Heliyon 6 (2020) e04830

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Integration of medicinal plants into the traditional system of medicine for the treatment of cancer in Sokoto State, Nigeria

Ibrahim Malami [a,b,*], Nasiru Muhammad Jagaba [a], Ibrahim Babangida Abubakar [c], Aliyu Muhammad [d], Alhassan Muhammad Alhassan [e], Peter Maitama Waziri [f], Ibrahim Zakiyya Yakubu Yahaya [a], Halilu Emmanuel Mshelia [a], Sylvester Nefy Mathias [a]

[a] Department of Pharmacognosy and Ethnopharmacy, Faculty of Pharmaceutical Sciences, Usmanu Danfodiyo University, PMB 2346, Sokoto, Nigeria
[b] Centre for Advanced Medical Research and Training (CAMRET), Usmanu Danfodiyo University, PMB 2346, Sokoto, Nigeria
[c] Department of Biochemistry, Faculty of Life Sciences, Kebbi State University of Science and Technology, Aliero, PMB 1144, Kebbi State, Nigeria
[d] Department of Biochemistry, Faculty of Life Sciences, Ahmadu Bello University Zaria, 810271, Nigeria
[e] Department of Pharmaceutical and Medicinal Chemistry, Faculty of Pharmaceutical Sciences, Usmanu Danfodiyo University, PMB 2346, Sokoto, Nigeria
[f] Department of Biochemistry, Kaduna State University, Main Campus, PMB 2336, Kaduna, Nigeria

ARTICLE INFO

Keywords:
Alternative medicine
Cancer research
Ethnopharmacology
Pharmaceutical science
Pharmacology
Traditional medicine practice
Cancer
Integrative medicine
Medicinal plants
Ethnobotanical survey
Sokoto state

ABSTRACT

This study was designed to explore and record various medicinal plants integrated into the traditional system of medicine for the treatment of cancer. The traditional system of medicine is a routine practiced among the indigenous ethnic groups of Sokoto state. A semi-structured questionnaire was designed and used for data collection around the selected Local Government Areas. A substantial number of plant species were identified, recorded, and collected for preservation. Data collected for each specie was analysed to assess its frequent use among the medicinal plants. A total of 67 species belonging to 31 families have been identified and recorded. Out of the 473 frequency of citation (FC), *Acacia nilotica* was the most frequently cited specie (32 FC, 64% FC, 0.6 RFC), followed by *Guiera senegalensis* (27 FC, 54% FC, 0.5 RFC), *Erythrina sigmoidea* (17 FC, 34% FC, 0.3 RFC), and subsequently *Combretum camporum* (15 FC, 30% FC, 0.3 RFC). The most common parts of the plants used include the barks (55.2%), the roots (53.2%), and the leaves (41.8%). Additionally, decoction (74.6%), powdered form (49.3%), and maceration (46.3%) are the most frequently used mode of preparation. The historical knowledge of a traditional system of medicine practiced by the native traditional healers of Sokoto for the treatment of cancer has been documented. The present study further provides a baseline for future pharmacological investigations into the beneficial effects of such medicinal plants for the treatment of cancer.

1. Introduction

Cancer is a major global disease burden with heavy morbidity and mortality affecting people around the world. Africa accounts for 7.3% of the cancer deaths and 5.8% of the total cancer incidence worldwide (Bray et al., 2018). While cancer incidence among males has varied 6-fold from 79 per 100,000 (Ferlay et al., 2015) to 95.6 per 100,000 (Bray et al., 2018) in the West African region, it was recoded in Nigeria (2012–2013) at 94.2 per 100,000 and 160.2 per 100,000 among males and females, respectively (Morounke et al., 2017).

Medicinal plants have played an important role in the life of people across the globe. To date, traditional medicine practitioners (TMP) are primarily considered as the first-line healthcare providers in a rural community. The frequent use of traditional herbal medicine is often ascribed to the failure of orthodox treatment. Africa is one of the continent richly endowed with medicinal plants (Mgbeahuruikea et al., 2019) and Nigeria is among the African region that regularly used complementary and alternative medicine (CAM) concurrently with traditional belief for the treatment of various forms of diseases (Shinkafi et al., 2015).

Nigeria is indigenously rich in plant biodiversity commonly used as medicine for the management and treatment of different form ailments. The use of CAM by the locals across the region has been known for generations and preserved through the transmission of knowledge towards the younger generation. Furthermore, the frequent dependency on the use of herbal remedies has been attributed to the inability of patients

* Corresponding author.
E-mail address: ibrahim.malami@udusok.edu.ng (I. Malami).

https://doi.org/10.1016/j.heliyon.2020.e04830
Received 20 May 2019; Received in revised form 4 February 2020; Accepted 27 August 2020

access convention therapy, thereby relying on TMP for their health care needs (Ekanem and Udoh, 2009). In Sokoto state, the traditional system of medicine has long been practiced among the indigenous ethnic groups before the advent of Usman bin Fodiyo. Historically, the state is known for traditional medicine practice and herbal trade, which attracts many people across the West African region (Shinkafi et al., 2015).

The use of herbal medicines in Sokoto state has been documented for the management of diabetes (Shinkafi et al., 2015) while for the treatment of malaria, peptic ulcer, and other ailments have been reported elsewhere (Adebisi and Alebiosu, 2014; Oluranti et al., 2012a, 2012b). On the other hand, the use of medicinal plants for the treatment of cancer has received less attention and priority over the years due to the apparent focus on tropical and communicable diseases such as malaria, diabetes, polio meningitis, HIV/AIDS, etc. At the time of writing this report, there has not been any documented information on the use of folk medicine in relation to cancer treatment. This study was designed to explore and record various medicinal plants used as folk medicines for the treatment of cancer among the indigenous ethnic groups of Sokoto state.

2. Materials and methods

2.1. Study area and survey design

The present study was conducted in Sokoto state located in the North-West of Nigeria (Figure 1). Approximately, the region is located on the coordinates: 11 33°04′N latitude and 5°14′E longitude with a total coverage area of 25,973 km^2 at the extreme end of the Northern region neighbouring the Saharan Countries (Adegboyega et al., 2016). The state has over 3.6 million populations (NPC, 2013) comprising different ethnic groups including Hausa, Fulani, Zabarmawa, and Tuareg. Hausa is considered as the largest ethnic group dominated in the region. Agriculture is predominantly the most common practice among the population living in the region. On the other side of the region, Sokoto borders with Zamfara to the south and Kebbi State to the West. Among the twenty-three (23) Local Government Areas (LGAs) contained, Sokoto-North, Sokoto-South, Wamakko, Dange-Shuni, and Bodinga LGAs were selected for the study. The LGAs were selected due to the closeness to the central region where herbal trade and traditional medical practice is most prominent.

A modified semi-structured questionnaire was adopted (Shinkafi et al., 2015) to quantitatively and qualitatively acquire different forms of information relevant to the study (Lee et al., 2018). The questionnaire used comprises personal information such as the name, age, sex, religious views, contact number, local tribe, and nationality. Additional information such as informant's area of specialty, duration of practice, means of diagnosis, mode of preparations, route of administration, admissions, and referrals were also included. The target participants for this study were primarily the traditional healer (e.g., TMP), those with knowledge of medicinal plants (e.g., herb sellers or older inhabitant), and herbalist. A total number of fifty (50) participants residing in the selected LGAs were randomly visited for the interview.

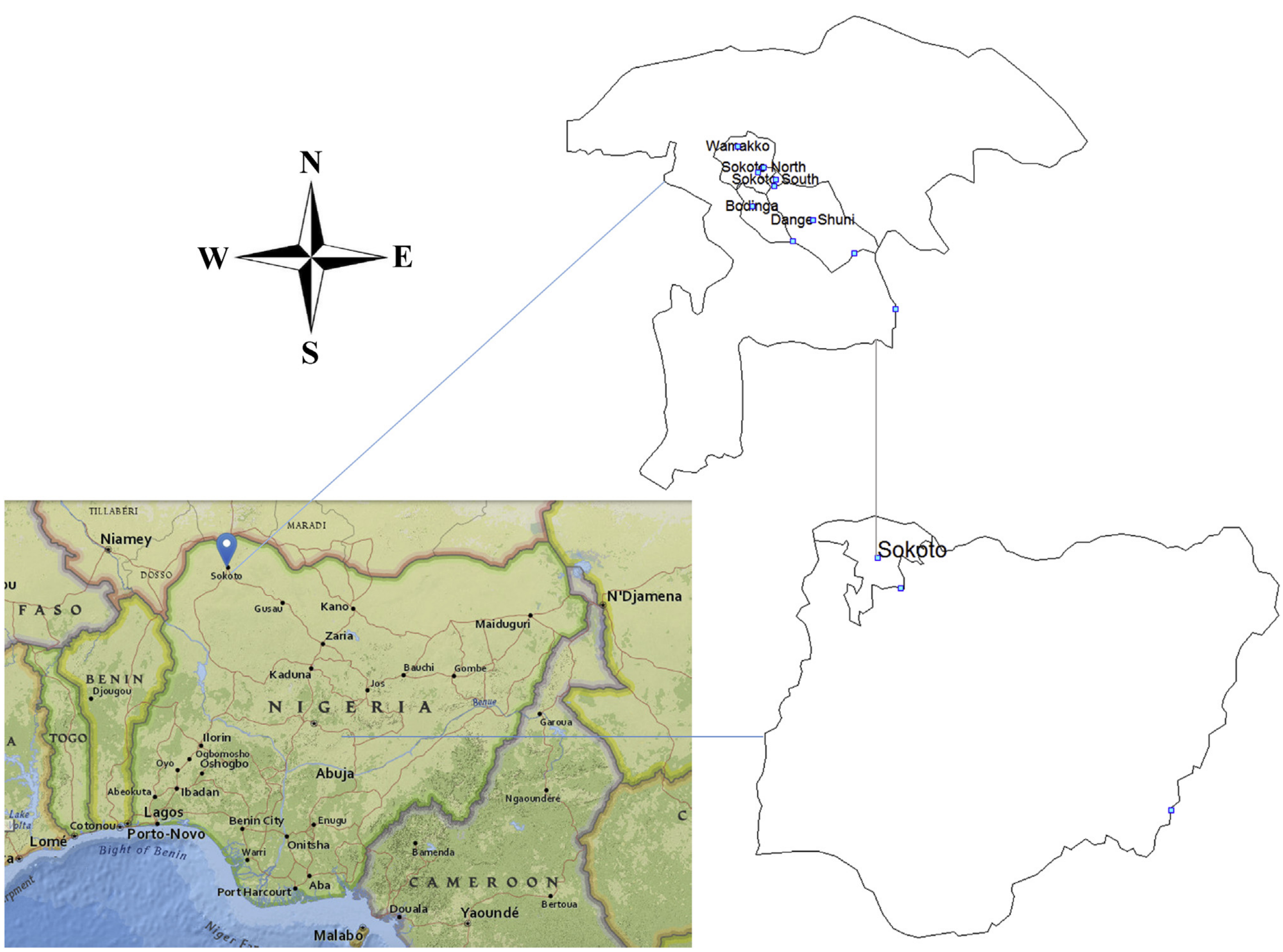

Figure 1. A map of Nigeria (bottom left corner) located along the Gulf of Guinea retrieved from MapMaker Interactive (https://mapmaker.nationalgeographic.org/); map of Nigeria (bottom right corner) showing Sokoto province were the study was performed; only the study areas involved are presented in the map. The maps are designed using academic version of Map Maker 4 software obtainable from www.mapmaker.com.

2.2. Data collection

An ethnobotanical survey was conducted from June to October 2018. Prior to the survey, consent of the interview was requested and granted by the Sokoto branch of the National Association of Nigerian Traditional Medicine Practitioners (NANTMP) and the procedures approved by the University Ethical Committee (PTAC/MP/AL/SQ/02–20). Informants involved during the interview include TMP, herbalist, and herb sellers. Informed consent was obtained from each of the informants prior to the administration of the questionnaire. An oral interview was granted to the informants that are unable to read or write, and the questionnaire was completed on their behalf. Each medicinal plant revealed by the respondent is recorded in the local names commonly recognised in the region. During specimen collection, informants were contacted for specimen collection and processed for identification. Subsequently, local names of medicinal plants were used to identify and collect specimens for proper identification. Each specimen was identified and assigned voucher number at the Herbarium of the Department of Pharmacognosy and Ethnopharmacy, Faculty of Pharmaceutical sciences, Usmanu Danfodiyo University, Sokoto. Furthermore, each plant species was validated via the Plant List database (http://www.theplantlist.org), Global Plants database (https://plants.jstor.org), and West African Plants database (http://www.westafricanplants.senckenberg.de).

2.3. Data analysis

Data generated from the ethnobotanical study were examined in a Microsoft Office application 2013 (Excel). To assess the local importance of each of the species identified, percentage Frequency of Citation (FC) (Shinkafi et al., 2015), Relative Frequency of Citation (RFC) (Ahmad et al., 2014), and Informant Agreement Ration (IAR) (Heinrich et al., 1998) were used to analyse and compare the use of a single specie among the medicinal plants.

$$FC\ (\%) = NC/TI \times 100$$

where, NC = total number of citations, TI = total number of informants

$$RFC = FC/N$$

where, FC = frequency of citations, N = total number of informants

$$IAR = (Nur - Nt)/(Nur - 1)$$

Where, Nur = number of used reports recorded as being used for a particular cancer type, Nt = number of plant species recorded for that type.

3. Results and discussion

3.1. Target participant for ethnobotanical studies

A total of 50 informants with knowledge of traditional medicine in the region were approached and interviewed for this study. For the period of the survey, the vast majority of the TMPs encountered were males (96%), whilst females constitute only 2% of the overall data. Culture, religious beliefs, and practices are the socio-cultural factors attributed to gender differences among the practitioners in Nigeria (Abara, 2012), which are predominantly found in most of the Northern parts of the country. A greater percentage (56%) of the respondents with substantial years of experience in practice are found ranging from 51 – 65 years of age while the least of the respondents found at the age of between 18 – 35 and 66–70 account for 4% and 6%, respectively. Furthermore, the Hausa ethnic group largely account for the highest percentage (66%) of the respondents in the survey followed by the Fulani ethnic group (32%) and both ethnic group specialised mainly in TMP and herbalism (Table 1).

