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## Abstract

**Background:** Plants still remain a prime source of drugs for the treatment of cancer and can provide leads for the development of novel anticancer agents. Our screening of indigenous medicinal plants from Tanzania has led to the identification of the number of anticancer activity.

**Material and methods:** The current study investigates the cytotoxic activity of methanol extracts of one hundred and thirty seven Tanzania plants used locally for the traditional medicine herb using the MTS assay on the HepG2 cell lines.

**Result** 16% of the tested plant extracts showed moderate to strong inhibitory activity with IC<sub>50</sub> values ranging from 17.1 ± 1.1 µg/ml to 79.2 ± 0.7 µg/ml ; meanwhile, ten extracts (7.3%) could demonstrate cytotoxic activity with IC<sub>50</sub> values less than 27.6 ± 2.0 µg/ml; twelve extracts (8.8%) could demonstrate cytotoxic activity with IC<sub>50</sub> values ranging from 30.4 ± 1.6 µg/ml to 79.2 ± 0.7 µg/ml.

**Conclusion :** Especially, a methanol extract from the bark extract of *Erythrophleum zimmermannii* (Fabaceae) was found to be the most cytotoxicity against HepG2 cell lines (IC<sub>50</sub> = 17.1 ± 1.1 µg/ml).

**Keywords:** Medicinal plants; Cytotoxicity; *Erythrophleum zimmermannii* (Fabaceae)

## Introduction

Cancer is one of the most prominent human diseases which has stimulated scientific and commercial interest in the discovery of new anticancer agents from natural sources. Plants have formed the basis for the treatment of diseases in traditional medicine systems for many years, and continue to play a major role in the primary health care of about 80% of the world's inhabitants (Koduru *et al.*, 2007). Research interest has focused on various plants that possess anticancer properties and this has led to the discovery and development of efficacious anticancer agents such as vinblastine and vincristine from *Catharanthus roseus*, and taxol from *Taxus brevifolia* (Noble, 1990). Although the use of ethnomedicines is widespread in Africa, many of these plants are yet to be investigated for their anticancer activity. This paper reports the cytotoxic activity of the methanol extracts of one hundred and thirty seven Tanzanian plants against HepG2 cells lines.

## Materials and Methods

### Plant material

All the tested methanol extracts of plants parcel out international biological material research centre, Korea Research Institute of Bioscience and Biotechnology (KRIBB), Daejeon, South Korea. Voucher specimens were deposited at the herbarium of the Research Institute of Bioscience and Biotechnology (KRIBB).

### Cell culture and Cytotoxicity assay

Human hepatocarcinoma HepG2 cell lines were maintained in DMEM (Invitrogen, Carlsbad, CA) containing 10% heat-inactivated fetal bovine serum (FBS), 100 units/ml penicillin, 10 µg/ml streptomycin at 37°C and 5% CO<sub>2</sub>. Cell-Counting Kit (CCK)-8 (Dojindo, Kumamoto, Japan) was used to analyze the effect of compounds on cell cytotoxicity. Cells were cultured overnight in 96-well plate (1 × 10<sup>4</sup> cells/well). Cell cytotoxicity was assessed after the addition of extracts in dose-dependent manner. After 24 h of treatment, 10µl of the CCK-8 solution was added to triplicate wells, and incubated for 1 h. Absorbance was measured at 450 nm to determine viable cell numbers in wells.

### Statistical Analysis

All experiments were performed in triplicate. Statistical comparisons of results were made using analysis of variance (ANOVA). Significant differences between the means of control and sample treated cells were analyzed by Student's t-test.

