Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2012, 4(11):4845-4851

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Physical characteristics and chemical compositions of the essential oils extracted from different parts of *Siphonochilus aethiopicus* (Schweinf.) B. L. Burtt (Zingiberaceae) harvested in Benin

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ABSTRACT

The chemical composition of essential oils of limbo, foliar sheath and rhizomes Siphonochilus aethiopicus by hydrodistillation was investigated by GC / MS. Curzerenone (12.9-51.9%), β-pinene (6.7-44.5%), intermedeol (8.0-31.7%), α-humulene (6.4-25.8%), caryophyllene oxide (4.9-25.4%), palmitic acid (13.6%), tetradecanoate ethyl (12.8%), α-cadinol (12.0%), methyl salicylate (9.9%) and geranyl octanoate (5.8%) were the major compounds of the essential oils studied, but they do not characterize specifically a particular organ of the plant. Significant differences were observed between the values of density, refractive index and rotatory power determined by standard methods (AFNOR) in essential oils. These values of the density, rotatory power and the refractive index will contribute to a better characterization of the essential oils of this plant.

Key words: *S. aethiopicus*, curzerenone, β-pinene, physical characteristics

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INTRODUCTION

Since ancient times, the volatile extracts of aromatic plants are looked for their biological properties. These plants are often used in the traditional medicine for therapeutic purposes and to alleviate, among other ailments, the cutaneous affections, the respiratory disorders, the digestive and cardiovascular diseases etc. It has also been attributed to volatile extracts of aromatic plants a certain number of biological properties may find applications in cosmetics: to anti-radical, anti-inflammatory activity [1]. Among these is *S. aethiopicus* (Zingiberaceae), a rhizomatous plant native from Asia. It is less common in Benin, but well known for its medicinal virtues. It grows wild to the spontaneous state in the savannas of tropical Africa [2]. Its roots and rhizomes are profusely used against the malaria, the cold, the cough, the flu, the hysteria, the pain and in several other traditional and socio-cultural practices in Africa [3, 4, 5]. In Benin traditional medicine, the decoction of the roots and rhizomes of *S. aethiopicus* treats female infertility and endometritis [2].

Several studies relatives to the pharmacological properties have been carried out on the rhizomes of *S. aethiopicus* [6, 7, 8, 9, 10, 11]. Moreover, Lategan et al. reported the antiplasmodial properties of furanoterpenoïds extracts from *S. aethiopicus* in 2009 [12]. If important studies reported in the literature the medicinal power of *S. aethiopicus*, it should be noted that in the field of chemistry, very few works have been done. In 2002, Holzapfel *et al*. isolated from *S. aethiopicus* two furanoterpenoïds (4aaH-3,5a,8ab-trimethyl-4,4a,9-tetrahydro-naphtho [2, 3-b]-furan-8-one et 2-hydroxy-4aaH-3,5a,8ab-trimethyl-4,4a,9-tetrahydronaphtho [2,3-b]-furan-8-one) [13] whose structures have been elucidated thanks to the technical of Nuclear Magnetic Resonance (NMR). In 2011, investigations by Igoli and Obanu reported the following majority odoriferous compounds: 2-methyl butanoate, 3-methyl butanoate, β-phellandrene, 2-isopropyl-3-methoxypyrazine, 2-isobutyl-3-methoxypyrazine, methional, furanodiene and curzerenone [14]. The present work reports the results of the determination of the chemical composition and physical characteristics of the essential oil extracted from limbo, foliar sheaths and rhizomes of the species *S. aethiopicus* naturalized in the savannas of central and northern regions of Benin.

EXPERIMENTAL SECTION

Plant material and distillation of the volatile constituents

The collection of organs (limbo, foliar sheaths and rhizomes) of *S. aethiopicus* had been made from Manigri in two samples (2007) and from Savalou (2008) in Benin. A voucher specimen of these diverse aromatic plants were deposited in Abomey-Calavi University National Herbarium. They were kept in the laboratory between 18 and 20°C in the shade during all the extractions period. Essential oils were extracted by hydrodistillation of the parts (250 g of limbo or foliar sheaths and 300 g of rhizomes) for 3 to 4 hours using a Clevenger according to the method described in british pharmacopoeia [15]. The volatile extracts collected were dried over anhydrous sodium sulfate and analyzed by GC/MS.

