyssinica*) to 100% (*Coleus* sp, *Ocimum gratissimum*, *Eremomastax speciosa*,
25 and *Dichrocephala integrifolia*). Six species were assessed as vulnerable ($V_i \geq 2$), while two

26 species were rated as highly vulnerable namely *G. rotundifolium* ($V_i = 2.71$) and *E.*
27 *abyssinica* ($V_i = 2.85$).

28 **Conclusion:** New anticancer plants were identified in the present study, some of which were
29 already vulnerable for exploitation in their actual habitat. Plants with high ICF, RFCs and FL
30 values should be subjected to further phytochemical and pharmacological investigations for
31 scientific validation while those with high Vulnerability index should be recommended for
32 participatory domestication by the main users.

33 **Keywords:** *anticancer medicinal plants, Cameroon, ethnobotany, human cancer categories,*
34 *medicinal uses, pharmaceutical forms, vulnerability assessment.*

35 Introduction

36 Cancer is the third leading cause of death worldwide, only preceded by cardiovascular
37 disease, infections and parasitic disease [1]. It is the second leading cause of death in developed
38 countries and is one of the three leading causes of death for adults in developing countries. There are
39 over 200 different types of cancer but four cancers: lung cancer, breast cancer, prostate cancer and
40 large bowel cancer account for more than half of all cases [2]. Of the 12.4 million new cancer cases in
41 2008, the most common cancers in terms of incidence were lung (1.52 million), breast (1.29 million)
42 and colorectal (1.15 million) [3]. The International Agency for Research on Cancer estimates of the
43 incidence of mortality and prevalence from major types of cancer, at national level, for 184 countries of
44 the world revealed that there were 14.1 million new cancer cases, 8.2 million cancer deaths, and 32.6
45 million people living with cancer (within 5 years of diagnosis) in 2012 worldwide [4]. By 2030, it is
46 projected that there will be 26 million new cancer cases and 17 million cancer deaths per year [5]. The
47 types of cancer vary around the world and there is significant variation in the risk of different cancers
48 by geographic area. Most of this global variation is due to exposure to known or suspected risk factors
49 related to lifestyle or environment and provides a clear challenge to prevention. In developed
50 countries, many cancer cases are attributable to an unhealthy diet and inactive lifestyle such as
51 smoking and obesity. Although a third of all cancer deaths are linked to cigarette smoking, obesity is
52 associated with colon, breast, uterine, oesophageal and kidney cancer [3, 6]. However, some cancers
53 are caused by biological carcinogens such as infections by viruses (hepatitis B/C and liver cancer and

54 human *Papillomavirus* (HPV) and cervical cancer), bacteria (*Helicobacter pylori* and gastric cancer)
55 and parasites (*Schistosomiasis* and bladder cancer). In addition, excessive alcohol consumption is
56 associated with several cancer types, including head and neck, oesophageal, throat, liver and breast
57 cancer [3, 6]. Cancer may be uncontrollable and incurable, and may occur at any time at any age in
58 any part of the body. It is caused by a complex, poorly understood interplay of genetic and
59 environmental factors. A large number of chemopreventive agents are used to cure various cancers,
60 but they produce side effects that prevent their extensive usage. Although more than 1500 anticancer
61 drugs are in active development with over 500 of the drugs under clinical trials, there is an urgent need
62 to develop much effective and less toxic drugs, for which the plant kingdom could play an important
63 role [7]. In recent years, the use of traditional medicine information on plant research has received
64 considerable interest. According to the world Health Organization (WHO), about three quarters of the
65 world's population currently use herbs and other forms of traditional medicines to treat diseases [8, 9].
66 It has been reported that 60% of the commercially available anticancer drugs are from natural sources.
67 Treatment by herbal medicines may have some advantages over treatment by single purified
68 chemicals [10]; as herbal medicine are a cocktail of metabolites with therapeutic or preventive
69 properties, and so might be more active than single products alone. Moreover, plant products for
70 cancer treatment could be available, affordable, and relatively cheap with little or no side effects [11,
71 12, 13, 14]. In spite of pharmacological progress, urban and rural populations of Cameroon still
72 depend on medicinal plants for their primary health and many plants species had already been
73 reported for the treatment of various ailments including cancer [15, 16]. The country is known to be
74 rich for its plant diversity, culture, language and tradition which contribute to the multiplicity of
75 practices. However, these practices remain poorly documented and less accessible for modern
76 research. Hence, the search for alternative anticancer drugs of plant origin in the country requires a
77 basic ethnobotanical survey in different localities to document diverse knowledge owned by different
78 ethnic groups. Only few workers [17, 18], have conducted ethnobotanical survey in some parts of
79 North-West Cameroon. Therefore, very limited ethnobotanical literature is available in the region.
80 Although various ethnobotanical surveys have been conducted in different parts of Cameroon [15, 19,
81 20, 21, 22, 23], scientific documentation on plant used to treat human cancer is scarce at the country
82 level. The overuse of plant' organs such as barks, roots, leaves and fruits for medicinal purpose are
83 known to differently affect the species sustainability depending on a set of factors among which are

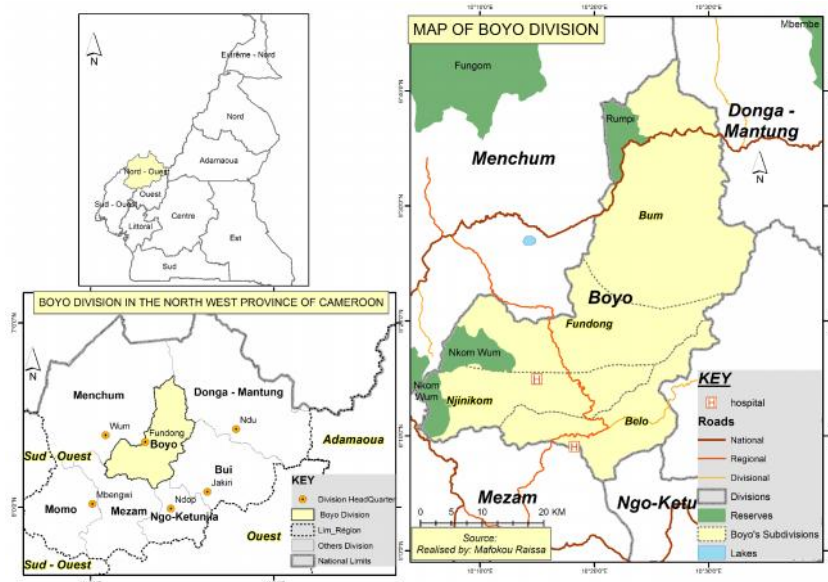
84 the species morphotype, the type of organ being used, the pharmaceutical form being administered,
85 the harvest frequency and intensity, the characteristics of the species' habitat among others [24, 25,
86 26, 27]. These factors have been compiled to elaborate a vulnerability index currently applied to raise
87 awareness on species sustainability to harvest [24, 28]. Therefore, present survey aimed to provide,
88 the first inventory and sustainability of medicinal plants used by traditional healers and the associated
89 indigenous knowledge for the treatment of cancer affliction in the western highland of Cameroon.

90 **Materials and Methods**

91 **Research setting/ Description of the study area**

92 The study was carried out in Boyo division (**Figure 1**). Boyo is about 1557.5 Km², and it is
93 situated between 6°09-6°17 North and 10°16-10°20 East. Boyo has four subdivision, which are:
94 Fundong, Njinikom, Belo and Bum, All the four subdivision, well reputed for the competence of their
95 traditional healers in treating many hopeless illness such as cancer [29] were considered in this study.
96 Temperature ranges from 15°C to 38° C with average temperature of 24.5 to 29.7°C. Average annual
97 rainfall stands at 2400 mm per annum and humidity of 82% with two seasons. The rainy season
98 begins from mid-march to mid-October and a dry season that extends from mid-October to mid-march.
99 The climate is Cameroonian humid tropical type with two seasons (rainy season from mid-march to
100 mid-November, and dry season from mid-November to mid-march) [30]. Boyo division has 128, 425
101 total population. The population density is about one per 82 per km². People mainly depend on
102 agriculture for their livelihoods. This division is characterized by the great diversity of its relief, climate,
103 vegetation and soils [31]

104 .