## Results

In our search for new classes of anti-cancer constituent from natural resources, we evaluated the anti-proliferative effects of one hundred

and thirty seven Tanzania plants used locally for the traditional medicine herb extracts on HepG2 cell line *in vitro*. Out of the one hundred thirty seven plants tested, twenty-two plants exhibited cytotoxic activity with IC<sub>50</sub> values below 80µg/ml (Table 2), the plants are listed in alphabetical order of their family name, followed by the scientific name, morphological part used, as well as ethnomedicinal used of extract (Table 1). Twenty two plant species which belonging to eleven families were selected. Total of twenty two extracts of Tanzania plants were investigated for their cytotoxic activity against human cancer cell lines such as HepG2. In the US NCI plant screening program, a crude extract is

**Table 1:** List of plants used in the cytotoxicity test.

Name of Plant	Family	Plant used	part	Ethnomedicinal Use	Voucher numbers
<i>Aerva lanata</i> (L.) Juss. ex Schult.	Amaranthaceae	Whole		chest pain	FBM023-001
<i>Ageratum houstonianum</i> Mill.	Asteraceae	Whole		dry cough	FBM024-004
<i>Alchornea hirtella</i> Benth.	Euphorbiaceae	Stem		Diarrhea	FBM115-062
<i>Allanblackia stuhlmannii</i> (Engl.) Engl.	Clusiaceae	Root		Tonsillitis	FBM023-002
<i>Aneilema aequinoctiale</i> (P. Beauv.) Loudon	Commelinaceae	leaf, Stem		ringworms	FBM023-004
<i>Angylocalyx braunii</i> Harms	Papilionaceae	Root		Diabetes	FBM045-009
<i>Aningeria pseudoracemosa</i> J.H. Hemsl.	Sapotaceae	Root		skin disease	FBM045-010
<i>Annickia kummerae</i> (Engl. & Diels) Setten & Maas	Annonaceae	Root		diarrhoea	FBM039-095
<i>Anthocleista grandiflora</i> Gilg	Loganiaceae	Stem		Fever	FBM117-084
<i>Antidesma membranaceum</i> Mull. Arg.	Phyllanthaceae	Stem		Flu	FBM115-065
<i>Antidesma venosum</i> E. Mey. ex Tul.	Phyllanthaceae	Stem		backache	FBM115-061
<i>Asystasia gangetica</i> (L.) T. Anderson	Acanthaceae	Whole		skin rashes	FBM028-013
<i>Barleria prionitis</i> L.	Acanthaceae	leaf, Stem		stomach upset	FBM023-007
<i>Begonia johnstonii</i> Oliv. ex Hook. f.	Begoniaceae	Whole		vineral diseases	FBM023-010
<i>Blighia unijugata</i> Baker	Sapindaceae	Root		skin disease	FBM039-065
<i>Bombax rhodognaphalon</i> K. Schum.	Malvaceae	Stem		headache	FBM117-076
<i>Bombax stolzii</i> Ulbr.	Malvaceae	Stem		inflammation	FBM115-095
<i>Bridelia atroviridis</i> Müll. Arg.	Euphorbiaceae	Root		Fever	FBM045-011
<i>Brillantaisia madagascariensis</i> Anderson ex Lindau	Acanthaceae	Root		loose stool	FBM028-020
<i>Calotropis gigantea</i> (L.) W.T. Aiton	Asclepiadaceae	Stem		skin diseases	FBM028-023
<i>Castilla elastica</i> Sesse ex Cerv.	Moraceae	Stem		Joints	FBM135-027
<i>Cecamone gracilis</i>	Asclepiadaceae	leaf, Stem		appetizer for kids	FBM023-020
<i>Cedrela odorata</i> L.	Meliaceae	Root		Fever	FBM045-012
<i>Celosia schweinfurthiana</i> Schinz	Amaranthaceae	Root		fever in children	FBM023-022
<i>Celtis durandii</i> Engl.	Ulmaceae	Root		Hernia	FBM045-013
<i>Celtis mildbraedii</i> Engl.	Ulmaceae	Root		Stomach	FBM045-014
<i>Celtis philippensis</i> Blanco	Ulmaceae	Root		Ulcer	FBM045-015
<i>Cephaloshaera usambarensis</i>	Myristicaceae	Stem		heavy bleeding	FBM135-026
<i>Chrysophyllum gorungosanum</i> Engl.	Sapotaceae	Root		Swelling	FBM045-016
<i>Chrysophyllum perpulchrum</i> Mildbr. ex Hutch. & Dalziel	Sapotaceae	Root		Flu	FBM045-017
<i>Cleome usambarica</i> Pax	Capparaceae	Whole		sort of depression	FBM023-025
<i>Coccinia grandis</i> (L.) Voigt	Cucurbitaceae	Whole		Colds	FBM023-026
<i>Cola clavata</i> Mast.	Sterculiaceae	Root		bleeding	FBM039-066