Physical properties

Physical parameters of the essential oils extracted from *S. aethiopicus* parts were determined using the methods described by AFNOR [16]. These parameters are the density, refractive index, rotatory power.

DENSITY AT 20°C

The density measure was carried out using a micro-pycnometer and a precision balance.

REFRACTIVE INDEX AT 20 ° C

The refractive index was determined by means of the refractometer CARL ZEISS JENA 234678.

ROTATORY POWER AT 20 ° C

The measurement was made by Carl Zeiss polarimeter 128291.

Analysis of the volatile constituents

GC/MS: The essential oils were analysed on a Hewlett-Packard gas chromatograph Model 7890, coupled to a Hewlett-Packad MS model 5875, equipped with a DB5 MS column (30m x 0.25mm; 0.25μm), programming from 50°C (5 min) to 300°C at 5°C/mn, 5 min hold. Helium as carrier gas (1.0 mL/min); injection in split mode (1:30); injector and detector temperature, 250 and 280°C respectively. The MS working in electron impact mode at 70 eV; electron multiplier, 2500V; ion source temperature, 180°C; mass spectra data were acquired in the scan mode in *m/z* range 33-450.

GC/FID: The essential oils were analysed on a Hewlett-Packard gas chromatograph Model 6890, equipped with a DB5 MS column (30m x 0.25mm; 0.25μm), programming from 50°C (5min) to 300°C at 5°C/min, 5min hold. Hydrogen as carrier gas (1.0 mL/min); injection in split mode (1:60); injector and detector temperature, 280 and 300°C respectively. The essential oil is diluted in hexane: 1/30.

The compounds assayed by GC in the different essential oils were identified by comparing their retention indices with those of reference compounds in the literature and confirmed by GC/MS by comparison of their mass spectra with those of reference substances [17, 18, 19].

RESULTS AND DISCUSSION

The *S. aethiopicus* essential oils yields values are presented in the table 1.

Table 1 : *S. aethiopicus* parts essential oils yields

harvesting location	Manigri			Manigri			Savalou		
parts distilled	F_1	T_1	R_1	F_2	T_2	R_2	F_3	T_3	R_3
yields (%)	0.16	0.03	0.18	0.60	0.15	0.21	0.41	0.12	0.22

F_1 = limbo (07-07-07), **T_1** = foliar sheaths (07-07-07), **R_1** = rhizome (07-07-07),
F_2 = limbo (01-09-07), **T_2** = foliar sheaths (01-09-07), **R_2** = rhizome (01-09-07),
F_3 = limbo (20-07-08), **T_3** = foliar sheaths (20-07-08), **R_3** = rhizome (20-07-08)

The table 2 presents the values of the physical parameters measured for the essential oils studied.

Table 2 : Physical parameters of *S. aethiopicus* essential oils samples

Manigri			Manigri			Savalou		
Density (20°C)			Refraction index (20°C)			Rotatory power (20°C)		
F_1	**T_1**	**R_1**	**F_1**	**T_1**	**R_1**	**F_1**	**T_1**	**R_1**
0.890	0.893	0.859	1.4812	1.4931	1.4961	-11.20	-2.39	-6.10
F_2	**T_2**	**R_2**	**F_2**	**T_2**	**R_2**	**F_2**	**T_2**	**R_2**
0.911	0.900	0.937	1.4890	1.4918	1.4959	-15.12	-2.28	-11.30
F_3	**T_3**	**R_3**	**F_3**	**T_3**	**R_3**	**F_3**	**T_3**	**R_3**
0.809	0.869	0.888	1.4701	1.4855	1.4977	-13.14	-5.38	-8.22

In Table 3, it was recorded the results obtained by coupling chromatography with mass spectrometry (GC/MS) of *S. aethiopicus* essential oils organs from different villages of Benin.