On the other hand, 96% of the data obtained from the informants have revealed to physically assess patients while the remaining informants (4%) do not specify. From the data obtained, none of the informants directs patients for conventional diagnosis. A significant number of traditional healers in the region are uneducated, and therefore, diagnose patients at their discretion. In a similar report, Shinkafi and co-workers have shown that traditional healers from the same region do not apply the services of conventional methods to diagnose patients (Shinkafi et al., 2015) hence the present report is consistent in respect to the author's observation. The most notable physical examination performed on the patients includes skin examination of the affected area, breast examination for the presence of swellings in the affected area, examining the presence of lumps in an inflamed area of the neck or armpits, and belly examination of an inflamed area for any sign of an internal tumour. They argued that the technique used in the evaluation is effective in identifying and treating tumour disease. Other physical observations encountered during diagnosis include foul breath, excessive coughing, bitterness in the mouth, numbness in the sole of the feet, hotness in the palm of the hands, among others. These observations serve as indicators for the presence of internal tumours (e.g., lung).

In relation to this, the traditional healers in the region classified tumours into two different classes according to their origin. The internal tumours are those found inside the body of a patient such as a lung, liver, colon, and gynaecological tumours. The outside tumours on the other hand, are those visibly found outside the body of a patient such as a breast and skin. A significant number of the informants argued that

Table 1. Demographic characterises of the informants.

Parameters	Specifications	% NI
Age	18–35	4
	36–50	34
	51–65	56
	66–80	6
Gender	Male	96
	Female	2
	Unspecified	2
Tribe	Hausa	66
	Fulani	32
	Others	2
Speciality	TMPs	58
	Herbalist	32
	Herb sellers	6
	TMPs/Herb sellers	2
	Unspecified	2
Year of practice	1–10 years	0
	11–20 years	34
	21–30 years	44
	31 and above	10
	Unspecified	12
Method of diagnosis	Physical	96
	Psychological	0
	Biological	0
	Others	0
	Unspecified	4
Admission of patients	Yes	4
	No	92
	Unspecified	4
Referral	Senior colleague	48
	Hospital	38
	Senior Colleague/Hospital	12
	Unspecified	2

NI: Number of informant.

internal tumours often developed from the outside tumours, e.g., the tumour from the breast can be transferred to the lung. Others believe that communicable diseases such as malaria and typhoid can lead to cancer development when they become intense. The implication of their techniques is that patients with different conditions are susceptible to misdiagnosis. For instance, we noted that almost all TMP mistakenly refers to inflammatory disorder for cancer. Generally, they defined cancer (commonly known as "*iska*" in Hausa) as any inflammatory disorder developed outside or inside the body. In some instances, some of the informants identified swelling and stiffness of the skin or inflammatory bowel disorders (e.g., irritable bowel syndrome) as a tumour. However, only a few of the respondents that have gone through years of experience argued to differentiate between the two inflamed characters. From our observation, these TMP diagnosed patients based on physical symptoms to commonly known disorders.

Furthermore, we noticed that 92% of the informants chose to offer outpatient care, and 4% advised their patients to reside for the duration of treatment. We asked them in what ways they handle patients beyond their capability, and we realised that 45% refer their patients to senior colleagues that have gone through years of experience. However, a significant percentage of the respondents (38%) willingly sent patients to a hospital, and the remaining respondents (12%) seek for either senior colleagues or professional assistance.

3.2. Data collection and analysis

Data obtained from the overall survey have identified a total of 67 species belonging to 32 families claimed to have been used for cancer treatment in different communities of Sokoto-South and North, Dange-Shuni, Bodinga, and Wamakko LGA. Sokoto-South LGA presented the highest percentage (25%) of the plant species identified, whereas about 47% of the species were equally distributed among Sokoto-North and Dange-Shuni LGA (Figure 2A). Further to this, Bodinga and Wamakko LGA provided 22.4 and 17.9% of the plant species, respectively. The overall plant species documented in the present study are provided alphabetically in the order of a genus (Table 2). Out of the total species identified, Leguminosae is recorded as the most commonly used family representing 19 plant species, while Malvaceae, Combretaceae, and Anacadiaceae provided 6, 5, and 4 species, respective. Others provided to 3 or less of the remaining plant species.

For the period of data collection, we noticed that more than one local name described a single species, e.g., '*Kayar kusa*' or '*bera*' ascribed to *Asparagus Africanus* Lam., '*Runhuu*' or '*Runfuu*' ascribed to *Cassia singueana* Delile., '*Dany'a* or '*Nunu*' ascribed to *Sclerocarya birrea* (A.Rich.) Hochst, among others. The differences are attributed to different ethnic groups in the region as well as the traditional uses of the species for a different purpose. In some cases, both language and traditional use in the region mix up at least two if not more than two species having the same local name. For instance, "*Girgizi*" ascribing to *Cyperus difformis* L. can also be described as *Borassus aethiopum*, *Cyperus digitatus*, and *Hyphaene thebaica*. There are other relevant instances, but we ensured the right plant is properly collected and identified in an appropriate manner.

In this study, we have recorded a total number of 473 FC by the informants. *Acacia nilotica* (L.) Delile (32 FC) was the most frequently cited, followed by *Guiera senegalensis* J.F.Gmel. (27 FC), *Erythrina sigmoidea* Hua. (17 FC), *Combretum camporum* Engl. (15 FC), *Lannea acida* A. Rich. (14 FC), *Ziziphus mucronata* Willd. (14 FC), *Cassia sieberiana* DC. (13 FC), *Dichrostachys cinerea* (L.) Wight & Arn (13 FC), and *Ficus polita* Vahl. (12 FC). Others include *Leptadenia hastata* Vatke., *Nauclea diderrichii* (De wild.) Merr., and *S. birrea*, each having 11 FC. Furthermore, leguminosae (28.4%) has recorded the highest number of species in the families, followed by malvaceae and combretaceae, which accounted for 9% and 7.5%, respectively (Figure 2B).

On the other hand, *A. nilotica* (64%) has recorded the highest percentage FC with an RFC of 0.6, followed by *G. senegalensis* (54% FC, 0.5 RFC), *E. sigmoidea* (34% FC, 0.3 RFC), *C. camporum* (30% FC, 0.3 RFC), *L. acida* (28% FC, 0.3 RFC), *Z. mucronata* (28% FC, 0.3 RFC), *C. sieberiana* (26% FC, 0.3 RFC), *D. cinerea* (26% FC, 0.3 RFC), and *F. polita* (24% FC, 0.3 RFC). The most frequently cited species in this study are shown in Figure 2C and their RFC values, which appeared in Table 2.

Furthermore, skin cancer was recorded to have the highest IAR value of 0.82, followed by breast (0.75), head and neck (0.74), colon (0.71), lung (0.71), cervical (0.67), and scrotum (0.50). The IAR values ranging from 0 to 1 indicate the number of times any plant species use by many informants for a specific disease type (Heinrich et al., 1998). The high ranking of IAR values might be attributed to the most notable tumours

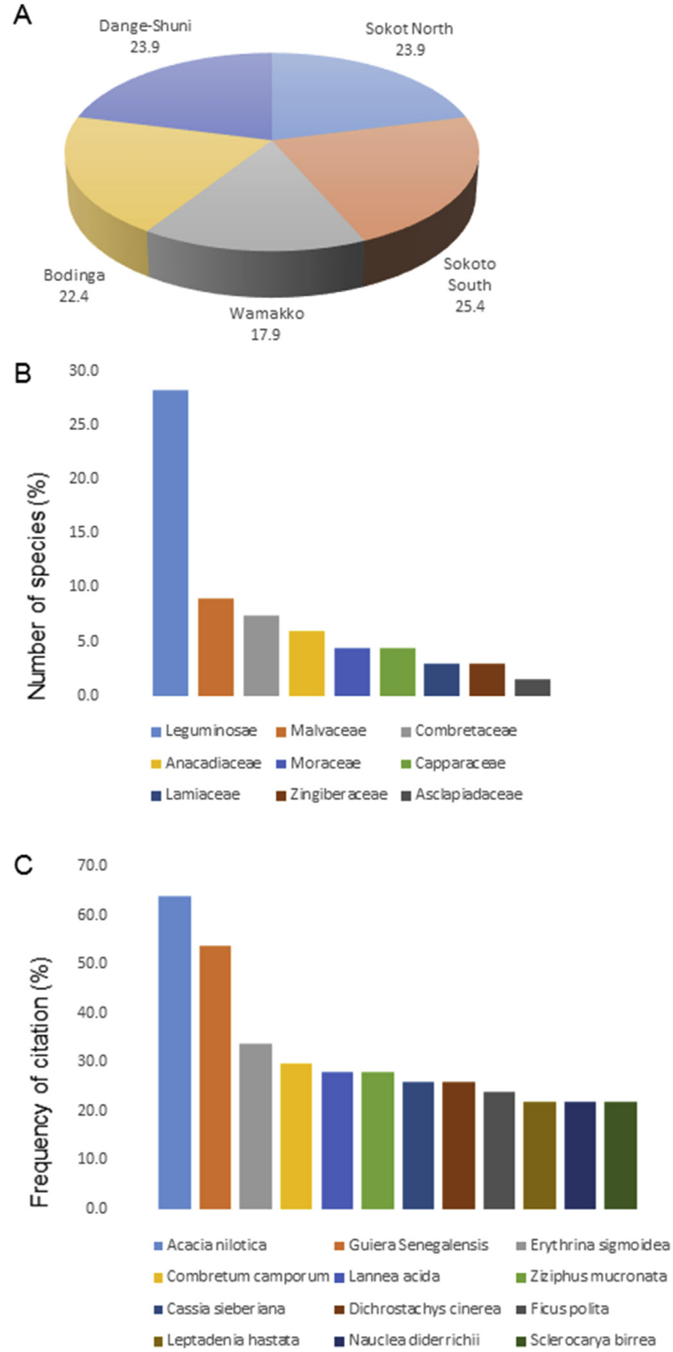

Figure 2. Percentage number of: A. plant species identified in each of the LGAs used in different communities; B. plant species recorded as being used for cancer treatment in a particular family; C. times any plant was cited as having used for cancer treatment.

Table 2. List of medicinal plants identified to be used for cancer treatment by the native traditional healers of Sokoto province.

Scientific name	Family	Common name	Local name	VN	LGA	PPU	MP	RT	RFC
Acacia nilotica (L.) Delile	Leguminosae	Egyptian mimosa	Bagaruwa	PCG/UDUS/Legu/0008	SS	L/B*/R/S	P/M/D*	O/T	0.6
Acacia sieberiana DC.	Leguminosae	Paperbark thorn	Farar kaya	PCG/UDUS/Legu/0001	SS	L/B*	P/M/D*	O/T	0.1
Albizia chevalieri Harms	Leguminosae	Silk plant	Katsari	PCG/UDUS/Legu/0002	SS/SN	B*/R	M/D*	O	0.2
Allium cepa L.	Amaryllidaceae	Onion	Albasa	CG/UDUS/Amar/0001	SS	L/B*	D*	O	0.1
Anacardium occidentale L.	Anacardiaceae	Cashew	Yazawa	PCG/UDUS/Anac/0002	SN/D	B*/R	M/D*	O	0.1
Anogeissus leiocarpus (DC.) Guill. & Perr.	Combretaceae	African birch	Marke	PCG/UDUS/Comb/0001	D	L/B*/R	P/M	O/T	0.2
Aristolochia albida Duch.	Aristolochiaceae	Duchiman pipe	Duman Dutse	PCG/UDUS/Aris/0001	SN	S	D*	O	0.2
Asparagus Africanus Lam.	Asparagaceae	Asparagus	Kayar kusa/bera	PCG/UDUS/Aspa/0001	SN	L	D*	O	0.0
Balanite aegyptiaca Del.	Zygosphllaceae	Desert date	Aduwa	PCG/UDUS/Zygo/0002	W/SN	B*/L	D*	O	0.2
Bauhinia rufescens Lam.	Leguminosae	Silver butterfly	Jirga	PCG/UDUS/Faba/0019	B	L/B*/R	P/D*	O/T	0.1
Boscia senegalensis (Pers.) Lam.	Capparaceae	Basari	Anza	PCG/UDUS/Capp/0001	W	L/R	M/D*	O	0.2
Cadaba farinosa Forssk.	Capparaceae	herds boy fruits	Bagayi	PCG/UDUS/Capp/0002	D	L/B*/R	M/D*	O	0.1
Cassia sieberiana DC.	Leguminosae	African laburnum	Malga	PCG/UDUS/Legu/0004	SS	B*/R/S	P/D*	O/T	0.3
Cassia singueana Delile.	Leguminosae	Sticky pod	Runhuu/Runfuu	PCG/UDUS/Faba/0003	B	L/B*/R	P/M	O/T	0.1
Citrullus lanatus (Thunb.) Matsum. & Nakai.	Curcubitaceae	Water melon	Kankana	PCG/UDUS/Curc/0001	SN	S	P	T	0.0
Combretum micranthum G. Don	Combretaceae	Bush tea	Geza	PCG/UDUS/Comb/0003	B	L/B*/R	P/M	O/T	0.0
Combretum camporum Engl.	Combretaceae	-	Taramniya	PCG/UDUS/Comb/0004	SS	B*/R	M/D*	O	0.3
Combretum molle R.Br. ex G.Don	Combretaceae	-	Wuyan damo	PCG/UDUS/Comb/0005	B	B*	P/M/D*	O/T	0.1
Curcuma longa L.	Zingiberaceae	Turmeric	Gangamau	PCG/UDUS/Zing/0001	SS	P*	P/D	O/T	0.1
Cyperus difformis L.	Cyperaceae	Rice sedge	Gizgiri	PCG/UDUS/Cype/0001	B/SN	S	M	O	0.2
Detarium senegalense J.F.Gmel.	Leguminosae	Tallow tree	Taura	PCG/UDUS/Legu/0014	W	L/B*/R	P/D*	O/T	0.2
Dichrostachys cinerea (L.) Wight & Arn	Leguminosae	Sickle bush	Dundu	PCG/UDUS/Legu/0005	D	B*/R	P/D*	O/T	0.3
Diospyros mespiliformis Hochst. ex A.DC.	Ebenaceae	Jackal berry	Kanya/Kaiwa	PCG/UDUS/Eben/0001	D	B*/R	M/D*	O	0.0
Entada Africana Guill. & Perr.	Leguminosae	Entada	Tawatsa	PCG/UDUS/Legu/0006	SN	B*/R	M/D*	O	0.0
Erythrina sigmoidea Hua.	Leguminosae	Frankincense tree	Hano	PCG/UDUS/Legu/0017	SS	R	P/D*	O/T	0.3
Faidherbia albida (Delile) A.Chev.	Leguminosae	Winter thorn	Gawo	PCG/UDUS/Legu/0007	B	B*	P/M	O/T	0.1
Ficus gnaphalocarpa (Miq.) Steud ex Miq.	Moraceae	Ficus tree	Baure	PCG/UDUS/Mora/0002	B	B*/R	P/D*	O/T	0.1
Ficus platyphylla Delile.	Moraceae	Red rubber tree	Gamji	PCG/UDUS/Mora/0003	W	B*/R	P/D*	O/T	0.2
Ficus polita Vahl.	Moraceae	Herat leaved fig	Durumi	PCG/UDUS/Mora/0001	B/D	B*/R	M/D*	O	0.2
Grewia mollis Juss.	Malvaceae	The air potato	Kamumuwa	PCG/UDUS/Malv/0002	B	R	D*	O	0.0
Grewia villosa Willd.	Malvaceae	Gray way	Dargaza	PCG/UDUS/Malv/0004	B	B*/R	M/D*	O	0.2
Guiera senegalensis J.F.Gmel.	Combretaceae	Moshi medicine	Sabara	PCG/UDUS/Comb/0002	SS	S*/R	P/D*	O/T	0.5
Gynandropsis gynandra (L.) Briq.	Capparaceae	African cabbage	Yar anguwa	PCG/UDUS/Capp/0003	D	L	D*	O	0.0
Hibiscus cannabinus L.	Malvaceae	Jute	Rama	PCG/UDUS/Malv/0003	SN/SS	S	S*	O	0.1
Hibiscus sabdariffa L.	Malvaceae	Roselle	Zobo	PCG/UDUS/Malv/0001	SN	S	S*	O	0.1
Indigofera tinctoria L.	Leguminosae	True indigo	Baaba	PCG/UDUS/Legu/0009	SN	R	M/D*	O	0.1
Ipomoea asarifolia (Desr.) Roem. & Schult	Convulvulaceae	Morning glory	Duman kada	PCG/UDUS/Conv/0001	D	L	D*	T	0.1
Khaya senegalensis (Desr.) A.Juss.	Miliaceae	African mahogany	Madaci	PCG/UDUS/Mili/0001	D	B*	P/D*	O/T	0.1
Leptadenia hastata Vatke.	Asclapiadaceae	Butterfly weed	Yadiya	PCG/UDUS/Ascl/0001	W/D	L/R	P/D*	O/T	0.2
Lannea acida A.Rich.	Anacadiaceae	Donbeya	Faru	PCG/UDUS/Anac/0004	W	B*/R/S	M/D*	O	0.3
Lophira lanceolata Tiegh. ex Keay	Ochonaceae	Red iron wood	Namijin Kade	PCG/UDUS/Ocho/0001	SS	L	P/D*	O/T	0.1
Mangifera indica L.	Anacadiaceae	Mango	Mangwaro	PCG/UDUS/Anac/0001	W/SN	L/B*	M/D*	O	0.1
Mimosa pigra L.	Leguminosae	Mimosa	Gumbi	PCG/UDUS/Legu/0013	B/SS	L/B*	P/D*	O/T	0.1
Moringa oleifera Lam.	Moringaceae	Drum stick tree	Zogale	PCG/UDUS/Mori/0001	SS	L	D*	O/I	0.1
Nauclea diderrichii (De wild.) Merr.	Rubiaceae	African peach	Tafashiya	PCG/UDUS/Rubi/0001	SN	B*	M	O	0.2
Ocimum basilicum L.	Lamiaceae	Basil	Sarakkuwar Sauro	PCG/UDUS/Lami/0002	SS	L/R	S**	O/DA	0.1
Ocimum gratissimum L.	Lamiaceae	Clove Basil	Doddowa	PCG/UDUS/Lami/0002	B	W*	D*	O	0.1
Parkia biglobosa (Jacq.) G.Don	Leguminosae bean tree	African locust	Doruwa	PCG/UDUS/Legu/0010	SS	B*/R	D*	O	0.1
Pennisetum pedicellatum Trin.	Poaceae	Nigeria Grass	Kyasuwa	PCG/UDUS/Poac/0001	D	L	D*	O	0.1
Piliostigma thonningii (Schum.) Milne-Redh.	Leguminosae	Camels foot	Kalgo	PCG/UDUS/Legu/0011	W	B*/R	D*	O	0.1
Pericopsis laxiflora (Baker) Meeuwen	Leguminosae	English satin wood	Makarho	PCG/UDUS/Legu/0012	D	B/R	P/M/D*	O	0.1
Psidium guajava L.	Myrtaceae	Guava	Gwaiba	PCG/UDUS/Myrt/0001	B	L/R	M/D*	O	0.1
Schwenkia Americana L.	Solanaceae	Slender herb	Dandana	PCG/UDUS/Sola/0001	SN	W*	M	O	0.1
Sclerocarya birrea (A.Rich.) Hochst.	Anacadiaceae	Marula	Danya/Nunu	PCG/UDUS/Anac/0003	SN	L/B*	P/M/D*	O	0.1
Senegalia polyacantha (Wild.) Seigler & Ebinger	Leguminosae	White thorn	Karoo	PCG/UDUS/Faba/0018	B	B*/R	P/M	O	0.1
Senna occidentalis (L.)	Leguminosae	Coffee senna	Sanga-sanga	PCG/UDUS/Legu/0016	W	L	D*	O	0.1