<i>Cola usambarensis</i> Engl.	Sterculiaceae	Root	Hernia	FBM039-067
<i>Commelina imberbis</i> Ehrenb. ex Hassk.	Commelinaceae	Whole	heavy menstruation bleeding	FBM023-028
<i>Commiphora africana</i> (A. Rich.) Engl.	Burseraceae	Stembark	Cough	FBM117-090
<i>Conyza aegyptiaca</i> (L.) Aiton	Asteraceae	Whole	loss of appetite	FBM024-032
<i>Craibia elliotii</i> Dunn	Fabaceae	Stem	Malaria	FBM117-086
<i>Crassesia speciosa</i>	Rubiaceae	Heartwood	Scabies	FBM028-029
<i>Croton silvaticus</i> Hochstetter ex Krauss-	Euphorbiaceae	Root	headache	FBM039-068
<i>Cussonia arborea</i> Hochst. ex A. Rich.	Araliaceae	Root	convulsions	FBM023-030
<i>Cussonia spicata</i> Thunb.	Araliaceae	Root	headache	FBM039-069
<i>Cussonia zimmermannii</i> Harms	Araliaceae	Root	dysentery	FBM039-070
<i>Cyathea manniana</i> Hook.	Cyatheaceae	Stembark	backache	FBM115-056
<i>Cylicomorpha parviflora</i> Urb.	Caricaceae	Root	loose stool	FBM023-031
<i>Cymbopogon citratus</i> (DC.) Stapf	Poaceae	leaf	Fever	FBM028-031
<i>Cynanchum tetrapterum</i> (Turcz.) R.A. Dyer ex Bullock	Asclepiadaceae	Whole	inflammation	FBM028-032
<i>Cynometra brachyrrhachis</i> Harms	Fabaceae	Root	fungal infections	FBM078-001
<i>Cynometra webberi</i> Baker f.	Fabaceae	Root	skin disease	FBM039-072
<i>Dialium holtzii</i> Harms	Fabaceae	Root	Fungus	FBM039-073
<i>Dichapetalum stuhlmannii</i> Engl.	Dichapetalaceae	Root	skin disease	FBM045-018
<i>Diospyros amaniensis</i> Gürke	Ebenaceae	Root	dysentery	FBM039-079
<i>Diospyros kabuyeana</i> F. White	Ebenaceae	Root	constipation	FBM045-025
<i>Diospyros squarrosa</i> Klotzsch	Ebenaceae	Root	veneral diseases	FBM045-026
<i>Dombeya shupangae</i> K. Schum.	Araucariaceae	Stem	colds, cough	FBM115-069
<i>Dracaena laxissima</i> Engl.	Asparagaceae	Root	Cough	FBM039-078
<i>Drypetes gerrardii</i> Hutch.	Putranjivaceae	Stem	Fever	FBM117-098
<i>Englerodendron usambarense</i> Harms	Fabaceae	Stembark	Fever	FBM117-088
<i>Entada rheedei</i> Spreng.	Fabaceae	Root	chest pain	FBM039-080
<i>Erythrina abyssinica</i> Lam.	Fabaceae	Stembark	backache	FBM117-092
<i>Erythrophleum zimmermannii</i>	Fabaceae	Root	joint pains	FBM050-006
<i>Ethulia greenwayi</i> M.G. Gilbert	Asteraceae	Whole	stomach ache	FBM028-035
<i>Fernandoa magnifica</i> Seem.	Bignoniaceae	Stem	childrens convulsions	FBM117-089
<i>Ficus altissima</i> Blume	Moraceae	Root	joint pains	FBM045-027
<i>Ficus sycomorus</i> L.	Moraceae	Root	veneral diseases	FBM039-081
<i>Flueggea virosa</i> (Roxb. ex Willd.) Royle	Phyllanthaceae	Stem	Malaria	FBM117-075
<i>Funtumia africana</i> (Benth.) Stapf	Apocynaceae	Root	diarrhoea	FBM024-048
<i>Galinsoga parviflora</i> Cav.	Asteraceae	Whole	Fatigue	FBM023-041
<i>Gynura colorata</i> Peter ex F.G. Davies	Asteraceae	Whole	dry cough	FBM023-043
<i>Harungana madagascariensis</i> Lam. ex Poir.	Hypericaceae	leaf	headache	FBM117-081
<i>Helichrysum mechonianum</i> var <i>ceres</i>	Asteraceae	Whole	loose stool	FBM023-044
<i>Hevea brasiliensis</i> (Willd. ex A. Juss.) Mull. Arg.	Euphorbiaceae	Stem	migrain headache	FBM135-049
<i>Homalanthus populifolius</i> Graham	Euphorbiaceae	Stem	bleeding	FBM115-054