Table 3 : chemical composition of the essential oil extracted from limbo, foliar sheaths and rhizomes of *S. aethiopicus*

compounds identified	KI	**Manigri**			**Manigri**			**Savalou**		
		(%)								
		F_1	**T_1**	**R_1**	**F_2**	**T_2**	**R_2**	**F_3**	**T_3**	**R_3**
3-methylbut-2-en-1-ol	774	-	-	-	-	-	-	3.8	-	0.8
3-hydroxy-3-methylbutan-2-one	**820**	-	-	-	-	-	-	**6.5**	-	1.4
tricyclene	929	0.8	-	2.6	0.3	-	-	-	-	-
α-thujene	**930**	**6.2**	2.5	-	**4.9**	-	2.8	-	-	-
α-pinene	934	-	-	-	-	-	-	-	-	0.4
α-fenchene	946	0.2	-	-	-	-	-	-	-	-
camphene	953	-	0.3	-	0.1	-	-	0.9	-	0.2
sabinene	**969**	**8.5**	1.7	0.5	1.1	0.8	1.1	1.8	1.2	1.2
β-pinene	**975**	**44.5**	**6.7**	**19.9**	**39.8**	-	**17.7**	1.5	-	0.5
cis-meta-mentha-2,8-diene	985	-	-	-	-	-	-	-	-	-
myrcene	886	0.7	0.7	-	0.2	-	-	-	-	0.6
δ-2-carene	993	-	0.3	-	-	-	-	-	-	-
para-mentha-1(7),8-diene	999	0.1	-	-	-	-	-	-	-	-
α-phellandrene	1005	-	0.2	-	-	-	0.3	-	-	0.4
meta-mentha-1,8-diene	1013	0.1	-	-	-	-	-	-	-	1.0
α-terpinene	1021	0.2	-	1.6	-	-	1.8	-	-	0.6
para-cymene	1025	1.9	0.8	-	0.2	0.9	0.8	2.0	-	6.8
ortho-cymene	1026	-	-	0.9	-	-	-	-	0.6	-
Sylvestrene	1027	-	-	-	-	-	-	-	-	-
β-phellandrene	1028	3.2	-	1.5	1.1	2.6	1.7	2.9	-	0.7
δ-3-carene	**1029**	-	**17.1**	-	-	-	-	-	0.6	-
(Z)-β-ocimene	1037	-	-	-	1.9	-	-	-	1.0	-
γ-terpinene	1055	0.4	0.4	1.2	0.2	-	1.2	-	-	0.5
cis- sabinene hydrate	1067	0.1	-	-	-	-	-	0.3	-	-
para-mentha-2,4(8)-diene	1085	-	-	-	-	-	-	-	-	-
terpinolene	1091	0.2	0.2	-	-	-	0.3	0.6	-	-
trans-sabinene hydrate	1097	0.1	-	-	-	-	-	1.0	-	-
linalool	1100	0.1	-	-	-	-	-	0.9	-	0.1
cis-para-menth-2-en-1-ol	1112	-	-	-	-	-	-	1.4	-	-
α-campholenal	1123	-	-	-	0.1	-	-	-	-	-
allo-ocimene	1129	-	-	-	-	-	-	-	-	0.2
nopinone	1136	-	-	-	0.3	-	-	-	-	-
trans-pinocarveol	1138	0.1	-	0.6	-	-	0.6	-	-	-
trans-sabinol	1139	-	-	-	0.6	-	-	-	-	-
pinocarvone	1160	-	-	0.4	0.4	-	0.5	-	-	-
isoborneol	1162	-	0.5	-	-	-	-	-	-	-
borneol	1170	-	-	0.9	-	1.2	0.5	-	-	-