(*continued on next page*)

Table 2 (*continued*)

Scientific name	Family	Common name	Local name	VN	LGA	PPU	MP	RT	RFC
Sesamum radiatum Schumach. & Thonn	Pediliaceae	Benni seed	Yodo	PCG/UDUS/Pedi/0001	D	L	S*	O	0.1
Stachytarpheta jamaicensis (L.) Vahl	Verbenaceae	Blue potter weed	Tsira-hoko	PCG/UDUS/Verb/0001	B	R	P/D*	O	0.1
Sterculia setigera Delile	Malvaceae	Karayagum tree	Kukuki	PCG/UDUS/Malv/0006	SS	B*/R	P/M/D*	O	0.1
Stereospermum kunthianum Cham.	Biginoniaceae	Pink jacaranda	Sansami	PCG/UDUS/Bigi/0001	SN	R	P/D*	O	0.1
Strychnos spinosa Lam.	Loganaceae	Monkey ball	Kokiya	PCG/UDUS/Loga/0001	B/D	B*/R/S	P/D*	O	0.1
Tamarindus Indica L.	Leguminosae	Tamarind	Tsamiya	PCG/UDUS/Legu/0015	W	L/B*/R/S	P/M/D*	O	0.1
Vitellaria paradoxa C.F.Gaertn	Sapotaceae	Shear tree	Kadanya/Kade	PCG/UDUS/Sapo/0001	W	L	P	O	0.1
Waltheria indica L.	Starculiaceae	Sleepig morning	Yankufa	PCG/UDUS/Star/0001	SS	R	P/M	O	0.1
Ximenia Americana L.	Malvaceae	Wild olive	Tsada	PCG/UDUS/Malv/0005	D	L/B*	P/M	O	0.2
Zingiber officinale Roscoe	Zingiberaceae	Ginger	Citta	PCG/UDUS/Zing/0002	D	P*	D*	O	0.0
Ziziphus mucronata Willd.	Rhamnaceae	Buffalo thorn	Magaryar kura	PCG.UDUS/Rham/0001	W	L/B*	P/M	O	0.3

Local name: Name of plant known by the local people; VN: Voucher number; LGA: Local Government Area (SS – Sokoto South, SN – Sokoto North, B – Bodinga, D – Dange-Shuni, W –Wamakko); PPU: Plant parts used (L – Leaf, R – Root, B* – Bark, S – Seed, P* – Pod, W* – Whole plant); MP: Mode of Preparation (M – Maceration, D* – Decoction, P – Powder, S* – Soup, S** – Smoke); RT: Route of Administration (O – Oral, T – Topical, I – Inhalation, DA – Dermal absorption); RFC: Relative Frequency of Citation.

found outside the body of patients, e.g., skin cancer. The IAR values recorded ranging from 0.50 to 0.82 is tabulated in Table 3.

Collectively, the most frequently used plant species cited by the informants are *A. nilotica* and *G. senegalensis*. *A. nilotica* is a thorny tree native to the African region and grows wild in Nigeria particularly, in the Northern region (Alli et al., 2016). In Sokoto state, the tree is found virtually in every community around the area. The plant parts are used traditionally for different treatment of disease to include cancer. It was observed that seeds obtained from the plant are used to treat patients with breast, colon and head and neck tumours. The seeds are crushed into a fine powder, mixed with a small portion of water, and applied around the breast. In some cases, seeds are mixed with other herbal materials to improve effectiveness. Furthermore, the whole herbal materials can be used for treatment, but seeds are most often used by the TMP. Pharmacologically, there have been several reports validating the anticancer properties of the *A. nilotica*. Its potentials have been demonstrated *in vitro* against colorectal (Hakkim et al., 2018), breast (Barapatre et al., 2016; Sundarraj et al., 2012), lung (Sundarraj et al., 2012), cervical (Kalaivani et al., 2011), glioblastoma, and ovarian cancer (Salem et al., 2011). Similarly, *in vivo* pharmacological properties have been further validated against oral (Mohan et al., 2017), lymphoma (Sakthive et al., 2012), hepatocellular carcinoma (Singh et al., 2009), skin (Meena et al., 2006), and breast cancer (Kaur et al., 2002). Thus, the reported studies have backed up the traditional use of *A. nilotica* in the region.

G. senegalensis and *E. sigmoidea* is commonly found widely distributed in the Northern region of Nigeria. Both the Hausa and Fulani ethnic groups in the region used powdered preparation of the plant materials to treat patients, whereas in some cases, a decocted crude drug is also used for patients with suspected internal tumours. Pharmacologically, the traditional use of *G. senegalensis* and *E. sigmoidea* for cancer treatment has also been demonstrated *in vitro* against prostate, breast, and liver (Bello et al., 2017; Kuete et al., 2016, 2014), leukaemia (Kuete et al., 2016, 2014, 2012), cervical, colon (Fiot et al., 2006; Kuete et al., 2016, 2014), and glioblastoma (Kuete et al., 2016, 2014). A quite number of plant species that have been pharmacologically validated with anticancer properties are listed in Table 4. On the contrary, over 60% of the species identified in this study have not been verified, pharmacologically. Despite the fact that some of the genus such as *Combretum* spp, *Cyperus* spp, *Erythrina* spp., *Ficus* spp. *Mimosa* spp., among others, are widely known for their anticancer properties, yet none among the species identified in this study have been validated for similar properties.

In a similar study, the traditional use of medicinal plants for cancer treatment around Borno state in the far Eastern region of Nigeria has been reported elsewhere (Ngulde et al., 2014). In the present study, a vast number of species identified in Sokoto are consistent with that of the species documented in the region of Borno state. For instance, *A. nilotica*, *C. sieberiana*, *D. cinerea*, among others, have also been cited by the native people of Askira/Uba LGA of the Borno state. Culturally, hausa and fulani ethnic groups formed the minority in the region when compared to Sokoto state. The study reported by Ngulde and co-workers was insufficiently documented, even though both regions lie in the Sudan savanna. In the study, respondents are reported to collect herbs during the day any time between sunrise through sunset of the plant. In the present study, informants argued that leaves are actively collected from the beginning of the flowering to premature fruiting. Barks, on the other hand, are best collected during the dry season before the beginning of the rainy season. This approach, they argued, is effective in collecting medicinally active principles of the plants.

3.3. Parts of plant used, method of herbal preparation and route of administration

The most frequently used plant parts are barks, roots, and leaves, which account for 55.2, 53.2, and 41.8%, respectively. Furthermore, seeds have accounted for 16.4% of the plant parts used, while the whole plant (3%) and pods (3%) are equally the least used by the TMP (Figure 3A). For the period of documentation, we noticed that the TMP injudiciously collects medicinal herbs by uprooting or cutting down the whole plant in the forest. This method of collection is operational in most parts of the region, and it is based on the belief that the plant species are accessible at all times. Some respondents are aware of the importance of medicinal plant conservation that may protect plant biodiversity, while some pretend ignorant for economic gains. In the present study, the higher percentage accounted for the bark and root parts can be attributed to unregulated access to the forest and disregarding the safety of plant biodiversity. The frequent use of plant bark and root by the TMP has been described unsustainably for traditional medicine development (Heinrich and Jäger, 2015). On the contrary, certain TMP argued that the collection

Table 3. IAR by cancer type.

Type of cancer	Nur	Nt	IAR value
Skin	29	155	0.82
Breast	32	127	0.75
Head and neck	21	77	0.74
Colon	17	56	0.71
Lung	13	42	0.71
Cervical	3	7	0.67
Scrotum	5	9	0.50

Nur: number of use reports; Nt: number of species.

Table 4. List of plants that were pharmacologically validated for their anticancer properties and their traditional use in the region of Sokoto state.