<i>Hypericum roepericanum</i>	Clusiaceae	Stem	appetitie	FBM023-047
<i>Impatiens usambarensis</i> Grey-Wilson	Balsaminaceae	Whole	prolonged labour	FBM024-053
<i>Ipomoea wightii</i> Var wightii	Convolvulaceae	Whole	itchy skin/ allergy	FBM023-049
<i>Isolona heinsenii</i> Engl. & Diels	Annonaceae	Stem	diarrhoea	FBM135-028
<i>Juniperus procera</i> Hochst. ex Endl.	Cupressaceae	Root	Strength	FBM023-051
<i>Justisia diclipteroides</i> subsp. usambarica	Acanthaceae	Whole	low abdominal pain	FBM023-052
<i>Kalanchoe densiflora</i> Rolfe	Crassulaceae	leaf, Stem	bleeding	FBM115-055
<i>Khaya anthotheca</i> (Welw.) C. DC.	Meliaceae	Root	Swelling	FBM045-003
<i>Lagenaria sphaerica</i> (Sond.) Naudin	Cucurbitaceae	leaf, Stem	Fungus	FBM023-055
<i>Landolphia owariensis</i> P. Beauv.	Apocynaceae	Stem	skin disease	FBM117-083
<i>Lannea amaniensis</i> Engl. & K.Krause	Anacardiaceae	Stem	pressure	FBM117-072
<i>Leptonychia usambarensis</i> K. Schum.	Malvaceae	Stem	bleeding	FBM117-100
<i>Lettowianthus stellatus</i> Diels	Annonaceae	Root	Nausea	FBM023-057
<i>Liquidamber stylaciflua</i> L.	Altingiaceae	Stembark	headache	FBM117-093
<i>Lonchocarpus capassa</i> Rolfe	Fabaceae	Stembark	headache	FBM117-087
<i>Luffa cylindrica</i> M. Roem.	Cucurbitaceae	leaf, Stem	Joints	FBM023-059
<i>Margaritaria discoidea</i> (Baill.) G.L. Webster	Euphorbiaceae	Root	inflammation	FBM039-061
<i>Maytenus undata</i> (Thunb.) Blakelock	Celastraceae	Root	skin diseases	FBM023-062
<i>Mellera lobulata</i> S. Moore	Acanthaceae	leaf, Stem	immune system	FBM023-060
<i>Michelia champaca</i> L.	Magnoliaceae	Stem	Stomache	FBM117-099
<i>Mikaniopsis usambarensis</i> (Muschl.) Milne-Redh.	Asteraceae	leaf, Stem	body ache	FBM023-063
<i>Millettia oblata</i> Dunn	Fabaceae	Root	skin disease	FBM117-094
<i>Momordica boivinii</i> Baill.	Cucurbitaceae	leaf, Stem	stomach problems	FBM023-064
<i>Monanthes taxis fornicata</i> (Baill.) Verdc.	Annonaceae	Root	skin disease	FBM039-060
<i>Monodora grandidieri</i> Baill.	Annonaceae	Root	skin diseases	FBM023-065
<i>Morus mesozygia</i> Stapf	Moraceae	Root	bleeding	FBM045-004
<i>Myroxylon perviana</i>	Fabaceae	Stem	Swelling	FBM117-085
<i>Mystroxydon aethiopicum</i> (Thunb.) Loes.	Celastraceae	Root	headache	FBM023-069
<i>Newtonia paucijuga</i> (Harms) Brenan	Fabaceae	Root	Labour	FBM039-062
<i>Nymphaea caerulea</i> Savigny	Nymphaeaceae	Flower	Flowers are taken and dried and used as a sedative	FBM028-064
<i>Obetia radula</i> (Baker) Baker ex B.D. Jacks.	Urticaceae	Root	chest pain	FBM045-005
<i>Parinari excelsa</i> Sabine	Chrysobalanaceae	Root	diarrhoea	FBM023-074
<i>Parkia filicoidea</i> Welw. ex Oliv.	Fabaceae	Root	fever in children	FBM045-006
<i>Parquetina nigrescens</i> (Afzel.) Bullock	Asclepiadaceae	leaf	flu/colds	FBM023-035
<i>Pavetta amaniensis</i> Bremek.	Rubiaceae	Root	sore body	FBM045-007
<i>Polysphaeria multiflora</i> Hiern	Rubiaceae	Root	convulsions	FBM039-074
<i>Premna chrysoclada</i> (Bojer) Gürke	Verbenaceae	Stembark	Fatigue	FBM050-005
<i>Pupalia lappacea</i> var. <i>argyrophylla</i> C.C. Towns.	Amaranthaceae	leaf, Flower	Stem, skin diseases	FBM024-079
<i>Quassia undulata</i> (Guill. & Perr.) D. Dietr.	Simaroubaceae	Root	Piles	FBM045-019
<i>Rothmania manganjae</i> (Hiern) Keay	Rubiaceae	Root	Hernia	FBM045-020