105

106 **Figure 1: Map showing the Boyo Division in the North-West region of Republic of Cameroon**107 **Ethnobotanical survey and data collection**

108 The primary goal of this survey was to collect ethnobotanical information about medicinal
 109 herbs for cancer treatment. The informants were selected among traditional healers members of the
 110 Mixed Farmer common Initiative groups (MIFACIGs), a community based organization collaborating
 111 with the World Agroforestry Centre (ICRAF) in the framework of the project on participatory
 112 domestication of indigenous fruit trees and medicinal plants in the African Humid Tropics region.
 113 Therefore, their willingness to participate to the study was very high. The data were collected between
 114 the months of May to September 2006 Traditional healers were chosen because they are likely to
 115 encounter a wide range of cancer patients. Indeed a total of 30 traditional healers were chosen using
 116 snowball sampling method [32]. Individual ethnobotanical semi-structured interviewing techniques
 117 were used for data collection [33, 34]. The questionnaire were constructed in English. However, for
 118 ease in communicating with the traditional healers during interviews, *Piging-english* was used. Among
 119 the questions asked during the interviews were age, sex, years of experience. Data were also focused
 120 on the uses of each cited medicinal plant which incorporated local names, cancer type treated, parts
 121 used, preparation methods, administration route, dosage, habits and habitats, and the medicinal plant
 122 conservation practices. Guided field walks were conducted with interviewed traditional healers to
 123 collect medicinal plant voucher specimens. Further identification and authentication was done by a

124 taxonomist in the Cameroon National Herbarium Yaoundé. Voucher specimens were prepared,
125 labeled and deposited in the Herbarium of Forestry Department, University of Dschang Cameroon.

126 **Vulnerability assessment:** seven (7) criteria were adapted from [28, 35, 36] and used for the
127 assessment of the vulnerability of harvest for the most common anticancer species cited in the study
128 site. Such criteria included: gathering method, the life form or morphology, the vegetative organ
129 harvested, the popularity of the species in a given site, the pharmaceutical form being used, and the
130 type of habitat and conservation status as well as the development stage at harvesting (**Table 1**). A
131 scale value from 1 to 3 were assigned to each of the criteria used for the assessment, which affected
132 the survival of the species within a particular habitat type. The overall vulnerability index (V_i) was
133 estimated by calculating the average of the values obtained for all the 7 parameters considered in
134 table 1, with:

- 135 - $1 < V_i \leq 2$, meaning that the plant is not vulnerable and the natural potential is still quite
136 appropriate for exploitation.
- 137 - $2 < V_i \leq 2.5$ indicates that the plant is becoming vulnerable in the given environment.
- 138 - $V_i \geq 2.5$ shows that the plant is highly vulnerable and need sustainable management
139 strategies.

140 **Data analysis**

141 All the recorded data values were tabulated by using Microsoft Excel 2010. Three
142 ethnobotanical parameters were calculated i.e., relative frequency of citation (RFCs), fidelity level (FL)
143 and informants consensus (IFC). Relative frequency citation reveals the importance of each species
144 and is calculated on the basis of the frequency of citation (FC) (the number of informants mentioning
145 the use of species), by using the following formula: $RFCs = FCs / N$ (the FC value is divided by total
146 number of informants participating in the survey (N), without considering the use-categories. Where,
147 **FCs** is the number of informants who mentioned the use of a plant species and N is the total number
148 of informants [37, 38]. Fidelity level (**FL**) was calculated to determine the percentage of informants
149 which reported the uses of a medicinal plant as a remedy for the same major ailment using the
150 formula: $FL = (I_p / I_u) \times 100$, where I_p is the number of informants who independently indicated the use of
151 a species for the same major ailment and I_u the total number of informants who mentioned the plant for
152 any major ailment [39].

153 **Table 1: Parameters used for the assessment of the vulnerability index (Vi) of the common**
 154 **anticancer plants species of the Boyo Division, Northwest province Cameroon**

Parameters	Vulnerability scales		
	Weak (Scale 1)	Medium (Scale 2)	High (Scale 3)
Life form (LF)	Herbs	Shrub	Tree
Popularity (Pop)	Not popular (RFL<20%)	Less popular (20% <RFL<60%)	Popular (RFL>60%)
Organ (s) harvested (Oh)	Leaves	Fruits	Bark, roots and wood
Gathering methods (GM)	Leaves harvesting/ ground picking of the fruits	Fruit an seeds Harvesting	Debarking and felling
Pharmaceutical forms (PhF)	crush concoction	Powder/crush concoction	Decoction/maceration
Habitat and conservation status (HCs)	cultivated	Preserved in human managed systems	wild
Development stage at harvesting (Dst)	Mature	growing stage	juvenile

155

156 The informant consensus factor (ICF) was calculated to determine the agreements of the informants
 157 on each remedy using the formula: $ICF = \frac{Nur - nt}{Nur - 1}$, where number of use citations in each
 158 category (**Nur**) minus the number of species used (**nt**), divided by the number of use citations in each
 159 category minus one, where **Nur** is the number of use citations and **nt** is the number of species used
 160 [40]. IFC values range between 0 and 1, "1" indicates the highest level of consensus. Thus, high IFC
 161 can be used to identify important plant species for search of novel bioactive compounds [41].

162 **Results**

163 **Informant's characteristics**

164 The informants interviewed in this study had received the lowest levels of formal education.
 165 The majority had attained only primary education (83.33%), and 16.67% had not attained any formal
 166 education. The occupation of the Informants were healing jobs and crop farming. All the 30 key
 167 informants were males; they were well-known in the locality due to their long practice in providing
 168 services related to traditional health care. Their ages ranged from 37 to 79 years, with 53% of them
 169 having more than 60 years old. All informants reported that, majority of their knowledge was received
 170 from their family members secretly, and sometime by dream. Yet, if it is not practiced secretly, they
 171 think that the potential of the medicinal values of the plants will be weakened.

172 **Plants reported as anticancer and Relative Frequency citation**

173 A total of 25 medicinal plant species belonging to 13 families were documented as being used
174 by traditional healers in Boyo division, north-west Cameroon (**Table 2**). These were reported to be
175 useful in controlling seven categories of cancer diseases. The families Asteraceae, Lamiaceae,
176 Fabaceae and Acanthaceae were represented by seven, four, three and two anticancer plants
177 respectively, and the rest by one anticancer plant each. One of the species recorded (*Prunus africana*)
178 is also listed in the IUCN (International Union for Conservation of Nature) red list as vulnerable to
179 extinction [42, 43]. Most of the reported anticancer plants were herbs (68%), followed by tree (24%)
180 and shrubs (8%). Leaves were the most preferred plant part (60%) used in herbal drug recipe,
181 followed by barks (20%), fruits (10%), whole plant (6.67%) and stem (3.33%) (**Table 2**). The most
182 frequently cited anticancer plant species were *Coleus* spp, *Ocimum gratissimum*, *Geniosporum*
183 *rotundifolium*, *Ocimum* spp, *Eremomastax speciosa*, *Dichrocephala integrifolia*, *Aframomum* spp,
184 *Entada abyssinica* and *Setaria barbata*. The RFCs of the reported species ranged from 3.33 to
185 96.66%, with the highest values obtained for *Coleus* spp (96.66), *Ocimum gratissimum* (93.33),
186 *Geniosporum rotundifolium* (83.33), *Ocimum* sp. (73.33), *Eremomastax speciosa* (63.33),
187 *Dichrocephala integrifolia* (63.33) and *Aframomum* sp. (40). These plants species were reported by a
188 maximum number of traditional healers, therefore having high frequency of citation. Traditional healers
189 assigned vernacular names to all of the documented medicinal plants (**Table 2**).

190

191 Table 2: Human anticancer medicinal plants characteristics, parts used and preparations by traditional healers in Boyo Division

Scientific name/ Family	Local name	Habit	Plant status	Medicinal uses	Parts used	Preparation & administration	Dosage	RFCs (%)
<i>Acanthus montanus</i> Acanthaceae	Nyo I nyo i	Herb	W	Skin cancer, liver cancer, stomach and pancreas cancer	Leaves	Decoction/I, concoction of leaves powder with palm oil /I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	3.33
<i>Aframomum spp</i> Zingiberaceae	Fessuifegang	Herb	W	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas and brain cancer	Leaves, fruits	Decoction/I, concoction of leaves powder with palm oil /I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	40
<i>Ageratum conyzoides</i> Asteraceae	Abve akedjem	Herb	W	Breast cancer, skin cancer, liver cancer, stomach and pancreas cancer	Whole plant	Decoction/I, concoction of leaves powder with palm oil /I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	3.33
<i>Albizia spp</i> Fabaceae	Fowoom	Tree	W	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas and lung cancer	Barks	Decoction/I, Crush/I & E	2 - 3 cups a day of decocted or crushed extract are taken orally and crushed extract is rubbed on areas where pain felt	10
<i>Aloe vera</i> Asparagaceae	Aloe	Herb	C	Breast cancer, skin cancer, liver cancer, stomach and pancreas cancer	Leaves	Decoction/I, concoction of leaves powder with palm oil /I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	3.33