Medicinal plant	Reference	Traditional use for type of cancer
A. nilotica	Hakkim et al. (2018); Mohan et al. (2017); Revathi et al. (2017); Barapatre et al. (2016); Sakthive et al. (2012); Sundarraj et al. (2012); Kalaivani et al. (2011); Kalaivani et al. (2011)	breast, skin, head and neck, scrotum
A. cepa	Pan et al. (2018); Nile et al. (2018); Fredotovi et al. (2017); Abdelrahman et al. (2017); Lee et al. (2014); Wang et al. (2012); Shrivastava and Ganesh (2010)	skin, and colon
A. occidentale	Santos et al. (2018); Taiwo et al. (2017); Ashraf and Rathinasamy (2017); Shilpa et al. (2015)	head and neck
A. leiocarpus	Hassana et al. (2018); Olugbami et al. (2017b); Salau et al. (2013)	breast, head and neck, skin
B. aegyptiaca	Yassin et al. (2017); Hassan et al. (2016); Saleh and Emara (2016); Issa et al. (2015)	breast, lung, skin
B. rufescens	Garbi et al. (2015)	skin
B. senegalensis	Elkhateeb et al. (2019)	breast, colon
C. longa	Li et al. (2018); Coker-Gurkan et al. (2018); Li et al. (2018); Zhao et al. (2018); Frassová and Rudá -Kučerová, 2018; Arumai Selvan et al. (2018); Perna et al. (2018); Naqvi et al. (2017); Mou et al. (2017); Wang et al. (2017); Zang et al. (2017); Zhou et al. (2017); de Campos et al. (2017); Rivera et al. (2017); Wang et al. (2017); Zhou et al., 2016; Santos et al. (2016); Liu et al. (2016); Mishra et al. (2016); Abdel-Lateef et al. (2016)	breast, lung, head and neckskin, cervical, scrotum, colon
D. cinerea	Long et al. (2009)	skin
E. Africana	Cioffi et al. (2006)	skin, breast
E. sigmoidea	Kuete et al. (2016); Kuete et al. (2014)	breast, colon, skin
G. senegalensis	Bello et al. (2017); Abubakr et al. (2013); Kuete et al. (2012); Fiot et al. (2006)	breast, lung, skin, colon
G. gynandra	Pettit et al. (2005)	skin
H. cannabinus	Wong et al. (2014)	breast
H. sabdariffa	Hassan et al. (2016); Tsai et al. (2014); Lin et al. (2011), 2007; Hou et al. (2005); Lin et al. (2005); Lin et al. (2002); Tseng et al. (2000)	lung, colon
I. tinctoria	Renukadevi and Suhani Sultana (2011); Kameswaran and Ramanibai (2008)	breast, head and neck
K. senegalensis	Olugbami et al. (2017a); Rabadeaux et al. (2017); Androulakis et al. (2006); Zhang et al. (2007)	breast, head and neck, skin
M. indica	Bai et al. (2018); Tan et al. (2018); Deng et al. (2018); Fernández-Ponce et al. (2017); Ganogpichayagrai et al. (2017); Ediriweera et al. (2017); Nemec et al. (2017); Nemec et al. (2016); Nguyen et al. (2016); Abdullah et al. (2014); Ramos et al. (2014); Kim et al. (2012); García-Rivera et al. (2011); Wilkinson et al. (2011); Noratto et al. (2010)	breast, skin, lung, colon
M. oliefera	Antonini et al. (2018); Tiloke et al. (2018); Cuellar-Nuñez et al. (2018); Jaafaru et al. (2018); Abd-Rabou et al. (2017); de Andrade Luz et al. (2017); Giacoppo et al. (2017); Adebayo et al. (2017); Abd-Rabou et al. (2016); Charlette et al. (2016); Michl et al. (2016); Jung et al. (2015); Al-Asmari et al. (2015); Elsayed et al. (2015); Krishnamurthy et al. (2014);	lung, breast
O. basilicum	Minari et al. (2018); Torres et al. (2018); Bayala et al. (2014); Behbahani (2014); Shirazi et al. (2014); Al-Ali et al. (2013); Kathirvel and Ravi (2012)	skin, head and neck
O. gratissimum	Lin et al. (2014); Ekunwe et al. (2014); Nangia-Makker et al. (2013); Chen et al. (2011); Ekunwe et al. (2010); Ye et al. (2010); Nangia-Makker et al. (2007)	skin
P. biglobosa	Fadeyi et al. (2013); Adetutu et al. (2012)	breast, skin
P. guajava	dos Santos et al. (2018); Qin et al. (2017); Ashraf et al. (2016); Rizzo et al. (2014); Levy and Carley (2012); Bontempo et al. (2012); Lee and Park (2010)	colon, head and neck skin, breast, scrotum
S. birrea	Armentano et al. (2015); Tanih and Ndip (2013)	head and neck
S. occidentalis	Qin et al. (2016); Yang et al. (2016); Bhagat and Saxena (2010)	breast, head and neck
S. spinosa	Isa et al. (2014)	skin
T. indica	Lim and Song (2013); Aravind et al. (2012); Shivshankar and Shyamala Devi (2004)	lung, colon
V. paradoxa	Zhang et al. (2015), 2014; Tagne et al. (2014); Mbaveng et al. (2011)	skin, head and neck
W. indica	Monteillier et al. (2017);	breast, skin
X. Americana	Murtaja et al. (2018); Pervaiz et al. (2016); Pervaiz et al. (2015); Bayer et al. (2012)	breast, skin
Z. officinale	Al-Otaibi et al. (2018); Fuzer et al. (2018); Morimoto et al. (2018); Oh et al. (2018); Mansingh et al. (2018); Luo et al. (2018); Li et al. (2018); Wang et al. (2018); Muhammad et al. (2018); El-Ashmawy et al. (2018); Li and Chiang (2017); Liu et al. (2017); Jaksevicius et al. (2017); Pashaei-Asl et al. (2017); Elkady et al. (2017); Al-Tamimi et al. (2016); Ansari et al. (2016); Lee (2016); Rubila et al. (2016); Cojocaru et al. (2015); Das et al. (2015); Wee et al. (2015); Marrelli et al. (2015); Akimoto et al. (2015); Tahir et al. (2015); Elkady et al. (2014a); Elkady et al. (2014b); Park et al. (2014)	lung, breast, colon, cervical
Z. mucronata	Beg et al. (2016); Sigidi et al. (2016); Bhatia et al. (2011)	skin, head and neck

of leaves from the plant is justified and, this will limit the exploitation, thereby preserving the extinction of the plant species from the area.

Furthermore, there are different methods of herbal preparation observed by the informants. In this study, decoction (74.6%) is the most frequently used mode of preparation by the informants followed by powder (49.3%) and subsequently maceration (46.3%). The least among the methods include soup (4.5%) and smoking (3%) mode of herbal preparation (Figure 3B). To obtain an herbal extract, it was observed that the TMP constantly boils water containing herbal material for at least two hours. Alternatively, the herbal material is allowed to macerate in water for a period of time, typically two to three days. Either way, the resultant herbal preparation is administered to patients at the dose recommended by the informant. In contrast, an herbal powdered drug is prepared from the dried herbs and pulverised into a fine powder. The powdered drug is then mixed with either water, milk, or any locally made drink (e.g., '*fura*' or '*kunu*') at the dose recommended by the informants. Interestingly, it was further observed that a few of the TMP used the method of smoking to treat patients. In this method, herbal material is placed on the burning charcoal and allowed smoke from the burning herbs to spread directly on the patient. Their argument was that by allowing smoke to spread through the patient's skin is quite effective in treating outside tumours.

The most common routes of administration cited by the informants are the oral route (82.1%) and topical application (32.8%) (Figure 3C). Sometimes, oral route and topical applications are concurrently applied to treat patients. Additionally, 1.5% of the informants treat patients either by smoke inhalation or dermal absorption (a process where smoke is absorbed through the patient's skin). During our discussion, it is interesting to document that patients are given an herbal drug such as *O. oleifera* to sniffs through the nostril in case of suspected lung cancer. In a similar treatment, smoke burnt from the aerial parts of the herbal material is inhaled by the patient through the nasal cavity to treat lung cancer.

3.4. Toxicological risk associated with the use of herbal medicines in the province

The ethical implications for the use of herbal medicines in the region have also been considered in the present study. The frequent use of herbal medicines has been implicated in cases of acute renal failure in other regions of the country (Akpan and Ekrikpo, 2015; Bamgboye et al., 1993; Kadiri et al., 1999; S. Kadiri et al., 1991). For the period of discussions, informants were asked the implications of prescribed herbal medicines, as a result, it is alarming to know that none among the informants could account for any side effects from the patients. They argued that herbal medicines are natural and therefore, considered safe for use ascribing to the long history of use. However, few of the experienced TMP are aware of the implications and, thus, recommends a minimal dose, e.g., a cup of decocted herbal material daily. In severe cases, patients were prescribed to a higher dose disregarding the toxicological implications for their therapeutic use.

For instance, *Aristolochia albida* Duch (0.2 RFC) has been prescribed for cancer treatment. While a species of *Aristolochia* have been documented in a similar study (Ngulde et al., 2014), its toxic side effects have yet to be established. Generally, *Aristolochia* and one of its chief components aristolochic acid have been known for its carcinogenic, and nephrotoxic effects for a very long time (Michael et al., 2009). Recently, several toxicological risks associated with a history of using herbal medicines containing aristolochic acid amongst cancer patients have been reported (Aydin et al., 2017; Ban et al., 2018; Chen et al., 2018; Hoang et al., 2016; Hung et al., 2016; Kanaan et al., 2016; Popovska--Jankovic et al., 2016; Xiong et al., 2018; Zhong et al., 2017). Despite the reported cases on the use of herbs containing aristolochic acid around the world, a similar effect associated with the use of *Aristolochia* spp has yet to be reported in Nigeria.

Herb-drug interaction is another major risk factor implicated in a widespread form of adverse effects (Amadi and Orisakwe, 2018). In the present study, we noted that patients with cancer cases recourse to traditional healers at the same time receiving orthodox treatment. These patients are desperate for treatment, which subject them to various forms of adverse drug reactions. For instance, we noticed a case of a patient undergoing chemotherapy for colorectal cancer at the same time the patient is receiving treatment from a traditional healer. The patient is administered a very high dose of decocted herbal medicine disregarding the effects of herb-drug interaction. There are several unknown similar cases of this type found most often in the region, an approach that requires government urgent attention.

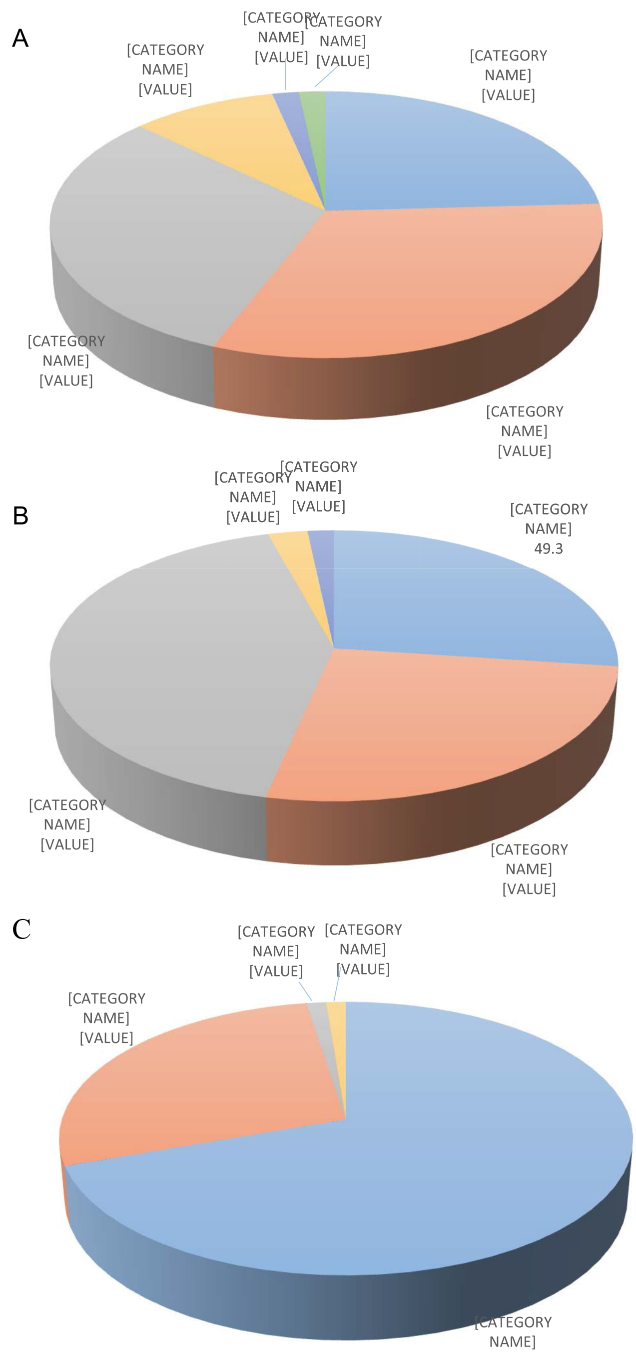

Figure 3. Percentage number of: A. parts of plant used; B. methods of herbal preparation used; and C. routes of administration used.

4. Conclusions

Concisely, we have documented for the first time traditional knowledge of medicinal plants integrated into the traditional system of medicine for the treatment of cancer in Sokoto state. In the present study, a total of 67 species of medicinal plants belonging to 31 families have been documented. Out of which, *A. nilotica* recorded the highest use-reports, followed by *G. senegalensis*, and subsequently *E. sigmoidea*. Additionally, various forms of diagnosis, the plant parts used, their modes of preparation, and different routes of administration have also been documented. The present study provides a baseline for future pharmacological investigations into the beneficial effects of local medicinal plants for the treatment of cancer.

Declarations

Author contribution statement

I. Malami: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

N. Jagaba: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data.

A. Muhammad and A. Alhassan: Conceived and designed the experiments; Wrote the paper.

I. Abubakar: Analyzed and interpreted the data.

P. Waziri, H. Mshelia, I. Yahaya and S. Mathias: Contributed reagents, materials, analysis tools or data.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

Acknowledgements

We wish to acknowledge and thank the local traditional healers of the region for patiently revealing their traditional ways of practice. We will like to also thank the NANTMP for their consent and assistance particularly, Mal. Ibrahim Dan Amadu for overseeing the whole process of the interviews and specimen collection. We would like to state here that this study was self-funded by the authors and received no additional funds from any external source.

References

Abara, J.C., 2012. Inequality and discrimination in Nigeria tradition and religion as negative factors affecting gender. In: Federation of International Human Rights Museums (FIHRM), pp. 1–18.

Abd-Rabou, A.A., Zoheir, K.M.A., Kishta, M.S., Shalby, A.B., Ezzo, M.I., 2016. Nano-micelle of moringa oleifera seed oil triggers mitochondrial cancer cell apoptosis. Asian Pac. J. Cancer Prev. APJCP 17, 4929–4933.

Abd-Rabou, A.A., Abdalla, A.M., Ali, N.A., Zoheir, K.M.A., 2017. Moringa oleifera root induces cancer apoptosis more effectively than leave nanocomposites and its free counterpart. Asian Pac. J. Cancer Prev. APJCP 18, 2141–2149.

Abdel-Lateef, E., Mahmoud, F., Hammam, O., El-Ahwany, E., El-Wakil, E., Kandil, S., Abu Taleb, H., El-Sayed, M., Hassenein, H., 2016. Bioactive chemical constituents of Curcuma longa L. rhizomes extract inhibit the growth of human hepatoma cell line (HepG2). Acta Pharm. 66, 387–398.

Abdelrahman, M., Mahmoud, H.Y.A.H., El-Sayed, M., Tanaka, S., Tran, L.S.P., 2017. Isolation and characterization of Cepa2, a natural alliospiroside A, from shallot (Allium cepa L. Aggregatum group) with anticancer activity. Plant Physiol. Biochem. 116, 167–173.

Abdullah, A.S.H., Mohammed, A.S., Abdullah, R., Mirghani, M.E.S., Al-Qubaisi, M., 2014. Cytotoxic effects of Mangifera indica L. kernel extract on human breast cancer (MCF-7 and MDA-MB-231 cell lines) and bioactive constituents in the crude extract. BMC Compl. Alternative Med. 14.

Abubakr, M., Sirag, N., Osman, I., Osman, M., Abakar, S., Aboul-Enein, A.M., 2013. Anticancer and antioxidant activities of Guiera senegalensis. Sudan J. Med. Sci. 8, 135–140.

Adebayo, I.A., Arsad, H., Samian, M.R., 2017. Antiproliferative effect on breast camcer (MCF7) of Moringa oleifera seed extracts. Afr. J. Tradit., Complementary Altern. Med. 14, 282–287.

Adebisi, I.M., Alebiosu, O.C., 2014. A survey of herbal abortificients and contraceptives in sokoto, North-West Nigeria. Int J Curr. Res. Chem. Pharm. Sci. 1, 81–87.