cis-pinocamphone	1174	-	0.4	-	-	-	-	-	-	-
terpinen-4-ol	**1178**	0.8	0.4	1.7	-	-	**4.1**	1.6	1.9	3.2
iso-verbanol	1180	-	-	-	0.4	-	-	-	-	-
cryptone	1184	-	0.6	-	-	1.8	-	1.1	1.3	0.5
methyl salicylate	**1191**	-	-	**9.9**	-	-	-	-	-	-
myrtenal	1192	-	-	-	1.4	0.9	-	-	-	-
α-terpineol	1193	0.3	-	3.5	-	-	3.3	-	-	-
4Z-decenal	1194	-	-	-	-	-	-	-	-	-
trans-dihydro carvone	1195	-	-	-	-	-	-	-	-	-
n-decanal	1199	0.1	0.3	-	-	-	-	-	-	-
myrtenol	1201	-	0.2	-	-	-	-	-	-	-
cumin aldehyde	1246	-	-	-	-	-	-	1.0	1.6	-
bornyl acetate	1281	0.1	-	-	-	-	-	-	-	-
para-cymin-7-ol	1291	-	-	-	-	-	-	-	0.6	-
phellandral	1294	-	-	-	-	-	-	1.3	-	-
cis-pinocarvyl acetate	1305	0.2	-	-	-	-	-	-	-	-
myrtenyl acetate	1319	0.1	-	-	-	-	-	-	-	-
mentha-1,4-dien-7-ol	1331	-	-	-	-	-	-	0.8	-	-
α-copaene	1373	0.1	0.4	-	-	-	-	-	-	-
β-bourbonene	1386	-	0.3	-	-	2.1	-	-	-	-
β-elemene	1391	-	0.3	0.6	0.2	-	0.8	-	-	0.5
β-longipinene	1399	-	-	-	-	-	-	-	-	-
cyperene	**1401**	-	-	-	-	0.8	**3.3**	-	-	-
italicene	1402	-	0.2	-				-	-	-
cyprenene	**1403**	-	-	**5.5**	-	-	-	-	-	-
α-gurjunene	1407	-	-	-	-	-	0.4	-	-	-
β-caryophyllene	**1419**	**13.4**	**15.8**	**4.7**	**9.4**	3.9	1.2	-	0.7	0.5
isobarbatene	1428	-	-	-	0.1	-	-	-	-	-
α-*trans*-bergamotene	1435	0.1	0.3	-	-	0.9	-	-	-	-
aromadendrene	1442	-	0.2	-	-	-	-	-	-	-
α-guaïene	1444	-	-	1.3	-	-	0.3	-	-	-
α-himachalene	1451	-	-	-	-	-	0.4	-	-	-
(E)-β-farnesene	1453	-	-	-	-	-	-	0.4	1.8	-
α-humulene	**1455**	**11.0**	**25.8**	**6.4**	3.3	**6.5**	1.0	-	-	-
allo-aromadendrene	1458	-	0.4	-	-	1.0	-	0.6	-	-