193 Table 2: Human anticancer medicinal plants characteristics, parts used and preparations by traditional healers in Boyo Division (continued)

Scientific name/ Family	Local name	Habit	Plant status	Medicinal uses	Parts used	Preparation & administration	Dosage	RFCs (%)
<i>Aspilia africana</i> Asteraceae	Ahovesse	Herb	W	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas and brain cancer	Whole plant	Decoction/I, concoction of leaves powder with castor oil /E	2 - 3 cups a day of decocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	3.33
<i>Bidens pilosa</i> Asteraceae	Fesse enou	Herb	W	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas and brain cancer	Leaves	Decoction/I, concoction of leaves powder/I	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	6.66
<i>Chromoleana odorata</i> Asteraceae	Tchakassala	Herb	W	Breast cancer, skin cancer, liver cancer, stomach and pancreas cancer	Leaves	Decoction/I, concoction of leaves powder with palm oil /I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	3.33
<i>Cleome</i> spp Capparidaceae	Y bany be	Herb	W	Breast cancer, skin cancer, liver cancer, stomach and pancreas cancer	Leaves	Decoction/I, concoction of leaves powder with palm oil /I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	3.33
<i>Coleus</i> spp Lamiaceae	Banguim femelle	Herb	W	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer, lung and brain cancer	Stems	Decoction/I, concoction of leaves powder with palm oil /I, Crush/I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug and crushed extract are taken orally and crushed extract rubbed on areas where pain felt	96.66

194 E: External; I: Internal; C: Cultivated; W: Wild; RFCs: Relative frequency citations

195

196 **Table 2: Human anticancer medicinal plants characteristics, parts used and preparations by traditional healers in Boyo Division (continued)**

Scientific name/ Family	Local name	Habit	Plant status	Medicinal uses	Parts used	Preparation & administration	Dosage	RFCs (%)
<i>Dichrocephala integrifolia</i> Asteraceae	Fessuifesse	Herb	W	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer, lung and brain cancer	Leaves	Decoction/I, concoction of leaves powder/I	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	63.33
<i>Entada abyssinica</i> Fabaceae	Feloung	Tree	W	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas and lung cancer	Leaves, Barks	Decoction/I, concoction of leaves powder/I & E	2 - 3 cups a day of decocted drug or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	40
<i>Eremomastax speciosa</i> Acanthaceae	Banguim male	Herb	C	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer, lung and brain cancer	Leaves	Decoction/I, concoction of leaves powder/I	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	63.33
<i>Geniosporum rotundifolium</i> Lamiaceae	Feungui	Herb	W	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas and brain cancer	Leaves	Decoction/I, concoction of leaves powder with palm oil /I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	83.33

197 *E: External; I: Internal; C: Cultivated; W: Wild; RFCs: Relative frequency citations*

198

199

200 Table 2: Human anticancer medicinal plants characteristics, parts used and preparations by traditional healers in Boyo Division (continued)

Scientific name/ Family	Local name	Habit	Plant status	Medicinal uses	Parts used	Preparation & administration	Dosage	RFCs (%)
<i>Kigelia Africana</i> Bignoniaceae	Atem	Tree	C	Breast cancer, skin cancer, liver cancer, stomach and pancreas cancer	Leaves, fruits	Decoction/I, concoction of leaves powder with palm oil /I, Crush/I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug and crushed extract are taken orally and crushed extract rubbed on areas where pain felt	10
<i>Lannea kerstingii</i> Anacardiaceae	Feuga'ah	Tree	W	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas and lung cancer	Barks	Decoction/I concoction of leaves powder with palm oil /I Crush/I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug and crushed extract are taken orally and crushed extract rubbed on areas where pain felt	6.66
<i>Ocimum gratissimum</i> Lamiaceae	Afato'oh	Herb	C	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas and brain cancer	Leaves	Decoction/I concoction of leaves powder/I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	93.33
<i>Ocimum sp.</i> Lamiaceae	Tongloan	Herb	C	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas and brain cancer	Leaves	Decoction/I concoction of leaves powder/I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	73.33

201 *E: External; I: Internal; C: Cultivated; W: Wild; RFCs: Relative frequency citations*

202

203

204

205 **Table 2: Human anticancer medicinal plants characteristics, parts used and preparations by traditional healers in Boyo Division (continued)**

Scientific name/ Family	Local name	Habit	Plant status	Medicinal uses	Parts used	Preparation & administration	Dosage	RFCs (%)
<i>Prunus africana</i> Rosaceae	Prunus	Tree	C	Breast cancer, skin and lung cancer	Barks	Decoction/ concoction of leaves powder with palm oil /I Crush/I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug and crushed extract are taken orally and crushed extract rubbed on areas where pain felt	3.33
<i>Sesbania</i> sp. Fabaceae	Y-yes	Shrub	W	Breast cancer, skin cancer, liver cancer, stomach and pancreas cancer	Leaves	Decoction/ concoction of leaves powder with palm oil /I Crush/I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug and crushed extract are taken orally and rubbed on areas where pain felt	6.66
<i>Setaria barbata</i> Poaceae	Fedjan fegué	Herb	W	Breast cancer, skin cancer, liver cancer, stomach and pancreas cancer	Leaves	Decoction/ concoction of leaves powder/I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	16.66

206 *E: External; I: Internal; C: Cultivated; W: Wild; RFCs: Relative frequency citations*

207

208

209

210

211

212

213

214 Table 2: Human anticancer medicinal plants characteristics, parts used and preparations by traditional healers in Boyo Division (end)

Scientific name/ Family	Local name	Habit	Plant status	Medicinal uses	Parts used	Preparation & administration	Dosage	RFCs (%)
<i>Solanum aculeastrum</i> Solanaceae	Fugnah	Shrub	W	Breast cancer, skin cancer, liver cancer, stomach and pancreas cancer	Leaves, fruits, barks	Decoction/I concoction of leaves powder with palm oil /I & E	2 - 3 cups a day of decocted or 2 - 3 spoons of concocted drug are taken orally and concoction mixture is rubbed on areas where pain felt	16.66
<i>Vernonia calvoana</i> Asteraceae	A tong tong	Herb	W	Breast cancer, skin and lung cancer	Leaves	Decoction/I Crush/I & E	2 - 3 cups a day of decocted or crushed extract are taken orally and rubbed on areas where pain felt	6.66
<i>Vernonia</i> sp. Asteraceae	Afessan	Herb	W	Breast cancer, skin and lung cancer	Leaves	Decoction/I Crush/I & E	2 - 3 cups a day of decocted or crushed extract are taken orally and rubbed on areas where pain felt	3.33
<i>Vitex</i> sp. Verbenaceae	Afeuh	Tree	W	Breast cancer, skin and lung cancer	Barks	Decoction/I Crush/I & E	2 - 3 cups a day of decocted or crushed extract are taken orally and rubbed on areas where pain felt	3.33

215 E: External; I: Internal; C: Cultivated; W: Wild; RFCs: Relative frequency citations

216 Preparation, dosage and mode of treatment

217 The most common mode of preparation were decoction (45.45%) and concoction (38.18%).
 218 All the treatments were prepared from a mixture of four to ten dry or fresh plants. Treatments were
 219 mainly taken orally and topically twice or three times in a day until recovery. The dosages were
 220 measured using a cup of about 50 – 100 ml. Solvent were water, raphia wine, palm oil and castor oil.
 221 Some additive substances such as salt and honey were mixed during preparations and
 222 administrations.

223 Informant's consensus factor for each cancer category and fidelity value of recorded 224 medicinal plants

225 Cancer affliction were divided into seven categories, namely: Breast cancer, skin cancer, liver
 226 cancer, stomach cancer, pancreas cancer, lung cancer and brain cancer. From the informant
 227 consensus factor analysis computed for each cancer category, it was shown that stomach cancer
 228 scored the highest ICF value (0.82) followed by skin, pancreas and liver cancer (0.81 each). The least
 229 values of ICF were found in lung cancer (0.16) and brain cancer (0.54) (Table 3).