Adegboyega, S., Olajuyigbe, A., Balogun, I., Olatoye, O., 2016. Monitoring drought and effects on vegetation in Sokoto State, Nigeria using statistical and geospatial techniques. Ethiop. J. Environ. Stud. Manag. 9, 56–69.

Adetutu, A., Morgan, W.A., Corcoran, O., Chimezie, F., 2012. Antibacterial activity and in vitro cytotoxicity of extracts and fractions of Parkia biglobosa (Jacq.) Benth. Stem bark and Ageratum conyzoides Linn. Leaves. Environ. Toxicol. Pharmacol. 34, 478–483.

Ahmad, M., Sultana, S., Fazl-i-Hadi, S., ben, Hadda T., Rashid, S., 1, Zafar, M., Khan, M.A., Khan, M.P.Z., Yaseen, G., 2014. An ethnobotanical study of medicinal plants in high mountainous region of Chail valley (District Swat- Pakistan). J. Ethnobiol. Ethnomed. 10, 36.

Akimoto, M., Iizuka, M., Kanematsu, R., Yoshida, M., Takenaga, K., 2015. Anticancer effect of ginger extract against pancreatic cancer cells mainly through reactive oxygen species-mediated autotic cell death. PloS One 10.

Akpan, E.E., Ekrikpo, U.E., 2015. Acute renal failure induced by Chinese herbal medication in Nigeria. Case Rep. Med 2015.

Al-Ali, K.H., El-Beshbishy, H.A., El-Badry, A.A., Alkhalaf, M., 2013. Cytotoxic activity of methanolic extract of Mentha longifolia and Ocimum basilicum against human breast cancer. Pakistan J. Biol. Sci. 16, 1744–1750.

Al-Asmari, A.K., Sulaiman Mansour, A., Md Tanwir, A., Abdul Quaiyoom, K., Hamoud, A.-S., Mozaffarul, I., 2015. Moringa oleifera as an anti-cancer agent against breast and colorectal cancer cell lines. PloS One 10, e0135814.

Al-Otaibi, W.A., Alkhatib, M.H., Wali, A.N., 2018. Cytotoxicity and apoptosis enhancement in breast and cervical cancer cells upon coadministration of mitomycin C and essential oils in nanoemulsion formulations. Biomed. Pharmacother. 106, 946–955.

Al-Tamimi, M., Rastall, B., Abu-Reidah, I.M., 2016. Chemical composition, cytotoxic, apoptotic and antioxidant activities of main commercial essential oils in Palestine: a comparative study. Medicines 3, 27.

Alli, L., Adesokan, A., Salawu, A., 2016. Antimalarial activity of fractions of aqueous extract of Acacia nilotica root. J. Intercult. Ethnopharmacol. 5, 180–185.

Amadi, C., Orisakwe, O., 2018. Herb-Induced liver injuries in developing nations: an update. Toxics 6, 24.

Androulakis, X.M., Muga, S.J., Chen, F., Koita, Y., Toure, B., Wargovich, M.J., 2006. Chemopreventive effects of Khaya senegalensis bark extract on human colorectal cancer. Anticancer Res. 26, 2397–2405.

Ansari, J.A., Ahmad, M.K., Khan, A.R., Fatima, N., Khan, H.J., 2016. Anticancer and antioxidant activity of zingiber officinale roscoe rhizome. Indian J. Exp. Biol. 54, 767–773.

Antonini, E., Iori, R., Ninfali, P., Salvatore Scarpa, E., 2018. A combination of moringin and avenanthramide 2f inhibits the proliferation of Hep3B liver cancer cells inducing intrinsic and extrinsic apoptosis. Nutr. Canc. 1–7.

Aravind, S.R., Joseph, M.M., Varghese, S., Balaram, P., Sreelekha, T.T., 2012. Antitumor and immunopotentiating activity of polysaccharide PST001 isolated from the seed kernel of tamarindus indica: an in vivo study in mice. Sci. World J. 2012, 361382.

Armentano, M.F., Bisaccia, F., Miglionico, R., Russo, D., Nolfi, N., Carmosino, M., Andrade, P.B., Valentão, P., Diop, M.S., Milella, L., 2015. Antioxidant and proapoptotic activities of sclerocarya birrea [(A. Rich.) Hochst.] methanolic root extract on the hepatocellular carcinoma cell line HepG2. BioMed Res. Int. 2015.

Arumai Selvan, D., Mahendiran, D., Senthil Kumar, R., Kalilur Rahiman, A., 2018. Garlic, green tea and turmeric extracts-mediated green synthesis of silver nanoparticles: phytochemical, antioxidant and in vitro cytotoxicity studies. J. Photochem. Photobiol. B Biol. 180, 243–252.

Ashraf, S.M., Rathinasamy, K., 2017. Antibacterial and anticancer activity of the purified cashew nut shell liquid: implications in cancer chemotherapy and wound healing. Nat. Prod. Res. 1–5.

Ashraf, A., Sarfraz, R.A., Rashid, M.A., Mahmood, A., Shahid, M., Noor, N., 2016. Chemical composition, antioxidant, antitumor, anticancer and cytotoxic effects of Psidium guajava leaf extracts. Pharm. Biol. 54, 1971–1981.

Aydin, S., Ambroise, J., Cosyns, J.P., Gala, J.L., 2017. TP53 mutations in p53-negative dysplastic urothelial cells from Belgian AAN patients: new evidence for aristolochic acid-induced molecular pathogenesis and carcinogenesis. Mutat. Res. Genet. Toxicol. Environ. Mutagen 818, 17–26.

Bai, X., Lai, T., Zhou, T., Li, Y., Li, X., Zhang, H., 2018. In vitro antioxidant activities of phenols and oleanolic acid from mango peel and their cytotoxic effect on A549 cell line. Molecules 23, E1395.

Bamgboye, E.L., Mabayoje, M.O., Odutola, T.A., Mabadeje, A.F.B., 1993. Acute renal failure at the Lagos university teaching hospital: a 10-year review. Ren. Fail. 15, 77–80.

Ban, T.H., Min, J.W., Seo, C., da Kim, R., Lee, Y.H., Chung, B.H., Jeong, K.H., Lee, J.W., Kim, B.S., Lee, S.H., Choi, B.S., Han, J.S., Yang, C.W., 2018. Update of aristolochic acid nephropathy in Korea. Korean J. Intern. Med. 33, 961–969.

Barapatre, A., Meena, A.S., Mekala, S., Das, A., Jha, H., 2016. In vitro evaluation of antioxidant and cytotoxic activities of lignin fractions extracted from Acacia nilotica. Int. J. Biol. Macromol. 86, 443–453.

Bayala, B., Bassole, I., Gnoula, C., Nebie, R., Yonli, A., Morel, L., Figueredo, G., Nikiema, J., Lobaccaro, J., Simpore, J., 2014. Chemical composition, antioxidant, anti-inflammatory and anti-proliferative activities of essential oils of plants from Burkina Faso. PloS One 9, e92122.

Bayer, H., Ey, N., Wattenberg, A., Voss, C., Berger, M.R., 2012. Purification and characterization of riproximin from Ximenia americana fruit kernels. Protein Expr. Purif. 82, 97–105.

Beg, M.A., Teotia, U.V.S., Farooq, S., 2016. In vitro antibacterial and anticancer activity of Ziziphus. J. Med. Plants Stud. 4, 230–233.

Behbahani, M., 2014. Evaluation of in vitro anticancer activity of Ocimum basilicum, Alhagi maurorum, Calendula officinalis and their parasite Cuscuta campestris. PloS One 9, e116049.

Bello, B., Khan, S.A., Khan, J., Syed, F., Anwar, Y., Khan, S.B., 2017. Antiproliferation and antibacterial effect of biosynthesized AgNps from leaves extract of Guiera senegalensis and its catalytic reduction on some persistent organic pollutants. J. Photochem. Photobiol., B 175, 99–108.

Bhagat, M., Saxena, A.K., 2010. Evaluation of Cassia occidentalis for in vitro cytotoxicity against human cancer cell lines and antibacterial activity. Indian J. Pharmacol. 42, 234–237.

Bhatia, A., Mishra, T., Khullar, M., 2011. Anticancer potential of aqueous ethanol seed extract of Ziziphus mauritiana against cancer cell lines and Ehrlich ascites carcinoma. Evidence-based Complement. Altern. Med. 2011.

Bontempo, P., Doto, A., Miceli, M., Mita, L., Benedetti, R., Nebbioso, A., Veglione, M., Rigano, D., Cioffi, M., Sica, V., Molinari, A.M., Altucci, L., 2012. Psidium guajava L. anti-neoplastic effects: induction of apoptosis and cell differentiation. Cell Prolif 45, 22–31.

Bray, F., Ferlay, J., Soerjomataram, I., Siegel, R., Torre, L., Jemal, A., 2018. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 Countries. Ca - Cancer J. Clin. 68, 394–424.

Charlette, T., Alisa, P., Anil A, C., 2016. The antiproliferative effect of moringa oleifera crude aqueous leaf extract on human esophageal cancer cells. J. Med. Food 19, 398–403.

Chen, H.-M., Lee, M.-J., Kuo, C.-Y., Tsai, P.-L., Liu, J.-Y., Kao, S.-H., 2011. Ocimum gratissimum aqueous extract induces apoptotic signalling in lung adenocarcinoma cell A549. Evidence-based complement. Altern. Med. 2011, 1–7.

Chen, C.J., Yang, Y.H., Lin, M.H., Lee, C.P., Tsan, Y.T., Lai, M.N., Yang, H.Y., Ho, W.C., Chen, P.C., 2018. Herbal medicine containing aristolochic acid and the risk of hepatocellular carcinoma in patients with hepatitis B virus infection. Int. J. Canc. 143, 1578–1587.

Cioffi, G., Dal Piaz, F., De Caprariis, P., Sanogo, R., Marzocco, S., Autore, G., De Tommasi, N., 2006. Antiproliferative triterpene saponins from Entada africana. J. Nat. Prod. 69, 1323–1329.

Cojocaru, S.I., Stan, M., Stoian, G., Dinischiotu, A., 2015. Effects of zingiber officinale roscoe fresh extract on amelanotic melanoma and normal skin fibroblasts. Rev. Med.-Chir. Soc. Med. Nat. Iasi 119, 592–596.

Coker-Gurkan, A., Bulut, D., Genc, R., Arisan, E.-D., Obakan-Yerlikaya, P., Palavan-Unsal, N., 2018. Curcumin prevented human autocrine growth hormone (GH) signaling mediated NF-κB activation and miR-183-96-182 cluster stimulated epithelial mesenchymal transition in T47D breast cancer cells. Mol. Biol. Rep.

Cuellar-Nuñez, M.L., Luzardo-Ocampo, I., Campos-Vega, R., Gallegos-Corona, M.A., González de Mejía, E., Loarca-Piña, G., 2018. Physicochemical and nutraceutical properties of moringa (Moringa oleifera) leaves and their effects in an in vivo AOM/DSS-induced colorectal carcinogenesis model. Food Res. Int. 105, 159–168.

Das, A., Miller, R., Lee, P., Holden, C.A., Lindhorst, S.M., Jaboin, J., Vandergrift, W.A., Banik, N.L., Giglio, P., Varma, A.K., Raizer, J.J., Patel, S.J., 2015. A novel component from citrus, ginger, and mushroom family exhibits antitumor activity on human meningioma cells through suppressing the Wnt/β-catenin signaling pathway. Tumor Biol. 36, 7027–7034.

de Andrade Luz, L., Rossato, F.A., Costa, R.A.P.e., Napoleão, T.H., Paiva, P.M.G., Coelho, L.C.B.B., 2017. Cytotoxicity of the coagulant Moringa oleifera lectin (cMoL) to B16-F10 melanoma cells. Toxicol. Vitro 44, 94–99.

de Campos, P.S., Matte, B.F., Diel, L.F., Jesus, L.H., Bernardi, L., Alves, A.M., Rados, P.V., Lamers, M.L., 2017. Low doses of curcuma longa modulates cell migration and cell–cell adhesion. Phyther. Res. 31, 1433–1440.

Deng, Q., Tian, Y.X., Liang, J.J., 2018. Mangiferin inhibits cell migration and invasion through Rac1/WAVE2 signalling in breast cancer. Cytotechnology 70, 593–601.

dos Santos, R.C., Ombredane, A.S., Souza, J.M.T., Vasconcelos, A.G., Plácido, A., das Amorim, A.G.N., Barbosa, E.A., Lima, F.C.D.A., Ropke, C.D., Alves, M.M.M., Arcanjo, D.D.R., Carvalho, F.A.A., Delerue-Matos, C., Joanitti, G.A., de Leite, J.R.S.A., 2018. Lycopene-rich extract from red guava (Psidium guajava L.) displays cytotoxic effect against human breast adenocarcinoma cell line MCF-7 via an apoptotic-like pathway. Food Res. Int. 105, 184–196.

Ediriweera, M.K., Tennekoon, K.H., Samarakoon, S.R., Adhikari, A., Thabrew, I., Dilip de Silva, E., 2017. Isolation of a new resorcinolic lipid from Mangifera zeylanica Hook.f. bark and its cytotoxic and apoptotic potential. Biomed. Pharmacother. 89, 194–200.

Ekanem, lbert P., Udoh, F.V., 2009. The diversity of medicinal plants in Nigeria: an overview. In: African Natural Plant Products: New Discoveries and Challenges in Chemistry and Quality, pp. 135–147.

Ekunwe, S.I.N., Thomas, M.S., Luo, X., Wang, H., Chen, Y., Zhang, X., Begonia, G.B., 2010. Potential cancer-fighting Ocimum gratissimum (Og) leaf extracts: increased anti-proliferation activity of partially purified fractions and their spectral fingerprints. Ethn. Dis. 20. S1-12–6.

Ekunwe, S.I.N., Hall, S.M., Luo, X., Wang, H., Begonia, G.B., 2014. Fractionated ocimum gratissimum leaf extract inhibit prostate cancer (PC3?AR) cells growth by reducing androgen receptor and survivin levels. J. Health Care Poor Underserved 24, 61–69.

El-Ashmawy, N.E., Khedr, N.F., El-Bahrawy, H.A., Abo Mansour, H.E., 2018. Ginger extract adjuvant to doxorubicin in mammary carcinoma: study of some molecular mechanisms. Eur. J. Nutr. 57, 981–989.

Elkady, A.I., El Hamid Hussein, R.A., Abu-Zinadah, O.A., 2014a. Differential control of growth, apoptotic activity and gene expression in human colon cancer cells by extracts derived from medicinal herbs, Rhazya stricta and Zingiber officinale and their combination. World J. Gastroenterol. 20, 15275–15288.

Elkady, A.I., Hussein, R.A.E.H., Abu-Zinadah, O.A., 2014b. Effects of crude extracts from medicinal herbs Rhazya stricta and Zingiber officinale on growth and proliferation of human brain cancer cell line in vitro. BioMed Res. Int. 2014.