trans-prenyl limonene	1459	0.1	-	-	-	-	-	-	-	-
9-epi-(E)-caryophyllene	1465	-	-	-	-	-	-	-	0.7	-
4,5-di-epi-aristochene	1472	-	-	1.0	-	-	-	-	-	-
5-epi-aristolochene	1476	-	-	0.6	-	-	-	-	-	-
γ-gurjunene	1477	-	-	-	-	-	1.0	-	-	-
germacrene-D	1479	0.8	2.6	0.5	0.4	-	-	-	-	0.7
γ-muurolene	1480	-	-	-	-	-	0.4	-	-	-
α-amorphene	1483	-	-	1.2	-	-	3.7	-	-	-
β-selinene	1486	-	-	0.6	-	1.1	0.8	-	-	-
allo-aromadendr-9-ene	1487	-	-	-	-	1.1	-	-	-	-
valencene	1490	-	-	-	-	-	0.9	-	-	-
α-amorphene	1491	-	-	-	-	-	-	-	-	-
bicyclogermacrene	1493	0.2	0.2	-				-	-	-
α-selinene	1494	-	-	0.6	-	-	-	-	-	-
(2E, 6E)-α-farnesene	1495	-	-	-	-	-	-	-	-	-
α-muurolene	1496	-	-	-	-	1.9	-	-	-	-
viridiflorene	1497	-	-	-	-	-	1.2	-	-	-
Cuzerene	1499	-	-	-	-	-	-	-	0.7	1.8
(Z)-α-bisabolene	1503	0.1	0.8	-	-	0.4	-	-	-	-
γ-cadinene	1510	-	0.2	-	-	1.9	1.1	-	-	-
δ-amorphene	1515	-	0.6	1.2	-	1.5	-	-	-	-
cis-calamenene	1518	-	-	-	-	1.9	-	-	-	-
β-sesquiphellandrene	1519	-	0.3	-	-	-	-	-	-	-
10-epi-cubenol	1520	-	-	-	-	-	-	-	2.1	-
(Z)-γ-bisabolene	1521	-	-	0.8	-	-	-	-	-	-
7-epi-α-selinene	1522	-	-	-	-	-	2.5	-	-	-
(E)-γ-bisabolene	1531	-	-	-	-	-	0.5	-	-	-
selina-4,(15),7,(11)-diene	1542	-	-	-	-	-	-	-	-	0.5
elemol	1545	-	-	0.7	-	-	0.3	-	-	0.2
selina-3,7(11)-diene	1546	-	-	-	-	-	-	-	-	0.5
cis-muurol-5-en-4-α-ol	1554	-	-	-	-	-	-	2.1	-	-
(E)-nerolidol	1555	0.2	0.9	-	-	-	-	-	1.1	-
germacrene-B	1556	-	-	-	1.1	1.2	-	1.6	-	1.5
germacrene-D-4-ol	1575	-	0.7	-	-	-	-	-	-	-
spathulenol	1578	-	-	-	-	-	-	5.1	-	-