230 **Table 3: informant consensus factor (ICF) value of cancer category for anticancer plants in**
 231 **Boyo division, Cameroon**

Use category	Plant species	Number of use citation	% of all citations	ICF value
Breast cancer	<i>Coleus</i> sp. (13), <i>Ocimum gratissimum</i> (12), <i>Geniosporum rotundifolium</i> (14), <i>Ocimum</i> sp. (11), <i>Eremomastax speciosa</i> (13), <i>Dichrocephala integrifolia</i> (9), <i>Aframomum</i> sp (7), <i>Entada abyssinica</i> (7), <i>Setaria barbata</i> (3), <i>Solanum aculeastrum</i> (2), <i>Kigelia africana</i> (2), <i>Albizia</i> sp. (2), <i>Bidens pilosa</i> (3), <i>Vernonia calvoana</i> (2), <i>Sesbania</i> sp. (1), <i>Lannea kerstingii</i> (2), <i>Vitex</i> sp. (1), <i>Prunus africana</i> (1), <i>Aegeratum conyzoides</i> (1), <i>Cleome</i> sp. (1), <i>Chromoleana odorata</i> (1), <i>Aspilia africana</i> (1), <i>Aloe vera</i> (1), <i>Vernonia</i> sp. (1)	111	18.65	0.79
Skin cancer	<i>Coleus</i> sp. (15), <i>Ocimum gratissimum</i> (13), <i>Geniosporum rotundifolium</i> (15), <i>Ocimum</i> sp. (13), <i>Eremomastax speciosa</i> (16), <i>Dichrocephala integrifolia</i> (11), <i>Aframomum</i> spp (7), <i>Entada abyssinica</i> (8), <i>Setaria barbata</i> (5), <i>Solanum aculeastrum</i> (2), <i>Kigelia africana</i> (2), <i>Albizia</i> sp. (3), <i>Bidens pilosa</i> (3), <i>Vernonia calvoana</i> (2), <i>Sesbania</i> spp (1), <i>Lannea kerstingii</i> (2), <i>Vitex</i> sp. (1), <i>Prunus</i>	127	21.34	0.81

	<i>africana</i> (1), <i>Aegeratum conyzoides</i> (1), <i>Cleome</i> sp. (1), <i>Chromolaena odorata</i> (1), <i>Aspilia africana</i> (1), <i>Aloe vera</i> (1), <i>Vernonia</i> sp. (1), <i>Acanthus montanus</i> (1)			
Liver cancer	<i>Coleus</i> spp (12), <i>Ocimum gratissimum</i> (14), <i>Geniosporum rotundifolium</i> (13), <i>Ocimum</i> sp. (11), <i>Eremomastax speciosa</i> (12), <i>Dichrocephala integrifolia</i> (10), <i>Aframomum</i> spp (6), <i>Entada abyssinica</i> (7), <i>Setaria barbata</i> (6), <i>Solanum aculeastrum</i> (2), <i>Kigelia africana</i> (2), <i>Albizia</i> sp. (2), <i>Bidens pilosa</i> (3), <i>Sesbania</i> spp (1), <i>Lannea kerstingii</i> (1), <i>Aegeratum conyzoides</i> (1), <i>Cleome</i> sp. (1), <i>Chromolaena odorata</i> (1), <i>Aspilia africana</i> (1), <i>Aloe vera</i> (1), <i>Acanthus montanus</i> (1)	108	18.15	0.81
Stomach cancer	<i>Coleus</i> spp (13), <i>Ocimum gratissimum</i> (15), <i>Geniosporum rotundifolium</i> (12), <i>Ocimum</i> sp. (12), <i>Eremomastax speciosa</i> (13), <i>Dichrocephala integrifolia</i> (11), <i>Aframomum</i> spp (7), <i>Entada abyssinica</i> (7), <i>Setaria barbata</i> (6), <i>Solanum aculeastrum</i> (2), <i>Kigelia africana</i> (2), <i>Albizia</i> sp.(2), <i>Bidens pilosa</i> (3), <i>Sesbania</i> sp. (1), <i>Lannea kerstingii</i> (1), <i>Ageratum conyzoides</i> (1), <i>Cleome</i> sp. (1), <i>Chromolaena odorata</i> (1), <i>Aspilia africana</i> (1), <i>Aloe vera</i> (1), <i>Acanthus montanus</i> (1)	113	18.99	0.82

232 Numbers in parenthesis indicate the number of citation of that plant by traditional healers against a
233 particular ailment category, ICF: Informant Consensus Factor

234 **Table 3: informant consensus factor (ICF) value of cancer category for anticancer plants in**
235 **Boyo division, Cameroon (end)**

Use category	Plant species	Number of use citation	% of all citations	ICF value
Pancreas cancer	<i>Coleus</i> sp. (12), <i>Ocimum gratissimum</i> (14), <i>Geniosporum rotundifolium</i> (12), <i>Ocimum</i> sp. (11), <i>Eremomastax speciosa</i> (12), <i>Dichrocephala integrifolia</i> (10), <i>Aframomum</i> sp. (6), <i>Entada abyssinica</i> (7), <i>Setaria barbata</i> (5), <i>Solanum aculeastrum</i> (2), <i>Kigelia africana</i> (2), <i>Albizia</i> sp. (2), <i>Bidens pilosa</i> (3), <i>Sesbania</i> sp. (1), <i>Lannea kerstingii</i> (1), <i>Aegeratum conyzoides</i> (1), <i>Cleome</i> sp. (1), <i>Chromolaena odorata</i> (1), <i>Aspilia africana</i> (1), <i>Aloe vera</i> (1), <i>Acanthus montanus</i> (1)	106	17.81	0.81
Lung cancer	<i>Coleus</i> sp. (1), <i>Eremomastax speciosa</i> (1), <i>Dichrocephala integrifolia</i> (1), <i>Entada abyssinica</i> (1), <i>Albizia</i> sp. (2), <i>Lannea kerstingii</i> (1)	7	1.18	0.16
Brain cancer	<i>Coleus</i> sp. (4), <i>Ocimum gratissimum</i> (3), <i>Geniosporum rotundifolium</i> (2), <i>Ocimum</i> sp.(3), <i>Eremomastax speciosa</i> (4), <i>Dichrocephala integrifolia</i> (2), <i>Aframomum</i> sp. (1), <i>Albizia</i> sp. (1), <i>Bidens pilosa</i> (1), <i>Aspilia africana</i> (1), <i>Acanthus</i>	23	3.86	0.54

montanus (1)

236 *Numbers in parenthesis indicate the number of citations of that plant species by traditional healers*
237 *against a particular ailment category, ICF: Informant Consensus Factor*

238

239 Eight medicinal plants scored highest FL values: These were *Coleus* spp, *Ocimum*
240 *gratissimum*, *Eremomastax speciosa*, and *Dichrocephala integrifolia* ranked first with the
241 highest score of FL value (100% each); followed by *Geniosporum rotundifolium* and *Ocimum*
242 sp. (92% each) ranked second, *Aframomum* sp. and *Entada abyssinica* ranked third with FL
243 value (91.67% each) (**Table 4**).

244

245

246

247

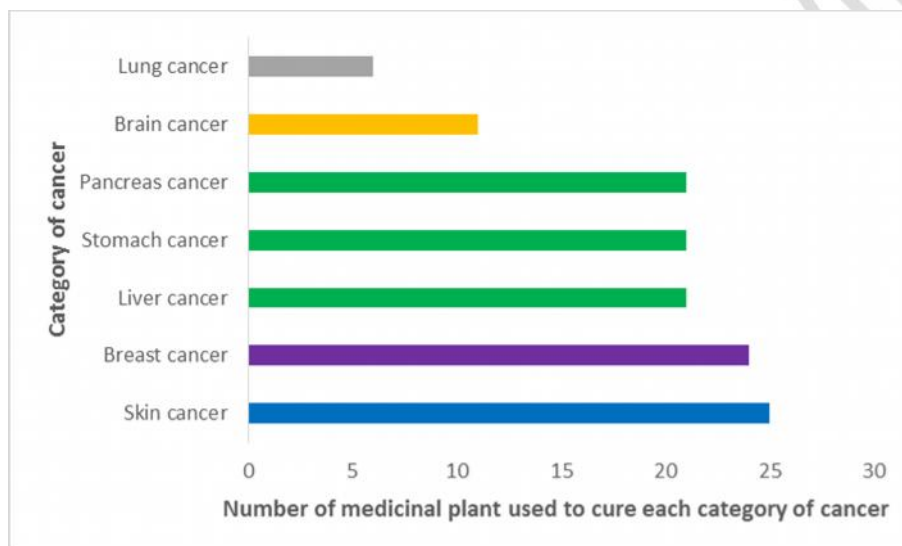
248 **Table 4: Fidelity level (FL) values for common medicinal plants used against some cancer**
249 **categories in Boyo division by local traditional healers**

Plant species	Disease category	Ip	Iu	FL%
<i>Coleus</i> sp.	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer, lung cancer & brain cancer	29	29	100
<i>Ocimum gratissimum</i>	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer & brain cancer	28	28	100
<i>Geniosporum rotundifolium</i>	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer & brain cancer	23	25	92
<i>Ocimum</i> sp.	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer & brain cancer	23	22	92
<i>Eremomastax speciosa</i>	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer, lung cancer & brain cancer	19	19	100
<i>Dichrocephala integrifolia</i>	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer, lung	19	19	100

	cancer & brain cancer			
<i>Aframomum</i> sp.	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer, lung cancer & brain cancer	11	12	91.67
<i>Entada abyssinica</i>	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer & lung cancer	11	12	91.67

250

251 Moreover, the highest number of plant species (more than 20 species) were cited for the treatment of
 252 five out of the seven cancer categories recorded, namely skin cancer, liver cancer, stomach cancer,
 253 pancreas cancer and breast cancer (**Figure 2**)



254

255 **Figure 2: Distribution of medicinal plants recorded for each cancer category in Boyo Division,**
 256 **Northwest region Cameroon**

257

258 **Threats and vulnerability assessment of medicinal plants used as anticancer in the** 259 **study area**

260 Most of the plant species were collected in the wild (76%), while 24% were cultivated. Some of
 261 these wild medicinal plants are considered as threatened due to expansion of agriculture and
 262 overgrazing.