Elkady, A.I., Abu-Zinadah, O.A., Hussein, R.A.E.H., 2017. Crude flavonoid extract of medicinal herb *Zingibar officinale* inhibits proliferation and induces apoptosis in hepatocellular carcinoma cells. Oncol. Res. Featur. Preclin. Clin. Cancer Ther. 25, 897–912.

Elkhateeb, A., Hussein, S.R., Salem, M.M., El Negoumy, S.I.M., 2019. LC-ESI-MS Analysis, Antitumor and Antiviral activities of Bosica senegalensis aqueous methanolic extract. Egypt. J. Chem. 62, 77–83.

Elsayed, E.A., Sharaf-Eldin, M.A., Wadaan, M., 2015. In vitro evaluation of cytotoxic activities of essential oil from Moringa oleifera seeds on HeLa, HepG2, MCF-7, CACO-2 and L929 cell lines. Asian Pac. J. Cancer Prev. APJCP 16, 4671–4675.

Fadeyi, S.A., Fadeyi, O.O., Adejumo, A.A., Okoro, C., Myles, E.L., 2013. In vitro anticancer screening of 24 locally used Nigerian medicinal plants. BMC Compl. Alternative Med. 13, 79.

Ferlay, J., Soerjomataram, I., Dikshit, R., Eser, S., Mathers, C., Rebelo, M., Parkin, D.M., Forman, D., Bray, F., 2015. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. Int. J. Canc. 136, E359–E386.

Fernández-Ponce, M.T., López-Biedma, A., Sánchez-Quesada, C., Casas, L., Mantell, C., Gaforio, J.J., Martínez De La Ossa, E.J., 2017. Selective antitumoural action of pressurized mango leaf extracts against minimally and highly invasive breast cancer. Food Funct. 8, 3610–3620.

Fiot, J., Sanon, S., Azas, N., Mahiou, V., Jansen, O., Angenot, L., Balansard, G., Ollivier, E., 2006. Phytochemical and pharmacological study of roots and leaves of Guiera senegalensis J.F. Gmel (Combretaceae). J. Ethnopharmacol. 106, 173–178.

Frassová, Z., Rudá-Kučerová, J., 2018. Curcumine (turmeric – curcuma longa) as a supportive phytotherapeutic treatment in oncology. Klin. Onkol. 31, 15–23.

Fredotovi, Ž., Šprung, M., Soldo, B., Ljubenkov, I., Budic-Leto, I., Bilušic, T., Cikeš-Culic, V., Puizina, J., 2017. Chemical composition and biological activity of Allium cepa L. And allium X cornutum (clementi ex visiani 1842) methanolic extracts. Molecules 22, E448.

Fuzer, A., Martin, A., Becceneri, A., da Silva, J., Vieira, P., Cominetti, M., 2018. Inhibition of mRNA processing activity from ginger-, clove- and cinnamon-extract, and by two ginger constituents, 6-gingerol and 6-shogaol. Anticancer Agent. Med. Chem.

Ganogpichayagrai, A., Palanuvej, C., Ruangrungsi, N., 2017. Antidiabetic and anticancer activities of Mangifera indica cv. Okrong leaves. J. Adv. Pharm. Technol. Res. 8, 19.

Garbi, M.I., Osman, E.E., Kabbashi, A.S., 2015. Anticancer activity of Bauhinia rufescens (Lam) leaf extracts on MCF-7 human breast cancer cells. ~ 103 ~. J. Med. Plants Stud. 3, 103–106.

García-Rivera, D., Delgado, R., Bougarne, N., Haegeman, G., Vanden Berghe, W., 2011. Gallic acid indanone and mangiferin xanthone are strong determinants of immunosuppressive anti-tumour effects of Mangifera indica L. bark in MDA-MB231 breast cancer cells. Canc. Lett. 305, 21–31.

Giacoppo, S., Iori, R., Rollin, P., Bramanti, P., Mazzon, E., 2017. Moringa isothiocyanate complexed with α-cyclodextrin: a new perspective in neuroblastoma treatment. BMC Compl. Alternative Med. 17, 362.

Hakkim, L., Revathi, S., Rajan, G., Sampath, G., Kumar, R., Al Buloshi, M., Anwar, S.S., Bakshi, H., Nagarajan, K., 2018. Induction of HT-29 colon cancer cells apoptosis by pyrogallol with growth inhibiting efficacy against drug resistant Helicobacter pylori. Anticancer. Agents Med. Chem. 18, 1875–1884.

Hassan, L.E.A., Dahham, S.S., Saghir, S.A.M., Mohammed, A.M.A., Eltayeb, N.M., Majid, A.M.S.A., Majid, A.S.A., 2016. Chemotherapeutic potentials of the stem bark of Balanite aegyptiaca (L.) Delile: an antiangiogenic, antitumor and antioxidant agent. BMC Compl. Alternative Med. 16, 396.

Hassana, L.E.A., Al-Suadea, F.S., Fadul, S.M., Majida, A.M.S.A., 2018. Evaluation of antioxidant, antiangiogenic and antitumor properties of Anogeissus leiocarpus against colon cancer. Angiotherapy 1, 56–66.

Heinrich, M., Jäger, A.K., 2015. Ethnopharmacology. John Wiley and Sons, Ltd, UK.

Heinrich, M., Ankli, A., Frei, B., Weimann, C., Sticher, O., 1998. Medicinal plants in Mexico: healers' consensus and cultural importance. Soc. Sci. Med. 47, 1859–1871.

Hoang, M.L., Chen, C.H., Chen, P.C., Roberts, N.J., Dickman, K.G., Yun, B.H., Turesky, R.J., Pu, Y.S., Vogelstein, B., Papadopoulos, N., Grollman, A.P., Kinzler, K.W., Rosenquist, T.A., 2016. Aristolochic acid in the etiology of renal cell carcinoma. Cancer Epidemiol. Biomark. Prev. 25, 1600–1608.

Hou, D.X., Tong, X., Terahara, N., Luo, D., Fujii, M., 2005. Delphinidin 3-sambubioside, a Hibiscus anthocyanin, induces apoptosis in human leukemia cells through reactive oxygen species-mediated mitochondrial pathway. Arch. Biochem. Biophys. 440, 101–109.

Hung, P.-H., Tsai, H.-B., Hung, K.-Y., Muo, C.-H., Chung, M.-C., Chang, C.-H., Chung, C.-J., 2016. Patients with urothelial carcinoma have poor renal outcome regardless of whether they receive nephrouretectomy. Oncotarget 7, 61679–61689.

Isa, A.I., Awouafack, M.D., Dzoyem, J.P., Aliyu, M., Magaji, R.A.S., Ayo, J.O., Eloff, J.N., 2014. Some Strychnos spinosa (Loganiaceae) leaf extracts and fractions have good antimicrobial activities and low cytotoxicities. BMC Compl. Alternative Med. 14, 456.

Issa, N.M., Mansour, F.K., El-Safti, F.A., Nooh, H.Z., El-Sayed, I.H., 2015. Effect of Balanites aegyptiaca on Ehrlich Ascitic carcinoma growth and metastasis in Swiss mice. Exp. Toxicol. Pathol. 67, 435–441.

Jaafaru, M.S., Karim, N.A.A., Eliaser, E.M., Waziri, P.M., Ahmed, H., Barau, M.M., Kong, L., Razis, A.F.A., 2018. Nontoxic glucomoringin-isothiocyanate (GMG-ITC) rich soluble extract induces apoptosis and inhibits proliferation of human prostate adenocarcinoma cells (PC-3). Nutrients 10, E1174.

Jaksevicius, A., Carew, M., Mistry, C., Modjtahedi, H., Opara, E.I., 2017. Inhibitory effects of culinary herbs and spices on the growth of HCA-7 colorectal cancer cells and their COX-2 expression. Nutrients 9, E1051.

Jung, I.L., Lee, J.H., Kang, S.C., 2015. A potential oral anticancer drug candidate, Moringa oleifera leaf extract, induces the apoptosis of human hepatocellular carcinoma cells. Oncol. Lett. 10, 1597–1604.

Kadiri, S., Ogunlesi, A., Osinfade, K., Akinkugbe, O.O., 1991. Causes of acute tubular necrosis in Nigeria. Afr. J. Med. Med. Sci. 2, 91–96.

Kadiri, S., Arije, A., Salako, B.L., 1999. Traditional herbal preparations and acute renal failure in south west Nigeria. Trop. Doct. 29, 244–246.

Kalaivani, T., Rajasekaran, C., Mathew, L., 2011. Free radical scavenging, cytotoxic, and hemolytic activities of an active antioxidant compound ethyl gallate from leaves of Acacia Nilotica (L.) wild. Ex. Delile Subsp. Indica (benth.) brenan. J. Food Sci. 76, T144–T149.

Kameswaran, T.R., Ramanibai, R., 2008. The antiproliferative activity of flavanoidal fraction of Indigofera tinctoria is through cell cycle arrest and apoptotic pathway in A-549 cells. J. Biol. Sci. 8, 584–590.

Kanaan, N., Hassoun, Z., Raggi, C., Jadoul, M., Mourad, M., De Meyer, M., Aydin, S., Schmeiser, H.H., Cosyns, J.P., Goffin, E., 2016. Long-term outcome of kidney recipients transplanted for aristolochic acid nephropathy. Transplantation 100, 416–421.

Kathirvel, P., Ravi, S., 2012. Chemical composition of the essential oil from basil (Ocimum basilicum Linn.) and its in vitro cytotoxicity against HeLa and HEp-2 human cancer cell lines and NIH 3T3 mouse embryonic fibroblasts. Nat. Prod. Res. 26, 1112–1118.

Kaur, K., Arora, S., Hawthorne, M.E., Kaur, S., Kumar, S., Mehta, R.G., 2002. A correlative study on antimutagenic and chemopreventive activity of Acacia auriculiformis A. Cunn. and Acacia nilotica (L.) willd. ex del. Drug Chem. Toxicol. 25, 39–64.

Kim, Hyeonji, Kim, Hana, Mosaddik, A., Gyawali, R., Ahn, K.S., Cho, S.K., 2012. Induction of apoptosis by ethanolic extract of mango peel and comparative analysis of the chemical constitutes of mango peel and flesh. Food Chem. 133, 416–422.

Krishnamurthy, P.T., Vardarajalu, A., Wadhwani, A., Patel, V., 2014. Identification and characterization of a potent anticancer fraction from the leaf extracts of Moringa oleifera L. Indian J. Clin. Biochem. 53, 98–103.

Kuete, V., Eichhorn, T., Wiench, B., Krusche, B., Efferth, T., 2012. Cytotoxicity, anti-angiogenic, apoptotic effects and transcript profiling of a naturally occurring naphthyl butenone, guieranone A. Cell Div. 7, 16.

Kuete, V., Sandjo, L.P., Djeussi, D.E., Zeino, M., Kwamou, G.M.N., Ngadjui, B., Efferth, T., 2014. Cytotoxic flavonoids and isoflavonoids from Erythrina sigmoidea towards multi-factorial drug resistant cancer cells. Invest. N. Drugs 32, 1053–1062.

Kuete, V., Djeussi, D.E., Mbaveng, A.T., Zeino, M., Efferth, T., 2016. Cytotoxicity of 15 Cameroonian medicinal plants against drug sensitive and multi-drug resistant cancer cells. J. Ethnopharmacol. 186, 196–204.

Lee, Y., 2016. Cytotoxicity evaluation of essential oil and its component from Zingiber officinale Roscoe. Toxicol. Res. 32, 225–230.

Lee, S., Park, H., 2010. Anticancer activity of guava (Psidium guajava L .) branch extracts against HT-29 human colon cancer cells. J. Med. Plants Res. 4, 891–896.

Lee, W.S., Yi, S.M., Yun, J.W., Jung, J.H., Kim, D.H., Kim, H.J., Chang, S.-H., Kim, G., Ryu, C.H., Shin, S.C., Hong, S.C., Choi, Y.H., Jung, J.-M., 2014. Polyphenols isolated from Allium cepa L. Induces apoptosis by induction of p53 and suppression of bcl-2 through inhibiting PI3K/akt signaling pathway in AGS human cancer cells. J. Cancer Prev. 19, 14–22.

Lee, C., Kim, S.-Y., Eum, S., Paik, J.-H., Bach, T.T., Darshetkar, A.M., Choudhary, R.K., Van Hai, D., Quang, B.H., Thanh, N.T., Choi, S., 2018. Ethnobotanical study on medicinal plants used by local van kieu ethnic people of bac huong hoa nature reserve, vietnam. J. Ethnopharmacol. 231, 283–294.

Levy, A., Carley, S.-K., 2012. Cytotoxic activity of hexane extracts of *Psidium guajava* L (myrtaceae) and *Cassia alata* L (caesalpineaceae) in kasumi-1 and OV2008 cancer cell lines. Trop. J. Pharmaceut. Res. 11, 201–207.

Li, T.Y., Chiang, B.H., 2017. 6-shogaol induces autophagic cell death then triggered apoptosis in colorectal adenocarcinoma HT-29 cells. Biomed. Pharmacother. 93, 208–217.

Li, X., Ma, S., Yang, P., Sun, B., Zhang, Y., Sun, Y., Hao, M., Mou, R., Jia, Y., 2018. Anticancer effects of curcumin on nude mice bearing lung cancer A549 cell subsets SP and NSP cells. Oncol. Lett. 16, 6756–6762.

Li, Y., Sun, W., Han, N., Zou, Y., Yin, D., 2018. Curcumin inhibits proliferation, migration, invasion and promotes apoptosis of retinoblastoma cell lines through modulation of miR-99a and JAK/STAT pathway. BMC Canc. 18, 1230.

Li, Z., Wang, Y., Gao, M., Cui, W., Zeng, M., Cheng, Y., Li, J., 2018. Nine new gingerols from the rhizoma of Zingiber officinale and their cytotoxic activities. Molecules 23, E315.

Lim, S.Y., Song, Y.J., 2013. The extract of Tamarindus indica L. suppresses IKK?? activity and NF-??B-dependent lymphoblastoid cell line survival. Mol. Cell. Toxicol. 9, 243–248.

Lin, L.T., Liu, L.T., Chiang, L.C., Lin, C.C., 2002. In vitro anti-hepatoma activity of fifteen natural medicines from Canada. Phyther. Res. 16, 440–444.

Lin, H.H., Huang, H.P., Huang, C.C., Chen, J.H., Wang, C.J., 2005. Hibiscus polyphenol-rich extract induces apoptosis in human gastric carcinoma cells via p53 phosphorylation and p38 MAPK/FasL cascade pathway. Mol. Carcinog. 43, 86–99.