<i>Rytigynia amaniensis</i> (K. Krause) Bullock	Rubiaceae	Root	constipation	FBM045-021
<i>Rytigynia flavida</i> Robyns	Rubiaceae	Root	loose stool	FBM039-075
<i>Saba comorensis</i> (Bojer ex A. DC.) Pichon	Apocynaceae	Root	hypertension	FBM023-085
<i>Schizogygia coffaeoides</i> Baill.	Apocynaceae	Root	headache	FBM045-022
<i>Scorodophloeus fischeri</i> (Taub.) J. Léonard	Fabaceae	Root	dysentery	FBM045-023
<i>Senecio lyratus</i> Forssk.	Asteraceae	Whole	diarrhoea	FBM028-081
<i>Spondias lutea</i> L.	Anacardiaceae	Stem	diarrhoea	FBM117-097
<i>Tabernaemontana holstii</i> K. Schum.	Apocynaceae	Root	impotence	FBM023-089
<i>Thunbergia alata</i> Bojer ex Sims	Acanthaceae	Whole	skin diseases	FBM024-094
<i>Tipuana tipu</i> (Benth.)Kuntze	Fabaceae	Stem	skin disease	FBM117-082
<i>Toona ciliata</i> M. Roem.	Meliaceae	Root	Wound	FBM045-024
<i>Treculia africana</i> Decne.	Moraceae	Stem	STD	FBM117-096
<i>Turraea robusta</i> Gürke	Meliaceae	Root	impotence	FBM039-076
Unidentified	Amaryllidaceae	Whole	migrain headache	FBM023-068
<i>Uvaria leptocladon</i> Oliv.	Annonaceae	Stem	swollen legs	FBM023-096
<i>Uvaria tanzaniae</i> Verdc.	Annonaceae	Root	Fever	FBM039-077
<i>Uvariadendron pycnophyllum</i> (Diels) R.E.Fr.	Annonaceae	Root	menstruation	FBM039-063
<i>Voacanga lutescens</i> Stapf	Apocynaceae	Stembark	Fever	FBM117-074
<i>Voacanga thouarsii</i> Roem. & Schult.	Apocynaceae	Root	headache	FBM039-064
<i>Warbugia ugandensis</i>	Lauraceae	Stembark	swollen legs	FBM023-099
<i>Warszewiczia coccinea</i> (Vahl) Klotzsch	Rubiaceae	Stem	dysentery	FBM117-091
<i>Whitfieldia elongata</i> C.B.Clarke	Acanthaceae	Root	nose bleeding	FBM028-098
<i>Zantedeschia aethiopica</i> (L.) Spreng.	Araceae	Whole	fever for adults	FBM023-100
<i>Ziziphue pubescens</i> Oliv.	Rhamnaceae	Root	diarrhoea	FBM045-008

generally considered to have in vitro cytotoxic activity if the IC<sub>50</sub> value (concentration that causes a 50% cell kill) in human cancer cells, following incubation for 48 hr, is less than 20 mg/mL (Boik, 2001). As shown in Table 2, twenty-two methanol extracts exhibited potent cytotoxic activity in HepG2 cell lines with the IC<sub>50</sub> values within 17.1 ± 1.1 - 79.2 ± 0.7 µg/mL.