caryophyllene oxide	**1581**	2.6	**5.9**	**4.9**	**18.9**	**12.0**	2.2	**25.4**	**20.5**	0.5
thujopsan-2-α-ol	1591	-	-	0.7	-	-	0.3	-	-	-
cis-β-elemenone	1594	-	-	-	0.3	-	-	-	-	-
neryl isovalerate	1588	0.1	-	-	-	-	-	-	-	-
β-oplopenone	1602	-	0.2	-	-	-	-	-	-	-
curzerenone	**1606**	-	-	-	-	-	-	**12.9**	**29.6**	**51.9**
humulene epoxide II	**1608**	1.0	3.2	**4.4**	3.0	**4.6**	0.6	1.5	-	-
norcopaanone	1616	-	-	-	-	-	-	3.6	3.5	-
α-acorenol	1624	-	-	-	-	0.8	-	-	-	-
pentanoate de citronellyle	1625	0.4	0.3	-	1.6	1.3	-	-	-	-
10-epi-γ-eudesmol	1631	-	-	1.9	-	-	-	-	-	-
caryophylla-4(14),8(15)-diene-5-α-ol	1635	0.2	-	-	-	-	-	-	-	-
caryophylla-4(12),8(13)-diene-5-β-ol	1636	-	-	-	2.2	-	-	-	-	-
3-iso-thujopsanone	1637	-	-	-	-	-	0.7	-	-	-
epi-α-cadinol	1640	-	0.3	0.7	-	3.0	1.0	-	-	-
epi-α-muurolol	**1641**	-	0.4	-	-	**4.8**	0.7	-	-	-
α-muurolol	1643	-	-	-	-	1.3	-	-	-	-
cubenol	1652	0.1	-	-	-	-	-	-	-	-
α-cadinol	**1654**	-	1.4	1.8	0.6	**12.0**	3.0	-	-	-
selin-11-en-4-α-ol	1656	-	-	-	-	1.0	-	-	-	-
neo-intermedeol	1658	-	-	1.5	-	-	-	-	-	-
intermedeol	**1664**	-	-	1.7	-	**8.0**	**31.7**	-	-	-
bulnesol	1670	-	-	-	-	-	-	2.1	-	1.0
14-hydroxy-9-epi-(E)-caryophyllene	1667	0.1	0.3	1.1	-	-	-	-	-	0.7
8-hydroxy-isobornylisobutanoate	1675	-	-	-	-	-	-	-	2.1	-
(Z)-nerolidyl acetate	1676	0.1	-	1.2	0.5	1.6	0.9		1.3	-
eudesm-7(11)-en-4-ol	1696	-	-	-	-	-	0.4	-	-	-
β-sinensal	1705	-	-	-	-	0.8	-	-	-	-
14-hydroxy-α-humulene	1709	-	-	-	-	0.7	-	-	-	-
iso-longifolol	1722	-	-	-	0.2	1.0	-	-	-	-
(6S, 7R)-bisabolone	1743	0.1	-	-	-	-	-	-	-	-
14-hydroxy-α-muurolene	1784	-	-	-	-	-	-	-	-	1.3
ethyl tetradecanoate	**1795**	-	-	-	-	-	-	-	-	**12.8**
epi-α-bisabolyl acetate	1799	-	-	-	-	1.3		-	-	-
β-bisabolenol	1800	-	0.2	2.8	1.2	-	-	-	-	-
14-hydroxy-δ-cadinene	1808	-	-	-	-	-	-	-	2.1	-
6-10-14-trimethyl pentadecanone	1834	-	-	-	0.2	-	-	-	-	-
n-hexadecanol	1881	-	-	-	-	-	-	-	0.7	1.4
isophytol	1945	-	-	-	-	-	-	0.5	-	-
geranyl octanoate	**1951**	-	-	-	-	**5.8**	-	-	-	-
dihydrocarveyl phenyl acetate	1977	-	-	1.0	0.2	-	0.4	-	-	-
palmitic acid	**1987**	-	1.0	-	-	-		0.9	**13.6**	-
phytol	2107	-	-	-	-	-	-	0.8	0.8	-
oleic acid	2143	-	-	-	-	-	-	-	1.1	-
hydrogenated monoterpenes		67.3	30.9	28.2	49.8	4.4	27.7	9.7	3.4	13.1
oxygenated monoterpenes		1.2	1.9	7.1	3.2	3.9	9.0	9.4	5.4	3.8
sesquiterpenes hydrogens		25.8	48.6	25.0	13.7	25.0	19.5	2.6	6.0	6.0
oxygenated sesquiterpenes		4.2	13.8	23.4	28	52.4	41.8	52.7	58.1	55.6
aliphatic alcohols		-	-	-	-	-	-	3.8	-	0.8
aliphatic aldehyde		0.2	-	-	-	-	-	-	0.7	-
aliphatic ketone		-	-	-	0.2	-	-	6.5	-	1.4
carboxylic acid		-	1.0	-	-	-	-	0.9	14.7	-
ester		1.0	0.3	10.9	0.7	8.7	0.4	-	2.1	-
diterpene alcohol		-	-	-	-	-	-	1.3	0.8	-
other compounds		-	-	-	0.8	-	-	-	-	1.4
Total		**99.7**	**96.5**	**94.6**	**96.4**	**94.4**	**98.4**	**86.9**	**91.2**	**94.9**