263

264

265 **Table 4: Fidelity level for common anticancer medicinal plants used by local traditional healers**
 266 **in Boyo division**

Plant species	Disease category	Ip	Iu	FL%
<i>Coleus</i> sp.	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer, lung cancer & brain cancer	29	29	100
<i>Ocimum gratissimum</i>	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer & brain cancer	28	28	100
<i>Geniosporum rotundifolium</i>	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer & brain cancer	23	25	92
<i>Ocimum</i> sp.	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer & brain cancer	23	22	92
<i>Eremomastax speciosa</i>	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer, lung cancer & brain cancer	19	19	100
<i>Dichrocephala integrifolia</i>	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer, lung cancer & brain cancer	19	19	100
<i>Aframomum</i> sp.	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer, lung cancer & brain cancer	11	12	91.67
<i>Entada abyssinica</i>	Breast cancer, skin cancer, liver cancer, stomach cancer, pancreas cancer & lung cancer	11	12	91.67

267 *I_p*: number of informants who independently indicated the use of the species for the same
 268 major ailment; *I_u*: the total number of informants who mentioned the plant for any major
 269 ailment

270 Furthermore, according to reports of informants and field observation, two of the anticancer
 271 plants, *E. abyssinica* and *G. rotundifolium* are becoming rare in the nearby areas and as a
 272 result traditional healers needed to travel longer distances to harvest them. The assessment of
 273 the vulnerability to harvest indicated that out of the eight common medicinal plants used in
 274 the treatment of cancer, six were found vulnerable with vulnerability index (*V_i*) varying from
 275 2 (*D. integrifolia* and *Aframomum* sp.) to 2.42 (*E. speciosa* and *Ocimum* sp.). Two of them,

276 namely *G. rotundifolium* and *E. abyssica* were assessed as highly vulnerable with Vi value of
 277 2.71 and 2.82 respectively (**Table 5**).

278 **Table 5. Vulnerability indices for common anticancer medicinal plants used by traditional**
 279 **healers in Boyo Division, Cameroon**

Parameters	LF	HCS	Pop	Oh	Dst	GM	PhF	Total	Vi
Species									
<i>Coleus sp</i>	1	2	3	1	2	3	3	15	2,14
<i>Ocimum gratissimum</i>	1	2	3	1	2	3	3	15	2,14
<i>Geniosporum rotundifolium</i>	2	2	3	3	3	3	3	19	2,71
<i>Ocimum sp.</i>	1	2	3	3	2	3	3	17	2,42
<i>Eremomastax speciosa</i>	1	2	3	3	2	3	3	17	2,42
<i>Dichrocephala integrifolia</i>	1	1	3	1	2	3	3	14	2
<i>Aframomum sp</i>	1	2	2	1	2	3	3	14	2
<i>Entada abyssinica</i>	3	3	2	3	3	3	3	20	2,85

280 LF: Life Form; HCS: Habitat and conservation status; Pop: popularity; Oh: organs harvested; Dst:
 281 development stage at harvesting; GM: gathering method; PhF: Pharmaceutical form, Vi: Vulnerability
 282 Index.

283

284 Discussion

285 Indigenous people of different localities have their own specific knowledge on plant use,
 286 management and conservation [44]. Various anticancer plant species have been assessed for their
 287 efficacy and tolerability. Some of these plant species including *Taxus baccata*, *Podophyllum peltatum*,
 288 *Camptotheca acuminata* and *Vinca rosea*, *Curcuma zedoaria*, *Typhonium flagelliforme*, *Phaleria*
 289 *macrocarpa*, *Catharanthus roseus*, *Selaginella corymbosa*, *Taraxacum mongolicum*, *Brucca javanica*,
 290 *Allium sativum*, *Smilax china*, *Helianthus annus*, *Solanum nigrum*, *Coix lachryma-Jobi*, *Asparagus*
 291 *cochinchinensis*, and others are used to manufacture anticancer drugs.

292 The fact that all informants claimed they had acquired their knowledge from their family
 293 members secretly and sometime by dream, is in agreement with those of Eyssartier et al. (2008) in
 294 Northwestern Patagonia, [45] in Western Region of Ghana, [23] in Bamboutos Division West

295 Cameroon. It was pointed out that in China, traditional medicinal knowledge and practices are passed
296 orally from generation to generation [46]. This pattern of knowledge transfer and the tendency of
297 secrecy are also reported in similar studies elsewhere [47, 48, 49]. The high illiteracy level (83.33%)
298 may explain why knowledge of medicinal properties and uses of plants are still oral and yet not written
299 down [45].

300 Some of the anticancer plants reported during the current study were found to be also used in
301 other countries for the treatment of cancer ailments. These included *Aloe vera* [6], *Entada abyssinica*,
302 *Ocimum gratissimum*, *Prunus africana*, *Albizia gummifera* [50]. Some of the listed species in this work
303 have also been earlier reported in the same study area to be useful in curing of other ailments [18].
304 Furthermore, *Coleus* sp., *Ocimum gratissimum*, *Geniosporum rotundifolium*, *Ocimum* sp.,
305 *Eremomastax speciosa*, *Dichrocephala integrifolia*, *Aframomum* sp., *Entada abyssinica* and *Setaria*
306 *barbata* were the most frequently cited plants in the study area and thus, may indicate their
307 effectiveness. Some genus or plant species listed in this work have also been clinically verified and
308 were found to be quite effective. This is the case for *Entada abyssinica*, *Ocimum gratissimum*, *Prunus*
309 *africana*, *Albizia gummifera*, *Vernonia lapiosus* and *Aloe volkensii* [50]. In addition, phytochemical
310 analysis of these plant extracts did by [51], revealed the presence of alkaloids, anthraquinones,
311 xanthines, valepotriates, cardioactive glycosides, flavonoids, essential oils, coumarins, lignans,
312 saponins and arbutin compounds. These bioactive compounds are known to possess important
313 pharmacological actions [50]. For instance, Phenolic compounds such as flavonoids have been
314 previously shown to have anti-apoptosis, anti-aging, anti-carcinogenic, anti-inflammatory, anti-
315 atherosclerotic, and cardiovascular protective activities [51]. Flavonoids in plants comprise a vast array
316 of biologically active compounds which have been used in traditional medicine for many years and
317 have majorly antioxidant and antiproliferative effects especially against chronic inflammatory and
318 allergic diseases, breast cancer and coronary artery disease [52]. [53] has reported evidence of
319 flavonoids having antimutagenic activity of quercetin that was shown to inhibit the mutagenic activity of
320 benzo(α)pyrene, a polyaromatic hydrocarbon carcinogen. Besides they have shown effectiveness as
321 antioxidants and strong anticancer activities [54]. Thus, the use of our plant species for the treatment
322 of various cancer categories in the study area might be due to their richness in bioactive constituents.
323 From this study, it is shown that more than three plant species are used in the treatment of each
324 cancer category for example skin cancer is treat by 25 plant species and breast cancer by 24 plant