The high potent cytotoxic activity was observed for the extracts of *Erythrophleum zimmermannii* (8) with IC<sub>50</sub> values of 17.1 ± 1.1 µg/mL; *Warbugia ugandensis* (22) with IC<sub>50</sub> at 20.6 ± 0.2 µg/ mL; *Entada rheedei* (7) with IC<sub>50</sub> values of 21.7 ± 4.5 µg/mL; *Alchornea hirtella* (1) with IC<sub>50</sub> value of 25.0 ± 4.0 µg/mL; *Khaya anthotheca* (11) with IC<sub>50</sub> value of 25.1 ± 2.3 µg/mL; *Spondias lutea* (17) with IC<sub>50</sub> at 25.8 ± 1.4 µg/ mL; *Englerodendron usambarensis* (6) with IC<sub>50</sub> values of 26.3 ± 1.3 µg/mL; *Cedrela odorata* (3) played marked strong with IC<sub>50</sub> at 26.8 ± 6.4 µg/mL; *Commiphora africana* (4) with IC<sub>50</sub> value of 27.2 ± 3.0 µg/mL; *Toona ciliata* (18) with IC<sub>50</sub> values of 27.6 ± 2.0 µg/mL. Further studies concerning the cytotoxic constituents of *Alchornea hirtella* (1), *Bombax rhodognaphalon* (2), *Cedrela odorata* (3), *Commiphora africana* (4), *Entada rheedei* (7), *Erythrophleum zimmermannii* (8), *Ficus altissima* (9), *Hypericum roepericanum* (10), *Khaya anthotheca* (11), *Landolphia owariensis* (12), *Monanthataxis fornicate* (14), *Newtonia paucijuga* (15), *Spondias lutea* (17), *Uvaria leptocladon* (19), *Uvaria tanzaniae* (20), *Voacanga thouarsii* (21) and *Warbugia ugandensis* (22) on which few or no phytochemical reports exist in the literatures, seem to be worthwhile.

**Table 2:** In vitro cytotoxic activity of the methanol extracts on the HepG2 cell lines measured by the MTS assay

Number	Name of Plant	Cytotoxicity Activity <sup>a</sup> (µg/mL) <sup>b</sup>
1	<i>Alchornea hirtella</i> Benth.	25.0 ± 4.0
2	<i>Bombax rhodognaphalon</i> K. Schum.	51.3 ± 2.4
3	<i>Cedrela odorata</i> L.	26.8 ± 6.4
4	<i>Commiphora africana</i> (A. Rich.) Engl.	27.2 ± 3.0
5	<i>Cynometra brachyrrhachis</i> Harms	79.2 ± 0.7

6	<i>Englerodendron usambarensense</i> Harms	26.3 ± 1.3
7	<i>Entada rheedei</i> Spreng.	21.7 ± 4.5
8	<i>Erythrophleum zimmermannii</i>	17.1 ± 1.1
9	<i>Ficus altissima</i> Blume	31.4 ± 1.0
10	<i>Hypericum roepericanum</i>	30.4 ± 4.2
11	<i>Khaya anthotheca</i> (Welw.) C. DC.	25.1 ± 2.3
12	<i>Landolphia owariensis</i> P. Beauv.	40.5 ± 0.5
13	<i>Liquidamber stylaciflua</i> L.	30.4 ± 1.6
14	<i>Monanthes fornicata</i> (Baill.) Verdc.	70.9 ± 4.0
15	<i>Newtonia paucijuga</i> (Harms) Brenan	71.5 ± 6.1
16	<i>Parinari excelsa</i> Sabine	52.2 ± 0.7
17	<i>Spondias lutea</i> L.	25.8 ± 1.4
18	<i>Toona ciliata</i> M. Roem.	27.6 ± 2.0
19	<i>Uvaria leptocladon</i> Oliv.	31.9 ± 8.3
20	<i>Uvaria tanzaniae</i> Verdc.	72.6 ± 0.7
21	<i>Voacanga thouarsii</i> Roem. & Schult.	64.0 ± 3.3
22	<i>Warbugia ugandensis</i>	20.6 ± 0.2
<b>Positive control</b>	Paclitaxel	0.73 ± 0.1