The values of the essential oils yields gathered in the Table 1 show an important accumulation but diversified by some volatile oils in *S. aethiopicus* organs. The volatile extract rate in the limbo is more brought up than in the rhizomes or foliar sheaths. The table 2 brings back the values of the physical characteristics measured for the samples of essential oils produced from plants material harvested to Manigri and to Savalou. Indeed, the density of essential oils resulting from Manigri increased in every organ of the plant between the two harvest dates. The second sampling of the *S. aethiopicus* species realized to Manigri contains essential oils denser than those of the samples F1, T1 and R1. For cons, the densities of essential oils stemming from parts of the *S. aethiopicus* species taken to Savalou diverged but are low compared to those extracted from Manigri plant material. It was also observed variation of the density between limbo, foliar sheaths and rhizomes collected during the same period. It has been observed that the refractive indexes measured are characteristics of each part of the plant investigated. The rotatory power values recorded show that these essential oils are composed by arrays of compounds optically active on polarized light. In the three categories essential oils samples, only the volatile extracts contained in the foliar sheaths showed high rates of rotatory power. The table 3 shows the different proportions of the chemical compounds that characterize the *S. aethiopicus* essential oil samples. In this table, 24 to 44 compounds representing 86.9% to 99.7% of investigated essential oils were identified. The hydrogenated monoterpenes are more abundant in limbo (9.7% to 67.3%) than in the foliar sheaths (3.4% to 30.9%) and rhizomes (12.9% to 28.2%). The lowest rates of hydrogenated monoterpenes are mainly recorded in samples resulting from Savalou (limbo (9.7%), foliar sheath (3.4%), rhizomes (13.1%)). Concerning the oxygenated monoterpenes, their proportions (<10%) were low in all the organs. The lower of oxygenated monoterpenes rates is more pronounced in limbo (1.2% and 3.2%) and foliar sheaths (1.9% and 3.9%) coming from Manigri. On the other hand in limbo and foliar sheaths of the plant material collected to Savalou, the rates border respectively 9.4% and 5.4%. Consequently, the *S. aethiopicus* species harvested at Manigri and at Savalou have volatile extracts chemical compositions different from that studied in South Africa by Juliani *et al*. in 2008 [20]. A significant proportion of hydrogenated sesquiterpenes was noted in the foliar sheaths of T_1 and T_2, respectively 48.6% and 25.0%. It remains very weak in the essential oil extracted from foliar sheaths of the plant harvested at Savalou (6.0%). F_1 and R_1 contains it almost equal proportions (25.8% and 25%). In F_2 and R_2, the percentages of hydrogenated sesquiterpenes are estimated at less than 20.0%. These proportions are lower (<7.0%) in F_3 and R_3. The oxygenated sesquiterpenes, meanwhile, are dominant over 50.0% in the essential oil of the foliar sheaths sample T_2 (52.4%) and in the different samples to Savalou (52.7% to 58.1%). In the sample of essential oil from F_1, the rate of the oxygenated sesquiterpenes is only 4.2%. Concerning the major compounds, the table 3 shows two different chemical profiles between the samples of essential oils resulting from Manigri and from Savalou. In the essential oils extracted from organs collected to Manigri, β-pinene (6.7-44.5%), intermedeol (8.0-31.7%), α-humulene (6.4-25.8%), caryophyllene oxide (4.9-18.9%), α-cadinol (11.9%) and methyl salicylate (9.9%) are the major compounds. By cons, it appeared the curzerenone (12.9-51.9%) among the most important compounds of the essential oil of *S. aethiopicus* organs (limbo, foliar sheath, rhizome) from Savalou. Its concentration is about 52% in rhizomes and less than 13% in limbo. This concentration reached 29.6% in the foliar sheaths (T_3). The curzerenone presence in essential oils extracted from organs taken to Savalou would probably explain the lower rates of β-pinene, β-caryophyllene, α-humulene and the absence of α-thujene observed in F_3, T_3 and R_3. The other major compounds accompanying the curzerenone are constituted by some caryophyllene oxide (20.5% to 25.4%), palmitic acid (13.6%) and ethyl tetradecanoate (12.8 %). The only compound common to the samples studied is the caryophyllene oxide present in all essential oils analyzed although F_1, R_2 and R_3 does not contain enough (<3%). This observation seems notified the not specificity of the caryophyllene to a particular organ of the plant. The samples taken to Savalou are marked by the presence of two very recurrent fatty acids in the vegetable kingdom (palmitic acid: 13.6%; oleic acid: 1.1%) and the diterpenes traces (isophytol: 0.5% and phytol 0.8%) in the limbo and foliar sheaths. Like the South African species [20], the samples of essential oils extracted from *S. aethiopicus* harvested to Manigri are marked by traces of α-terpineol (0.3-3.5%) in limbo and rhizomes.

It appears from this investigation that the physical and chemical characteristics of an essential oil can be influenced by several factors, namely the part of the plant material targeted by the study, the period and the place of harvest, etc ... The results obtained at the end of this work show a qualitative and quantitative variation of the essential oils compounds according to the plant organ Treaty. The samples F_1, T_1, R_1 and F_2 are marked by high levels of hydrogenated terpenes (53.2-93.1%) conversely extracts T_2, R_2, F_3, T_3 and R_3, rich in oxygenated terpenes (50.8-63.5%) accompanied by two diterpenes: phytol and isophytol. Further investigation will assess the potential biological properties of these natural biodegradable volatile extracts. The various compounds described from every part of the plant will can allow an optimal use of this one.

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