325 species. Multiple plant species used to treat ailments have been confirmed by [15, 22, 23] in
326 Cameroon and [55] in Thailand. The utilization of medicinal plant species belonging to Asteraceae,
327 Lamiaceae, Fabaceae and Acanthaceae families was in line with ethnomedicinal flora reported from
328 other parts of Cameroon [15, 17, 22, 23] and in other areas of the world [44, 56]. This may be due to
329 the wide distribution of plant belonging to Asteraceae, Lamiaceae, Fabaceae and Acanthaceae
330 families and their traditional uses known by the indigenous communities living in different parts of the
331 world. Moreover, the wide utilization of species from these families might be relate to the presence of
332 effective bioactive secondary metabolites that work against reproductive health-related infections [57,
333 58, 59, 60, 61]. For example, studies have reported that the Asteraceae family is rich in
334 monoterpenes, sesquiterpenes, sesquiterpene lac-tones, diterpenes, triterpenes, polyacetylenes,
335 benzofuranes, and phenyl-propanes that help to treat various diseases [62]. Most medicinal plants
336 used in the area were herbs. This finding is in line with results from other studies in Cameroon [15, 17,
337 20, 23]. This could be relate to the fact that herbs are usually more readily available than shrubs and
338 trees that are often harvested from forest patches always distant from residential areas. It could also
339 be due to the fact that our informants live in shrubby savannas and grass-lands where herbs abound
340 [17]. Our observation agrees with the general pattern of dominance of herbaceous species seen in
341 most medicinal plant inventories in Cameroon [18, 20], and in other African countries like Ethiopia [63,
342 64] and Uganda [59]. Moreover, the frequent use of herbs by traditional healers may be due to their
343 accessibility and high efficacy in the treatment of cancer compared to other life forms [65, 66, 67]. Leaf
344 was the most commonly used plant part in the area, the harvest of which does not normally causes
345 significant harm to survival of individuals as compared to other parts such as the stem, bark and root.
346 This could be explained by the fact that leaves are sites where more phytochemicals are produced via
347 photosynthesis [68, 69]. This finding is in agreement with those of certain others [15, 17, 18].
348 Furthermore, plants were reported to be used in various forms such as dry and fresh; however,
349 preference was given to those that were freshly collected. This could be an indication that medicinal
350 activities of plants are readily available when the plants are freshly collected as some of their
351 metabolites may be volatile and could be lost through evapotranspiration. This corroborates the
352 findings of [22, 23, 69, 70] who reported that fresh plant material was used to prepare remedies as
353 mixtures of multiple ingredients from different plants. The number of plants in mixture ranged from four
354 to ten. The informants in the study area perceived that use of multiple plants in preparation of

355 traditional drugs adds up the curing potential and confer synergetic actions. On the other hand, the
356 use of multiple plants to cure an ailment could be an indication of the prevalence and severity of that
357 illness in the locality. This finding is in affinity with the study of [71]. Anticancer drugs in the study area
358 were prepared in form of decoction and concoction, which is in concordance with results of a study
359 conducted by [23, 72]. Oral and topical were the only administration route. Oral route was also
360 reported in many studies in Cameroon [17, 22, 23] and elsewhere [71, 72, 73] and may reflect the low
361 toxicity of the plant extract for human being. Informants used additive such as honey in order to
362 improve taste and flavor and therefore facilitate oral administration [23]. The use of water, palm wine,
363 palm oil and castor oil as solvent may be due to their ability to better extract active compounds present
364 in the plant than other solvents.

365 It was observed in this study that informants assigned local names to all the medicinal plants
366 species used in the cancer treatment, indicating the existence of a very close interaction between the
367 traditional healers and their plant resources. According to [74, 75], the importance of plants in local
368 culture is usually shown by the proportion of plants that can be identified by local people and in
369 vernacular names. Furthermore, species such as *Coleus* sp., *Ocimum gratissimum*, *Eremomastax*
370 *speciosa*, *Dichrocephala integrifolia*, *Geniosporum rotundifolium*, *Ocimum* spp, *Aframomum* spp and
371 *Entada abyssinica* in the present work scored the highest FL and could be therefore subjected to
372 phytochemical and pharmacological investigation to prove their efficacy [76]. Moreover, the ICF results
373 proved that breast, skin, liver, pancreas and stomach cancers had higher informant consensus factor
374 values, indicating that traditional healers share the knowledge of the most important medicinal plants
375 species used to treat cancer ailments. Nevertheless, most medicinal plants claimed by traditional
376 healers for cancer treatment have least relative frequency citations, which could not necessary mean
377 that they are less effective in the treatment. This could be because the knowledge on medicinal plants
378 is still very secret [77].

379 The majority of medicinal plants used to treat cancer diseases in the study area was harvested
380 from the wild. Similar results were obtained by [59] in Uganda, Yineger *et al.* [78] in Ethiopia and [23]
381 in Cameroon. Moreover, the vulnerability assessment revealed that the most frequently used plant
382 species were becoming vulnerable in these wild habitats. This could be explained either by the
383 exploitation pressure on these species, or by the fragility of the savannah grassland extensively

384 converted to cropping and grazing lands. In order to ensure availability of these species for future
385 generations and improve their use and pharmaceutical valorization, alternative sources of supply
386 should be developed in more closely human-managed systems such as homegardens and food crop
387 farms. Informants have expressed their willingness to participate in the domestication process of these
388 species and some of them had started planting multiple used species such as *Ocimum* spp. These
389 initiatives need to be strengthened through capacity building for medicinal gardens creation and
390 management as well as nursery techniques.

391

392 **Conclusion**

393 The present study documented 25 medicinal plants species and their uses, of which many had
394 already been reported to contain active ingredient against symptoms of various categories of cancer.
395 Furthermore, reported plant species can serve as a basis for formal analysis of active constituents and
396 validation of results. However, the threat reported for some of these species need to be urgently
397 addressed to ensure their long term availability.

398

399 **List of abbreviations**

400 Dst: development stage at harvesting; ICF: Informant Consensus Factor; **FL**: Fidelity level; FC:
401 frequency of citation; GM: gathering method; HCs: Habitat and conservation status; LF: Life Form; Oh:
402 organs harvested; Pop: popularity; PhF: Pharmaceutical form; RFCs: Relative Frequency of Citations;
403 Vi: Vulnerability index.

404 **Declarations**

405 **Ethics approval and consent to participate:** interviews with traditional healers were done following
406 mutual contentment as they were participating in the domestication programme led by the World
407 Agroforestry Centre (ICRAF)

408 **Consent for publication:** Not applicable

409 **Availability of data and materials**

410 All data are available from CHS. Herbarim voucher specimen are deposited in the Department of
411 Forestry of the Faculty of Agronomy and Agricultural Sciences, University of Dschang.

412

413 **Competing Interests:** the authors declare that they have no competing interests.

414 **References**

- 415 1. Mathers CD, Sadana R, Salomon JA, Murray CJL, Lopez AD. Healthy life expectancy in 191
416 countries, 1999. *The Lancet*. 2001; 357:1685–1691.
- 417 2. Peedell C. Concise Clinical Oncology. Elsevier: Philadelphia USA. 2005; 3-5. 7.
- 418 3. Boyle P, Levin B. World Cancer Report. IARC, Lyon. *International Agency for Research on*
419 *Cancer*. 2008; 42.
- 420 4. Ferlay J, Shin HR, Bray F, Forman D, Mathers CD, Parkin D. Lyon, France: IARC.
421 GLOBOCAN 2008: Cancer Incidence and Mortality Worldwide. *IARC CancerBase*. 2010; N°
422 10.
- 423 5. Thun MJ, DeLancey JO, Center MM, Jemal A, Ward EM. The global burden of cancer:
424 priorities for prevention. *Carcinogenesis*. 2009; 31(1):100-110.
- 425 6. Das R, Mehta DK, Chaudhary AK, Khan MU. Important herbs in treatment of cancer.
426 *International Journal of Research and Development in Pharmacy & Life Sciences*. 2012; 1(3):
427 135-142.
- 428 7. Gupta AK, Tandon N. Reviews on indian medicinal plants. Vol 2. New Delhi: *Indian Council of*
429 *Medical Research*; 2004.
- 430 8. Rao CV, Sairam K, Goel RK. Experimental evaluation of *Bacopa monniera* on rat gastric
431 ulceration and secretion. *Indian Journal of Physiology & Pharmacology*. 2000; 44:435.
- 432 9. Goel RK, Sairam K. Anti-ulcer drugs from indigenous sources with emphasis on *Musa*
433 *sapientum*, *Tamrabhasma*, *Asparagus racemosus* and *Zingiber officinale*. *Indian Journal of*
434 *Pharmacology*. 2002; 34:100- 110.
- 435 10. Gordaliza M. Natural products as leads to anticancer drugs. *Clinical and Translational*
436 *Oncology*. 2007; 9(12):767-776.