Lin, H.H., Chen, J.H., Kuo, W.H., Wang, C.J., 2007. Chemopreventive properties of Hibiscus sabdariffa L. on human gastric carcinoma cells through apoptosis induction and JNK/p38 MAPK signaling activation. Chem. Biol. Interact. 165, 59–75.

Lin, H.-H., Chen, J.-H., Wang, C.-J., 2011. Chemopreventive properties and molecular mechanisms of the bioactive compounds in Hibiscus sabdariffa linne. Curr. Med. Chem. 18, 1245–1254.

Lin, C.-C., Chao, P.-Y., Shen, C.-Y., Shu, J.-J., Yen, S.-K., Huang, C.-Y., Liu, J.-Y., 2014. Novel target genes responsive to apoptotic activity by *Ocimum gratissimum* in human osteosarcoma cells. Am. J. Chin. Med. 42, 743–767.

Liu, Z., Li, H., Fan, Y., Liu, Y., Man, S., Yu, P., Gao, W., 2016. Combination treatment with Rhizoma Paridis and Rhizoma Curcuma longa extracts and 10-hydroxycamptothecin enhances the antitumor effect in H22 tumor model by increasing the plasma concentration. Biomed. Pharmacother. 83, 627–634.

Liu, C.M., Kao, C.L., Tseng, Y.T., Lo, Y.C., Chen, C.Y., 2017. Ginger phytochemicals inhibit cell growth and modulate drug resistance factors in docetaxel resistant prostate cancer cell. Molecules 22, 1477.

Long, C., Marcourt, L., Raux, R., David, B., Gau, C., Menendez, C., Gao, M., Laroche, M.F., Schambel, P., Delaude, C., Ausseil, F., Lavaud, C., Massiot, G., 2009. Meroterpenes from Dichrostachys cinerea inhibit protein farnesyl transferase activity. J. Nat. Prod. 72, 1804–1815.

Luo, You.U., Chen, X., Luo, L., Zhang, Q., Gao, C., Zhuang, X., Yuan, Su.U., Qiao, T., 2018. [6]-Gingerol enhances the radiosensitivity of gastric cancer via G2/M phase arrest and apoptosis induction. Oncol. Rep. 39, 2252–2260.

Mansingh, D.P., Sunanda, O.J., Sali, V.K., Vasanthi, H.R., 2018. [6]-Gingerol–induced cell cycle arrest, reactive oxygen species generation, and disruption of mitochondrial membrane potential are associated with apoptosis in human gastric cancer (AGS) cells. J. Biochem. Mol. Toxicol. 32.

Marrelli, M., Menichini, F., Conforti, F., 2015. A comparative study of Zingiber officinale Roscoe pulp and peel: phytochemical composition and evaluation of antitumour activity. Nat. Prod. Res. 29, 2045–2049.

Mbaveng, A.T., Kuete, V., Mapunya, B.M., Beng, V.P., Nkengfack, A.E., Meyer, J.J.M., Lall, N., 2011. Evaluation of four Cameroonian medicinal plants for anticancer, antigonorrheal and antireverse transcriptase activities. Environ. Toxicol. Pharmacol. 32, 162–167.

Meena, P.D., Kaushik, P., Shukla, S., Soni, A.K., Kumar, M., Kumar, A., 2006. Anticancer and antimutagenic properties of Acacia nilotica (Linn.) on 7,12-dimethylbenz(a) anthracene-induced skin papillomagenesis in Swiss albino mice. Asian Pac. J. Cancer Prev. APJCP 7, 627–632.

Mgbeahuruikea, E.E., Holma, Y., Vuorelaa, H., Amandikwab, C., Fyhrquista, P., 2019. An ethnobotanical survey and antifungal activity of Piper guineense used for the treatment of fungal infections in West-African traditional medicine. J. Ethnopharmacol. 229, 157–166.

Michael, H., Jennifer, C., Stefan, W., Christoph, Neinhuis., Monique, S.J. Simmonds., 2009. Local uses of Aristolochia species and content of nephrotoxic aristolochic acid 1 and 2-A global assessment based on bibliographic sources. J. Ethnopharmacol. 125, 108–144.

Michl, C., Vivarelli, F., Weigl, J., De Nicola, G.R., Canistro, D., Paolini, M., Iori, R., Rascle, A., 2016. The chemopreventive phytochemical moringin isolated from Moringa oleifera seeds inhibits JAK/STAT signaling. PloS One 11.

Minari, J.B., Okelola, C.A., Ugochukwu, N.C., 2018. Analysis of Kras gene from induced pancreatic cancer rats administered with Momordicacharantia and Ocimumbasilicum leaf extracts. J. Tradit. Complement. Med. 8, 282–288.

Mishra, D., Singh, S., Narayan, G., 2016. Curcumin induces apoptosis in Pre-B acute lymphoblastic leukemia cell lines via PARP-1 cleavage. Asian Pac. J. Cancer Prev. APJCP 17, 3863–3867.

Mohan, S., Thiagarajan, K., Chandrasekaran, R., 2017. Evaluation of ethyl gallate for its antioxidant and anticancer properties against chemical-induced tongue carcinogenesis in mice. Biochem. J. 474, 3011–3025.

Monteillier, A., Cretton, S., Ciclet, O., Marcourt, L., Ebrahimi, S.N., Christen, P., Cuendet, M., 2017. Cancer chemopreventive activity of compounds isolated from Waltheria indica. J. Ethnopharmacol. 203, 214–225.

Morimoto, M., Mitsukawa, M., Fujiwara, C., Kawamura, Y., Masuda, S., 2018. [10]-Gingerol affects multiple metastatic processes and induces apoptosis in MDA-MB-231 breast tumor cells. Biosci. Biotechnol. Biochem. 14, 1–4.

Morounke, S.G., Ayorinde, J.B., Benedict, A.O., Adedayo, F.F., Adewale, F.O., Oluwadamilare, I., Sokunle, S.S., Benjamin, A., 2017. Epidemiology and incidence of common cancers in Nigeria. J. Canc. Biol. Res. 5, 1105.

Mou, S., Zhou, Z., He, Y., Liu, F., Gong, L., 2017. Curcumin inhibits cell proliferation and promotes apoptosis of laryngeal cancer cells through Bcl-2 and PI3K/Akt, and by upregulating miR-15a. Oncol. Lett. 14, 4937–4942.

Muhammad, A., Ibrahim, M.A., Erukainure, O.L., Malami, I., Adamu, A., 2018. Spices with breast cancer chemopreventive and therapeutic potentials: a functional foods based-review. Anticancer. Agents Med. Chem. 18.

Murtaja, A., Eyol, E., Xiaoqi, J., Berger, M.R., Adwan, H., 2018. The ribosome inhibiting protein riproximin shows antineoplastic activity in experimental pancreatic cancer liver metastasis. Oncol. Lett. 15, 1441–1448.

Nangia-Makker, P., Tait, L., Shekhar, M.P.V., Palomino, E., Hogan, V., Piechocki, M.P., Funasaka, T., Raz, A., 2007. Inhibition of breast tumor growth and angiogenesis by a medicinal herb: ocimum gratissimum. Int. J. Canc. 121, 884–894.

Nangia-Makker, P., Raz, T., Tait, L., Shekhar, M.P.V., Li, H., Balan, V., Makker, H., Fridman, R., Maddipati, K., Raz, A., 2013. Ocimum gratissimum retards breast cancer growth and progression and is a natural inhibitor of matrix metalloproteases. Canc. Biol. Ther. 14, 417–427.