<sup>a</sup>IC<sub>50</sub>: the concentration that caused 50% cell growth inhibition; <sup>b</sup>Data are presented as mean±SEM of at least three distinct experiments  
\*Significantly different from control (p<0.05).

## Discussion and conclusions

Recently, there has been a global trend toward the use of natural phytochemical anticancer present in natural resources, such as herbs, vegetables, fruits and oilseeds (Mann, 2002). Herbs have begun as raw materials for finding new drugs (Lee *et al.*, 2006). Herbal medicines derived from plants are increasingly being utilized to treat a wide variety of clinical diseases, even though relatively little is known about their modes of action. Until now, numerous plants and their constituents have already demonstrated cytotoxic activity (de Mesquita *et al.*, 2009), illustrating that there is still potential for novel innovative cytotoxic activities to be identified from natural plant resources. Vincristine, irinotecan, etoposide, and paclitaxel are examples of plant-derived compounds that are being used in cancer treatment. The taxanes and the camptothecins are presently approved for human use in various countries (da Rocha *et al.*, 2001). This study provides high potent cytotoxic activities of *Alchornea hirtella* (1), *Cedrela odorata* (3), *Commiphora africana* (4), *Englerodendron usambarensense* (6), *Entada rheedei* (7), *Erythrophleum zimmermannii* (8), *Khaya anthotheca* (11), *Spondias lutea* (17), *Toona ciliata* (18) and *Warbugia ugandensis* (22) indicating their ultimate potential for pharmaceutical use among the test samples. Of those, three plants (4, 7 and 18) exhibited considerable anticancer activity (Ma *et al.*, 2005; Nzowa *et al.*, 2010; Zhang *et al.*, 2012).

Phytochemical studies revealed the presence of sesquiterpenoid constituents with bisabolane skeleton such as bisabolone and β-sesquiphellandrene, dihydroflavonol glucoside; phellamurin in *C. africana* (Avlessi *et al.*, 2005; Ma *et al.*, 2005), revealed the presence of phenylpropanoid glycosides, thioamide glycoside and oleanane-type triterpene oligoglycosides in *E. rheedei* (Sugimoto *et al.*, 2011, 2012; Nzowa *et al.*, 2010), and revealed the presence of diterpenoids, triterpenoids, neolignans, phenylpropanoid, steroids, polyynes and coumarins in *T. ciliate* (Liu *et al.*, 2011; Ning *et al.*, 2010; Lu *et al.*, 2009). The extract of *C. africana* was found to mediate (Cu<sup>2+</sup>)-dependent relaxation of supercoiled plasmid DNA (Ma *et al.*, 2005). Previous studies on *E. rheedei* also indicated the effects of its isolated saponins on the human cancer cell lines such as T98G, A431, PC3 and B16-F1 (Nzowa *et al.*, 2010). The inhibitory effects of isolated triterpenoids from *T. ciliate* were evaluated on human cancer cell lines, such as K562 (leukemia), SMMC-7721 (hepatocellular carcinoma), MCF-7 (breast cancer), HL-60 (human myeloid leukemia), SW480 (colon cancer), A549 (lung cancer), and KB (oral epithelial cancer), as well as multidrug-resistant cell lines MCF-7/ADM and KB/VCR (Zhang *et al.*, 2012). And neolignans and phenylpropanoid from the leaves and stems of *T. ciliate*, The antiproliferative activities of these compounds against four cancer cell lines A549, Colo205 (colon cancer), QGY-7703 (Human hepatoma), and LOVO (colon cancer) were also evaluated by MTT method. (Liu *et al.*, 2011), polyynes from this plants exhibited potent cytotoxicity against the HL-60 cell lines (Ning., 2010). Steroid from *T. ciliata* was found cytotoxic in a brine shrimp lethality bioassay with LC50 of 9.9 μg/mL and it also showed significant antitumor activity with Ti50 value of 14.1 μg/mL in a potato disk bioassay (Chowdhury *et al.*, 2004). Nevertheless, no report has been described for their effects on the HepG2 cell lines which were used in this study. The other plants (3, 11, 17, and 22) presented significantly antimicrobial, antifeedant, antimalarial, antidiabetes and antitrotavirus effects (Villanueva *et al.*, 2009; Lee *et al.*, 2008; Ei *et al.*, 2000; Njoroge *et al.*, 2005). The bark essential oil of *C. odorata* (3) exhibited antimicrobial activity. However no report related to cytotoxicity of this plant has been carried out. In 1997, de Paula *et al.* reported the presence of sesquiterpenes, triterpenoids, limonoids and flavonoids (de Paula *et al.*, 1997).