- 437 11. Bonham M, Arnold H, Montgomery B, Nelson PS. Molecular effects of the herbal compound
438 PC-SPES: identification of activity pathways in prostate carcinoma. *Cancer Research*. 2002;
439 62: 3920-3924.
- 440 12. Hu H, Ahn NS, Yang X, Lee YS, Kang KS. *Ganoderma lucidum* extract induces cell cycle
441 arrest and apoptosis in MCF-7 human breast cancer cell. *International Journal of Cancer*.
442 2002; 102: 250-253.
- 443 13. Vickers A. Botanical medicines for the treatment of cancer: rationale, overview of current data,
444 and methodological considerations for phase I and II trials. *Cancer Investigation*. 2002; 20:
445 1069-1079.
- 446 14. El-Shemy HA, Aboul-Enein AM, Aboul-Enein MI, Issa SI, Fujita K: The effect of willow leaf
447 extracts on human leukemic cells in vitro. *Journal of Biochemistry & Molecular Biology*. 2003;
448 36: 387-389.
- 449 15. Adjanohoun EJ, Aboubakar N, Dramane K, Ebot ME, Ekpere JA, Enow-Orock EG et al.
450 Traditional medicine and pharmacopoeia. Contribution to ethnobotanical and floristic studies in
451 Cameroon. Lagos, Nigeria: Organisation of African Unity. Scientific, Technical and research
452 commission (OAU/STRC) 1996.
- 453 16. Mpondo Mpondo E, Ngene JP, Mpounze Som L, Etame Loe G, Ngo Boumsong PC, Yinyang
454 J, Dibong SD. Connaissances et usages traditionnels des plantes médicinales du
455 Département du Haut Nyong. *Journal of Applied Biosciences*. 2017; 113: 11229-11245.
- 456 17. Simbo DJ. An ethnobotanical survey of medicinal plants in Babungo, North West re-gion,
457 Cameroon. *Journal of Ethnobiology & Ethnomedicine*. 2010; 6:8.
- 458 18. Focho DA, Muh CN, Mendi GA, Fongod AN, Fonge BA. Ethnobotanical survey of trees in
459 Fundong, Northwest Region, Cameroon. *Journal of Ethnobiology & Ethnomedicine*. 2009;
460 5:17.
- 461 19. Jiofack T, Kemeuze V, Fongnzossie E, Tsabang N, Nkuinkeu R, Mapongmetsem PM,
462 Nkongmeneck BA. Ethnobotany and phytopharmacopea of the South-West ethnoecological
463 region of Cameroon. *Journal of Medicinal Plants Research*. 2008; 2: 197–206.

- 464 20. Jiofack T, Fokunang C, Guedje N, Kemeuze V, Fongnzossie E, Nkongmeneck BA et al.
465 Ethnobotanical uses of medicinal plants of two ethnoecological regions of Cameroon.
466 *International Journal of Medicine & Medical Sciences*. 2010; 2(3): 60–79.
- 467 21. Noumi E. Ethnomedicines used for treatment of prostatic disease in Fouban, Cameroon.
468 *African Journal of Pharmacy & Pharmacology*. 2010; 4(11):793–805.
- 469 22. Tsobou R, Mapongmetsem PM, Van Damme P. Medicinal plants used against typhoid fever in
470 Bamboutos Division, Western Cameroon. *Ethnobotany Research & Applications*. 2013;
471 11:163–174.
- 472 23. Tsobou R, Mapongmetsem PM, Van Damme P. Medicinal Plants Used for Treating
473 Reproductive Health Care Problems in Cameroon, Central Africa. *Economic Botany*. 2016;
474 XX(X): 1–15.
- 475 24. Stewart KM. Effects of bark harvest and other human activity on populations of the African
476 cherry (*Prunus africana*) on Mount Oku, Cameroon. *Forest Ecology and Management*. 2009;
477 258(7):1121 – 11208.
- 478 25. Delvaux C, Sinsin B, Darchamberau F, Van Damme P. Recovery from bark harvesting of 12
479 medicinal trees species in Benin, West Africa. *Journal of Applied Ecology*. 2010; 46(3): 703-
480 712.
- 481 26. Momo SMC, Temgoua LF, Ngueguim JR, Nkongmeneck BA. Comparison of plant
482 communities between primary and secondary tropical forests of Mount Oku, Cameroon.
483 *Journal of Ecology and Natural Environment*. 2016; 8(10): 163-174.
- 484 27. Momo SMC, Avana TML, Ngueguim J R, Kemeuze VA. Wood characterization of *Gnidia*
485 *glauca* (Fresen.) gilg (Thymelaeaceae) and its possible utilization as material for pulp
486 production in Northwest Cameroon. *Revue Scientifique et Technique Forêt et Environnement*
487 *du Bassin du Congo*. 2017; 8: 36-44.
- 488 28. Betti JL. Usages traditionnels et vulnérabilité des plantes médicinales dans la réserve de
489 biosphère du Dja et dans les marchés de Yaoundé, Cameroun. Thèse Doctorat, Université
490 Libre de Bruxelles, Belgique 2001.

- 491 29. Sime SCH. Etude ethnobotanique, vulnérabilité et potentiel de conservation des plantes
492 médicinales utilisées dans le traitement du cancer dans le Département de Boyo au Nord-
493 Ouest Cameroun. Mémoire d'Ingénieur de Conception en Eaux, Forêt et Chasse, FASA,
494 Université de Dschang, 2006.
- 495 30. Belo rural council, North-West Region Cameroon 2004.
- 496 31. Institut National de la Statistique (INS). Rapport sur le 3ème Recensement Générale de la
497 Population et de l'Habitat 2005, Yaoundé, Cameroun 2010.
- 498 32. Patton M. Qualitative evaluation and research methods, Sage Publications, Newbury Park,
499 California 1990.
- 500 33. Martin GJ. Ethnobotany: A people and plants conservation manual. Chapman & Hall, London,
501 U.K; 1995.
- 502 34. Cotton CM. Ethnobotany: Principles and applications. John Wiley and Sons Ltd., Chichester,
503 U.K ; 1996.
- 504 35. Tsabang N. Etude ethnobotanique des plantes à vertus antidiabétiques et/ou
505 antihypertensives au Cameroun. Ph.D Thesis in Ethnobotany, University of Yaoundé 1,
506 Cameroon 2008.
- 507 36. Kemeuze VA. Identification et caractérisation des indicateurs biologiques d'aridité et de
508 dégradation du milieu dans les régions semi-arides du Cameroun, Msc Thesis in Botany and
509 systematics, University of Dschang, Cameroon, 2010.
- 510 37. Ilker U, Suleyman B, Nurettin Y, Yunus D. The investigation and quantitative ethnobotanical
511 evaluation of medicinal plants used around Izmir province, *Turkey Journal of Medicinal Plants*
512 *Research*. 2009; 3: 345-367.
- 513 38. Vitalini S, Iriti M, Puricelli C, Ciuchi D, Segale A, Fico G. Traditional knowledge on medicinal
514 and food plants used in Val San Giacomo (Sondrio, Italy) -An alpine ethnobotanical study.
515 *Journal of Ethnopharmacology*. 2013; 145: 517-529.

- 516 39. Friedman J, Yaniv Z, Dafni A, Palewitch DA. Preliminary classification of the healing potential
517 of medicinal plants, based on the rational analysis of an ethnopharmacological field survey
518 among Bedouins in Negev Desert. *Israel Journal of Ethnopharmacology*. 1986; 16:275–87.
- 519 40. Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. Medicinal plants in Mexico:
520 Healers'consensus and cultural importance. *Social Sciences & Medicine*. 1998; 47:1863–75.
- 521 41. Carrió E, Vallès J. Ethnobotany of medicinal plants used in Eastern Mallorca (Balearic Islands,
522 Mediterranean Sea). *Journal of Ethnopharmacology*. 2012; 141: 1021–1040.
- 523 42. IUCN. IUCN Red List of threatened species. Version 2012. Accessed 09 November 2012.
- 524 43. Otieno NE, Analo C. Local indigenous knowledge about some medicinal plants in and around
525 Kakamega forest in western Kenya. *F1000 Research*. 2012; 1:40.
- 526 44. Tolossa K, Debela E, Athanasiadou S, Tolera A, Ganga G, Houdijk JGM. Ethnomedicinal
527 study of plants used for treatment of human and livestock ailments by traditional healers in
528 South Omo, Southern Ethiopia. *Journal of Ethnobiology & Ethnomedicine*. 2013; 9: 32-46.
- 529 45. Diame GLA. Ethnobotany and ecological studies of plants used for reproductive health: A case
530 study at Bia Biosphere reserve in the western region of Ghana. UNESCO, Accra, Ghana;
531 2010.
- 532 46. Pei SJ. Ethnobotany and modernization of traditional chinese medicine. In himalayan
533 medicinal and aromatic plants, balancing, use and conservation (eds. Thomas, Y., Karki, M.,
534 Gurung, K. and Parajuli, D.), Ministry of Forest and Soil Conservation, HMG, Nepal 2005.
- 535 47. Nanyingi MO, Mbaria JM, Lanyasunya AL, Wagate CG, Koros KB, Kaburia HF et al.
536 Ethnopharmacological survey of Samburu district, Kenya. *Journal of Ethnobiology &*
537 *Ethnomedicine*. 2008; 4:14.
- 538 48. Mesfin F, Demissew S, Teklehaymanot T. An ethnobotanical study of medicinal plants in
539 Wonago Woreda, SNNPR, Ethiopia. *Journal of Ethnobiology & Ethnomedicine*. 2009; 5: 28.
- 540 49. Muthee JK, Gakuya DW, Mbaria JM, Kareru PG, Mulei CM, Njonge FK. Ethnobotanical study
541 of anthelmintic and other medicinal plants traditionally used in Loitokitok district of Kenya.
542 *Journal of Ethnopharmacology*. 2011; 135:15–21.