Naqvi, A., Malasoni, R., Gupta, S., Srivastava, A., Pandey, R., Dwivedi, A., 2017. In Silico and in Vitro anticancer activity of isolated novel marker compound from chemically modified bioactive fraction from Curcuma longa (NCCL). Phcog. Mag. 13, 640.
Nemec, M.J., Kim, H., Marciante, A.B., Barnes, R.C., Talcott, S.T., Mertens-Talcott, S.U., 2016. Pyrogallol, an absorbable microbial gallotannins-metabolite and mango polyphenols (Mangifera Indica L.) suppress breast cancer ductal carcinoma in situ proliferation in vitro. Food Funct. 7, 3825–3833.
Nemec, M.J., Kim, H., Marciante, A.B., Barnes, R.C., Hendrick, E.D., Bisson, W.H., Talcott, S.T., Mertens-Talcott, S.U., 2017. Polyphenolics from mango (Mangifera indica L.) suppress breast cancer ductal carcinoma in situ proliferation through activation of AMPK pathway and suppression of mTOR in athymic nude mice. J. Nutr. Biochem. 41, 12–19.
Ngulde, S., Sandabe, U., Hussaini, I., 2014. Ethnobotanical survey of anticancer plants in Askira/Uba local government area of Borno state, Nigeria. Planta Med. 80–88.
Nguyen, H.X., Van Do, T.N., Le, T.H., Nguyen, M.T.T., Nguyen, N.T., Esumi, H., Awale, S., 2016. Chemical constituents of mangifera indica and their antiausterity activity against the PANC-1 human pancreatic cancer cell line. J. Nat. Prod. 79, 2053–2059.
Nile, A., Nile, S.H., Kim, D.H., Keum, Y.S., Seok, P.G., Sharma, K., 2018. Valorization of onion solid waste and their flavonols for assessment of cytotoxicity, enzyme inhibitory and antioxidant activities. Food Chem. Toxicol. 119, 281–289.
Noratto, G.D., Bertoldi, M.C., Krenek, K., Talcott, S.T., Stringheta, P.C., Mertens-Talcott, S.U., 2010. Anticarcinogenic effects of polyphenolics from mango (Mangifera indica) varieties. J. Agric. Food Chem. 58, 4104–4112.
NPC, 2013. Report of Nigeria ' s national population commission on the 2006 census. Popul. Counc. 33, 206–210.
Oh, T.-I., Jung, H.-J., Lee, Y.-M., Lee, S., Kim, G.-H., Kan, S.-Y., Kang, H., Oh, T., Ko, H., Kwak, K.-C., Lim, J.-H., 2018. Zerumbone, a tropical ginger sesquiterpene of zingiber officinale roscoe, attenuates α-MSH-induced melanogenesis in B16F10 cells. Int. J. Mol. Sci. 19, 3149.
Olugbami, J.O., Damoiseaux, R., France, B., Gbadegesin, M.A., Stieg, A.Z., Sharma, S., Odunola, O.A., Gimzewski, J.K., 2017a. Atomic force microscopy correlates antimetastatic potentials of HepG2 cell line with its redox/energy status: effects of curcumin and Khaya senegalensis. J. Integr. Med. 15, 214–230.
Olugbami, J.O., Damoiseaux, R., France, B., Onibiyo, E.M., Gbadegesin, M.A., Sharma, S., Gimzewski, J.K., Odunola, O.A., 2017b. A comparative assessment of antiproliferative properties of resveratrol and ethanol leaf extract of Anogeissus leiocarpus (DC) Guill and Perr against HepG2 hepatocarcinoma cells. BMC Compl. Alternative Med. 17, 381.
Oluranti, A.C., Jane, U.-O.C., Michael, U.O., 2012a. Ethnobotanical survey of medicinal plants used the treatment of malaria in sokoto state, North western Nigeria. Ijirds 1, 292–304.
Oluranti, A.C., Michael, U.O., Jane, U.-O.C., Ayembe, N.A., 2012b. Ethno botanical studies of medicinal plants used in the management of Peptic ulcer disease in Sokoto State, North Western Nigeria. Int. Res. J. Pharm. Pharmacol. 2, 2251–2276.
Pan, Y., Zheng, Y.M., Ho, W.S., 2018. Effect of quercetin glucosides from allium extracts on hepG2, PC-3 AND HT-29 cancer cell lines. Oncol. Lett. 15, 4657–4661.
Park, G.H., Park, J.H., Song, H.M., Eo, H.J., Kim, M.K., Lee, J.W., Lee, M.H., Cho, K., Lee, J.R., Cho, H.J., Jeong, J.B., 2014. Anti-cancer Activity of Ginger (Zingiber Officinale) Leaf through the Expression of Activating Transcription Factor 3 in Human Colorectal Cancer Cells 1–8.
Pashaei-Asl, R., Pashaei-Asl, F., Gharabaghi, P.M., Khodadadi, K., Ebrahimi, M., Ebrahimie, E., Pashaiasl, M., 2017. The inhibitory effect of ginger extract on Ovarian cancer cell line; Application of systems biology. Adv. Pharmaceut. Bull. 7, 241–249.
Perna, A., De Luca, A., Adelfi, L., Pasquale, T., Varriale, B., Esposito, T., 2018. Effects of different extracts of curcumin on TPC1 papillary thyroid cancer cell line. BMC Compl. Alternative Med. 18, 63.
Pervaiz, A., Adwan, H., Berger, M.R., 2015. Riproximin: a type II ribosome inactivating protein with anti-neoplastic potential induces IL24/MDA-7 and GADD genes in colorectal cancer cell lines. Int. J. Oncol. 47, 981–990.
Pervaiz, A., Zepp, M., Adwan, H., Berger, M.R., 2016. Riproximin modulates multiple signaling cascades leading to cytostatic and apoptotic effects in human breast cancer cells. J. Canc. Res. Clin. Oncol. 142, 135–147.
Pettit, G.R., Meng, Y., Herald, D.L., Stevens, A.M., Pettit, R.K., Doubek, D.L., Gr, P., Meng, Y., Dl, H., Am, S., Rk, P., Dl, D., 2005. Antineoplastic agents 540. The Indian gynandropsis gynandra (capparidaceae). Oncol. Res. 15, 59–68.
Popovska-Jankovic, K., Noveski, P., Jankovic-Velickovic, L., Stojnev, S., Cukuranovic, R., Stefanovic, V., Toncheva, D., Staneva, R., Polenakovic, M., Plaseska-Karanfilska, D., 2016. MicroRNA profiling in patients with upper tract urothelial carcinoma associated with balkan endemic nephropathy. BioMed Res. Int. 2016.
Qin, R.X., Zuo, Q., Huang, X.H., Ma, H.Y., Yang, Y., Xing, H.H., Zhou, L., Zhou, M., Hu, Q.F., 2016. A new nor-sesquiterpene from Cassia occidentalis and its bioactivity. Zhongguo Zhongyao Zazhi 41, 4389–4392.
Qin, X.J., Yu, Q., Yan, H., Khan, A., Feng, M.Y., Li, P.P., Hao, X.J., An, L.K., Liu, H.Y., 2017. Meroterpenoids with antitumor activities from guava (psidium guajava). J. Agric. Food Chem. 65, 4993–4999.
Rabadeaux, C., Vallette, L., Sirdaarta, J., Davis, C., Cock, I.E., 2017. An examination of the antimicrobial and anticancer properties of khaya senegalensis (desr.) A. Juss. Bark extracts. Pharm. J. 9, 504–518.
Ramos, E.H.S., Moraes, M.M., Nerys, L.L.D.A., Nascimento, S.C., Militão, G.C.G., De Figueiredo, R.C.B.Q., Da Câmara, C.A.G., Silva, T.G., 2014. Chemical composition, leishmanicidal and cytotoxic activities of the essential oils from Mangifera indica L. Var. Rosa and Espada. BioMed Res. Int. 2014.
Renukadevi, K.P., Suhani Sultana, S., 2011. Determination of antibacterial, antioxidant and cytotoxicity effect of Indigofera tinctoria on lung cancer cell line NCI-H69. Int. J. Pharmacol. 7, 356–362.
Revathi, S., Govindarajan, R.K., Rameshkumar, N., Hakkim, F.L., Mohammed, A.B., Krishnan, M., Kayalvizhi, N., 2017. Anti-cancer, anti-microbial and anti-oxidant properties of Acacia nilotica and their chemical profiling. Biocatal. Agric. Biotechnol. 11, 322–329.
Rivera, M., Ramos, Y., Rodríguez-Valentín, M., López-Acevedo, S., Cubano, L.A., Zou, J., Zhang, Q., Wang, G., Boukli, N.M., 2017. Targeting multiple pro-apoptotic signaling pathways with curcumin in prostate cancer cells. PloS One 12.
Rizzo, L.Y., Longato, G.B., Ruiz, A.L.G., Tinti, S.V., Possenti, A., Vendramini-Costa, D.B., Sartoratto, A., Figueira, G.M., Silva, F.L.N., Eberlin, M.N., Souza, T.A.C.B., Murakami, M.T., Rizzo, E., Foglio, M.A., Kiessling, F., Lammers, T., Carvalho, J.E., 2014. In vitro, in vivo and in silico analysis of the anticancer and estrogen-like activity of guava leaf extracts. Curr. Med. Chem. 21, 2322–2330.
Rubila, S., Ranganathan, T.V., Sakthivel, K.M., 2016. Protective effect of zingiber officinale against dalton's lymphoma ascites tumour by regulating inflammatory mediator and cytokines. Appl. Biochem. Biotechnol. 180, 1482–1496.
Sakthive, K.M., Kannan, N., Angeline, A., Guruvayoorappan, C., 2012. Anticancer activity of Acacia nilotica (L.) wild. Ex. Delile subsp. indica against dalton's ascitic lymphoma induced solid and ascitic tumor model. Asian Pac. J. Cancer Prev. APJCP 13, 3989–3995.
Salau, A., Yakubu, M., Oladiji, A., 2013. Cytotoxic activity of aqueous extracts of Anogeissus leiocarpus and Terminalia avicennioides root barks against Ehrlich Ascites Carcinoma cells. Indian J. Pharmacol. 45, 381.
Saleh, S.S., Emara, N.A., 2016. Anticancer activity of balanitis aegyptiaca extract on human hepatoma cells and prostate cell line culture. Int. J. PharmTech Res. 9, 53–64.
Salem, M.M., Davidorf, F.H., Abdel-Rahman, M.H., 2011. In vitro anti-uveal melanoma activity of phenolic compounds from the Egyptian medicinal plant Acacia nilotica. Fitoterapia 82, 1279–1284.
Santos, P.A.S.R., Avanço, G.B., Nerilo, S.B., Marcelino, R.I.A., Janeiro, V., Valadares, M.C., Machinski, M., 2016. Assessment of cytotoxic activity of rosemary (Rosmarinus officinalis L.), Turmeric (Curcuma longa L.), and Ginger (Zingiber officinale R.) essential oils in cervical cancer cells (HeLa). Sci. World J. 2016.
Santos, J.M., Cury, N.M., Yunes, J.A., López, J.A., Hernández-Macedo, M.L., 2018. Effect of Anacardium occidentale leaf extract on human acute lymphoblastic leukaemia cell lines. Nat. Prod. Res. 1–4.
Shilpa, P., Kaveri, K., Salimath, B.P., 2015. Anti-metastatic action of anacardic acid targets VEGF-induced signalling pathways in epithelial to mesenchymal transition. Drug Discov. Ther. 9, 53–65.
Shinkafi, T.S., Bello, L., Hassan, S.W., Ali, S., 2015. An ethnobotanical survey of antidiabetic plants used by Hausa-Fulani tribes in Sokoto, Northwest Nigeria. J. Ethnopharmacol. 172, 91–99.
Shirazi, M.T., Gholami, H., Kavoosi, G., Rowshan, V., Tafsiry, A., 2014. Chemical composition, antioxidant, antimicrobial and cytotoxic activities of Tagetes minuta and ocimum basilicum essential oils. Food Sci. Nutr. 2, 146–155.
Shivshankar, P., Shyamala Devi, C.S., 2004. Evaluation of co-stimulatory effects of Tamarindus indica L. on MNU-induced colonic cell proliferation. Food Chem. Toxicol. 42, 1237–1244.
Shrivastava, S., Ganesh, N., 2010. Tumor inhibition and cytotoxicity assay by aqueous extract of onion (Allium cepa) & Garlic (Allium sativum): an in-vitro analysis. Int. J. Phytomed. 2, 80–84.
Sigidi, M.T., Anokwuru, C.P., Zininga, T., Tshisikhawe, M.P., Shonhai, A., Ramaite, I.D.I., Traoré, A.N., Potgieter, N., 2016. Comparative in vitro cytotoxic, anti-inflammatory and anti-microbiological activities of two indigenous Venda medicinal plants. Transl. Med. Commun. 1, 9.
Singh, B.N., Singh, B.R., Sarma, B.K., Singh, H.B., 2009. Potential chemoprevention of N-nitrosodiethylamine-induced hepatocarcinogenesis by polyphenolics from Acacia nilotica bark. Chem. Biol. Interact. 181, 20–28.
Sundarraj, S., Thangam, R., Sreevani, V., Kaveri, K., Gunasekaran, P., Achiraman, S., Kannan, S., 2012. γ-Sitosterol from Acacia nilotica L. induces G2/M cell cycle arrest and apoptosis through c-Myc suppression in MCF-7 and A549 cells. J. Ethnopharmacol. 141, 803–809.
Tagne, R.S., Telefo, B.P., Nyemb, J.N., Yemele, D.M., Njina, S.N., Goka, S.M.C., Lienou, L.L., Kamdje, A.H.N., Moundipa, P.F., Farooq, A.D., 2014. Anticancer and antioxidant activities of methanol extracts and fractions of some Cameroonian medicinal plants. Asian Pac. J. Trop. Med. 7, S442–S447.
Tahir, A.A., Sani, N.F.A., Murad, N.A., Makpol, S., Ngah, W.Z.W., Yusof, Y.A.M., 2015. Combined ginger extract & Gelam honey modulate Ras/ERK and PI3K/AKT pathway genes in colon cancer HT29 cells. Nutr. J. 14.
Taiwo, B.J., Fatokun, A.A., Olubiyi, O.O., Bamigboye-Taiwo, O.T., van Heerden, F.R., Wright, C.W., 2017. Identification of compounds with cytotoxic activity from the leaf of the Nigerian medicinal plant, Anacardium occidentale L. (Anacardiaceae). Bioorg. Med. Chem. 25, 2327–2335.
Tan, H.Y., Wang, N., Li, S., Hong, M., Guo, W., Man, K., Cheng, C.S., Chen, Z., Feng, Y., 2018. Repression of WT1-Mediated LEF1 transcription by mangiferin governs β-catenin-independent Wnt signalling inactivation in hepatocellular carcinoma. Cell. Physiol. Biochem. 47, 1819–1834.
Tanih, N.F., Ndip, R.N., 2013. The acetone extract of sclerocarya birrea (Anacardiaceae) possesses antiproliferative and apoptotic potential against human breast cancer cell lines (MCF-7). Sci. World J. 2013.
Tiloke, C., Anand, K., Gengan, R.M., Chuturgoon, A.A., 2018. Moringa oleifera and their phytonanoparticles: potential antiproliferative agents against cancer. Biomed. Pharmacother. 108, 457–466.
Torres, R.G., Casanova, L., Carvalho, J., Marcondes, M.C., Costa, S.S., Sola-Penna, M., Zancan, P., 2018. Ocimum basilicum but not Ocimum gratissimum present cytotoxic effects on human breast cancer cell line MCF-7, inducing apoptosis and triggering mTOR/Akt/p70S6K pathway. J. Bioenerg. Biomembr. 50, 93–105.

Tsai, T.C., Huang, H.P., Chang, Y.C., Wang, C.J., 2014. An anthocyanin-rich extract from hibiscus sabdariffa linnaeus inhibits N-nitrosomethylurea-induced leukemia in rats. J. Agric. Food Chem. 62, 1572–1580.

Tseng, T.H., Kao, T.W., Chu, C.Y., Chou, F.P., Lin, W.L., Wang, C.J., 2000. Induction of apoptosis by Hibiscus protocatechuic acid in human leukemia cells via reduction of retinoblastoma (RB) phosphorylation and Bcl-2 expression. Biochem. Pharmacol. 60, 307–315.

Wang, Y., Tian, W.-X., Ma, X.-F., 2012. Inhibitory effects of onion (Allium cepa L.) extract on proliferation of cancer cells and adipocytes via inhibiting fatty acid synthase. Asian Pac. J. Cancer Prev. APJCP 13, 5573–5579.

Wang, J., Qi, L., Mei, L., Wu, Z., 2017. Curcumin inhibits the proliferation and induces apoptosis in HT-29 cell lines through a reactive oxygen species (ROS)-dependent mechanism. Pak. J. Pharm. Sci. 30, 1671–1677.

Wang, X.P., Wang, Q.X., Lin, H.P., Chang, N., 2017. Anti-tumor bioactivities of curcumin on mice loaded with gastric carcinoma. Food Funct. 8, 3319–3326.

Wang, L.X., Qian, J., Zhao, L.N., Zhao, S.H., 2018. Effects of volatile oil from ginger on the murine B16 melanoma cells and its mechanism. Food Funct. 9, 1058–1069.

Wee, L.H., Morad, N.A., Aan, G.J., Makpol, S., Ngah, W.Z.W., Yusof, Y.A.M., 2015. Mechanism of chemoprevention against colon cancer cells using combined gelam honey and ginger extract via mTOR and wnt/β-catenin pathways. Asian Pac. J. Cancer Prev. APJCP 16, 6549–6556.

Wilkinson, A.S., Flanagan, B.M., Pierson, J.-T., Hewavitharana, A.K., Dietzgen, R.G., Shaw, P.N., Roberts-Thomson, S.J., Monteith, G.R., Gidley, M.J., 2011. Bioactivity of mango flesh and peel extracts on peroxisome proliferator-activated receptor γ [PPARγ] activation and MCF-7 cell proliferation: fraction and fruit variability. J. Food Sci. 76, H11–H18.

Wong, Y., Tan, W., Tan, C., Long, K., Nyam, K., 2014. Cytotoxic activity of kenaf (Hibiscus cannabinus L.) seed extract and oil against human cancer cell lines. Asian Pac J Trop Biomed 4, 510–515.

Xiong, G., Yao, L., Hong, P., Yang, L., Ci, W., Liu, L., He, Q., Gong, K., Li, X., Zhou, L., 2018. Aristolochic acid containing herbs induce gender-related oncological differences in upper tract urothelial carcinoma patients. Canc. Manag. Res. 10, 6627–6639.

Yang, Y., Wang, Y., Xing, H., Ma, H., Zhou, L., Dong, W., Zhou, K., Zhou, M., Ye, Y., Hu, Q., 2016. A new sesquiterpene from seeds of Cassia occidentalis and its cytotoxicity. Zhongguo Zhongyao Zazhi 41, 3256–3259.

Yassin, A.M., El-Deeb, N.M., Metwaly, A.M., El Fawal, G.F., Radwan, M.M., Hafez, E.E., 2017. Induction of apoptosis in human cancer cells through extrinsic and intrinsic pathways by balanites aegyptiaca furostanol saponins and saponin-coated SilverNanoparticles. Appl. Biochem. Biotechnol. 182, 1675–1693.

Ye, J.C., Hsiao, M.W., Hsieh, C.H., Wu, W.C., Hung, Y.C., Chang, W.C., 2010. Analysis of caffeic acid extraction from ocimum gratissimum linn. By high performance liquid chromatography and its effects on a cervical cancer cell line. Taiwan. J. Obstet. Gynecol. 49, 266–271.

Zang, S., Tang, Q., Dong, F., Liu, H., Li, L., Guo, F., Pan, X., Lin, H., Zeng, W., Cai, Z., Zhong, Q., Zang, N., Zang, L., 2017. Curcumol inhibits the proliferation of gastric adenocarcinoma MGC-803 cells via downregulation of IDH1. Oncol. Rep. 38, 3583–3591.

Zhang, H., Wang, X., Chen, F., Androulakis, X.M., Wargovich, M.J., 2007. Anticancer activity of limonoid from Khaya senegalensis. Phyther. Res. 21, 731–734.

Zhang, J., Kurita, M., Shinozaki, T., Ukiya, M., Yasukawa, K., Shimizu, N., Tokuda, H., Masters, E.T., Akihisa, M., Akihisa, T., 2014. Triterpene glycosides and other polar constituents of shea (Vitellaria paradoxa) kernels and their bioactivities. Phytochemistry 108, 157–170.

Zhang, J., Kurita, M., Ebina, K., Ukiya, M., Tokuda, H., Yasukawa, K., Masters, E.T., Shimizu, N., Akihisa, M., Feng, F., Akihisa, T., 2015. Melanogenesis-inhibitory activity and cancer chemopreventive effect of glucosylcucurbic acid from shea (vitellaria paradoxa) kernels. Chem. Biodivers. 12, 547–558.

Zhao, W., Zhou, X., Qi, G., Guo, Y., 2018. Curcumin suppressed the prostate cancer by inhibiting JNK pathways via epigenetic regulation. J. Biochem. Mol. Toxicol. 32, e22049.

Zhong, W., Zhang, L., Ma, J., Shao, S., Lin, R., Li, X., Xiong, G., Fang, D., Zhou, L., 2017. Impact of aristolochic acid exposure on oncologic outcomes of upper tract urothelial carcinoma after radical nephroureterectomy. OncoTargets Ther. 10, 5775–5782.

Zhou, J., Wu, Y., Tan, C., Zhu, M., Ma, L., 2016. Screening of anti-lung cancer bioactive compounds from Curcuma longa by target cell extraction and UHPLC/LTQ Orbitrap MS. China J. Chin. Mater. Med. 41, 3624–3629.

Zhou, Q.M., Sun, Y., Lu, Y.Y., Zhang, H., Chen, Q.L., Su, S.B., 2017. Curcumin reduces mitomycin C resistance in breast cancer stem cells by regulating Bcl-2 family-mediated apoptosis. Canc. Cell Int. 17.