Triterpenoids from *K. anthotheca* showed potent antimalarial activity against malaria parasites with IC<sub>50</sub> values of 1.4 and 0.17 μM using two different assays (Lee *et al.*, 2008). However no report related to cytotoxicity of this plant has been carried out. In 2000, El *et al.* reported that *S. lutea* extracts revealed the presence of a series of C16-32 hydrocarbons, cholesterol and stigmasterol. In addn. β-amyryn and lupeol were isolated from the unsaponifiable fraction. Twelve fatty acids were identified in the saponifiable fraction and quantitative determined by gas-liquid chromatography(GLC). Palmitic, linoleic, oleic, linolenic and stearic acids were the major components (84%). Four flavonoid compounds (quercetin, quercetrin, rutin, and most probably quercetin-7-O-glucoside) were isolated from fresh pericarp and leaves. The amount of total flavonoids was 0.52% in the fresh pericarp and 1.55% in leaves. In addition two triterpenoid saponin glycosides with ursolic acid as common aglycon were isolated from leaves. The percentage of total saponin in leaves was found to be (0.22%) (El., 2000). This plant extracts

(17) presented significantly anti-rotavirus effects (Goncalves *et al.*, 2005). However no report toward the cytotoxic activity of the isolated compound to date. Until now, less cytotoxicity and phytochemical study have been reported to this plant, except for the significant antimicrobial activity of 7 $\alpha$ -acetylugandensolide together with thirteen known drimane-type sesquiterpenes were isolated from *W. ugandensis* bark extract was investigated against fungi and bacteria (Opiyo *et al.*, 2011). *A. hirtella* have not yet been assessed for *in vitro* cytotoxicity but phytochemical study was reported presence of tetrahydroimidazo [1,2- $\alpha$ ] pyrimidine alkaloid alchornine. The other remained plants, *Bombax rhodognaphalon* (2), *Cynometra brachyrrhachis* (5), *Englerodendron usambarensis* (6), *Erythrophleum zimmermannii* (8), *Ficus altissima* (9), *Hypericum roepericanum* (10), *Landolphia owariensis* (12), *Liquidamber stylaciflua* (13), *Monanthes taxifolia* (14), *Newtonia paucijuga* (15), *Parinari excels* (16), *Uvaria leptocladon* (19), *Uvaria tanzaniae* (20) and *Voacanga thouarsii* (21), have not yet been assessed for *in vitro* cytotoxicity and also phytochemical studies.

In conclusion, plants still remain a prime source of drugs for the treatment of cancer and can provide leads for the development of novel anticancer agents. Our screening of indigenous medicinal plants from Tanzania has led to the identification of the number of anticancer activity. Total methanol extracts of one hundred thirty seven plant species were screened for *in vitro* anticancer activity against HepG2 cell lines. Results showed that ten methanol extracts of plants as *Alchornea hirtella* (1), *Cedrela odorata* (3), *Commiphora africana* (4), *Englerodendron usambarensis* (6), *Entada rheedii* (7), *Erythrophleum zimmermannii* (8), *Khaya anthotheca* (11), *Spondias lutea* (17), *Toona ciliata* (18) and *Warburgia ugandensis* (22) exhibited high cytotoxic activity against HepG2 cell lines.

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