- 543 50. Ochwang DO, Kimwele CN, Oduma JA, Gathumbi PK, Kiama SG, Efferth T. Phytochemical
544 Screening of Medicinal Plants of the Kakamega Country, Kenya commonly used plants
545 against cancer. *Medicinal & Aromatic*. 2016; 5:6.
- 546 51. Han X, Shen T, Lou H. Dietary polyphenols and their biological significance. *International*
547 *Journal of Molecular Sciences*. 2007; 950-988.
- 548 52. Elliott MJ, Chithan K, Theoharis T. The effects of plant flavonoids on mammalian Cells:
549 implications for inflammation, heart disease and cancer. *Pharmacological Review*. 2000; 52:
550 673-751.
- 551 53. Ogawa S, Hirayama T, Mohara M, Tokuda M, Hirai K. The effect of quercetin on the
552 mutagenicity of 2-acetylaminofluorene and benzo[a]pyrene in *Salmonella typhimurium* strains.
553 *Mutat. Res*. 1985; 142: 103-107.
- 554 54. Salah N, Miller NJ, Pagange G, Tjburg L, Bolwell GP. Polyphenolic flavonoids as scavenger
555 of aqueous phase radicals as chai breaking antioxidant. *Arc. Biochem. Broph*. 1995; 2: 339-
556 346.
- 557 55. Sriithi K, Trisonthi C, Wangpakapattanawong P, Balslev H. Medicinal plants used in Hmong
558 women's healthcare in northern Thailand. *Journal of Ethnopharmacology*. 2012; 139:119 –
559 135.
- 560 56. De Wet H, Ngubane SC. Traditional herbal remedies used by women in a rural community in
561 northern Maputaland (South Africa) for the treatment of gynaecology and obstetrics
562 complaints. *South African Journal of Botany*. 2014; 94: 129-139.
- 563 57. Cowan MM. Plant products as antimicrobial agents. *Clinical Microbiology Reviews*. 1999; 22:
564 564–582.
- 565 58. Gazzaneo LRS, Lucena RFP, Albuquerque UP. Knowledge and use of medicinal plants by
566 local specialists in a region of Atlantic Forest in the state of Pernambuco (Northeastern Brazil).
567 *Journal of Ethnobiology & Ethnomedicine*. 2005; 1:9.
- 568 59. Kamatenesi–Mugisha M, Oryem–Origa H. Medicinal plants used to induce labour during
569 childbirth in western Uganda. *Journal of Ethnopharmacology*. 2007; 109:1–9.

- 570 60. Kothale KV, Rothe SP, Pawade PN. Phytochemical screening of some Euphorbiaceae
571 members. *Journal of Phytology*. 2011; 3(12): 60–62.
- 572 61. Néné Bi SA, Traoré F, Soro TY, Souza A. Étude phytochimique et pharmacologique de
573 *Bridelia ferruginea* Benth (Euphorbiaceae) sur la motricité du *Taenia colide* cobaye. *Afrique*
574 *Science*. 2009; 5(2):305–320.
- 575 62. Alvarenga SAV, Ferreira MJP, Emerenciano VP, Cabrol-Bass D. Chemosystematic studies of
576 natural compounds isolated from Asteraceae: Characterization of tribes by principal
577 component analysis. *Chemometrics & Intelligent Laboratory Systems*. 2001; 56:27–37.
- 578 63. Agize M, Demissew S, Asfaw Z. Ethnobotany of medicinal plants in Loma and Gena Bosa
579 Districts (Woredas) of Dawro zone, Southern Ethiopia. *Topclass Journal of Herbal Medicine*.
580 2013; 2(9):194–212.
- 581 64. Giday M, Asfaw Z, Elmqvist T, Woldu Z: An ethnobotanical study of medicinal plants used by
582 the Zay people in Ethiopia. *Journal of Ethnopharmacology*. 2003; 85. 43–52.
- 583 65. Uniyal SK, Sing HK, Jamwa IP, La LB. Traditional use of medicinal plants among the tribal
584 communities Of Chhota Bhangal, Western Himalaya. *Journal of Ethnobiology &*
585 *Ethnomedicine*. 2006; 2:14.
- 586 66. Singh AG, Kumar A, Tewari DD. An ethnobotanical survey of medicinal plants used in Terai
587 forest of western Nepal. *Journal of Ethnobiology & Ethnomedicine*. 2012; 8:19.
- 588 67. Umair M, Altaf M, Abbasi AM. An ethnobotanical survey of indigenous medicinal plants in
589 Hafizabad district, Punjab-Pakistan. *Plos ONE*. 2017; 6: 1-22.
- 590 68. Odutuga AA, Dairo JO, Minari JB, Bamisaye FA. Antidiabetic effect of *Morinda lucida*
591 stembark extract on alloxan-induced diabetic rat. *Journal of Pharmacology*. 2010; 4 (3):78-82.
- 592 69. Kadiri M, Ojewumi AW, Adebisi DT, Yahaya M, Bala SA. Ethnophytotherapy of plants used for
593 managing diarrhea in Abeokuta, Ogun State, Nigeria. *International Journal of Green & Herbal*
594 *Chemistry*. 2014; 3(3): 1307-1319.

- 595 70. Devi Prasad AG, Shyma TB, Raghavendra MP. Traditional herbal remedies used for
596 management of reproductive disorders in wayanad district, kerala. *International journal of*
597 *Research in Pharmacy & Chemistry*. 2014; 4(2): 333-341.
- 598 71. Teklehaymanot T. An ethnobotanical survey of medicinal and edible plants of yalo Woreda in
599 Afar Regional State, Ethiopia. *Journal of Ethnobiology & Ethnomedicine*. 2017; 13: 40.
- 600 72. Alelign N, Giday M, Teklehaymanot T, Animut A. Ethnobotanical survey of antimalarial plants
601 in Awash-Fentale District of Afar Region of Ethiopia and in vivo evaluation of selected ones
602 against Plasmodium berghei. *Asian Pacific Journal of Tropical Biomedicine*. 2018; 8(1): 73-78.
- 603 73. Muthaura CN, Rukunga GM, Chhabra SC, Omar SA, Guanti AN, Gathirawaj W. Antimalarial
604 activity of some plants traditionally used in treatment of malaria in Kewale district of Kenya.
605 *Sci Dir*. 2007; 112: 545-551.
- 606 74. Munishi PKT, Mkiramweni EN, Temu RPC, Nancy, P. Indigenous Knowledge and technology
607 in medicinal use of plant resources in South Pare Mountains, North Eastern Tanzania 2004.
- 608 75. Assegid A, Tesfaye A. Ethnobotanical Study of Wild Medicinal Trees and Shrubs in Benna
609 Tsemay District, Southern Ethiopia. *Journal of Science & Development*. 2014; 2(1): 1-33.
- 610 76. Akash T, Sakina M, Muhammad A, Abd-Allah EF, Abeer H, Abdulaziz AA, Riaz U.
611 Ethnomedicinal evaluation of medicinal plants used against gastrointestinal complaints.
612 *BioMed Research International*. 2015; 14.
- 613 77. Chekole G. Ethnobotanical study of medicinal plants used against human ailments in
614 Gubalafto District, Northern Ethiopia. *Journal of Ethnobiology & Ethnomedicine*. 2017; 13: 55.
- 615 78. Yineger H, Yewhalaw D. Traditional medicinal plant knowledge and use by local healers in
616 Sekoru District, Jimma Zone, South-western Ethiopia. *Journal of Ethnobiology &*
617 *Ethnomedicine*. 2007; 3:24.