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A Comparative Chemical Study of Essential oils isolated from the leaves and flowers of *Bidens macroptera* using Steam-distillation

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Abstract

***Bidens macroptera* locally known as *Adeyabeba* (Amh) is endemic to Ethiopia, grown from September to November. The chemical compositions of essential oils isolated from the leaves (4.74%) and flowers (6.49 %) of this plant were compared. The GC-MS analysis resulted in the identification of 45 and 60 compounds, representing more than 75% of each of the total oil obtained from leaves and flowers by steam distillation, respectively. Compounds, namely, geraniol (45.37%), 1,8-cineol (9.72%) and *β*-citronellol (7.75%) were the major components in the leaves essential oil whereas the main constituents of that of the flower were geraniol (22.62%), eucalyptol (5.44%), caryophyllene oxide (4.50%) and thymol (2.80%).**

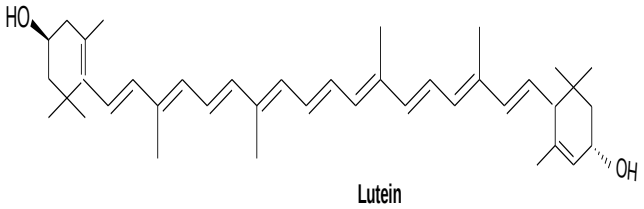
Keywords: Bidens macroptera, steam distillation, essential oil, GC-MS

1. Introduction

About 15% of the flora of Ethiopia, the fifth largest floral country in tropical Africa, are endemic. The country has a potential of 65% arable land with geographic diversity. In Ethiopia, yellow is a symbol of peace, hope, and love. Yellow flowers of *Bidens macroptera* (*Asteraceae, Adeyabeba in Amh*) are often displayed to signify the end of the rainy season and the beginning of the dry and sunny season, and, more specifically the start of the Ethiopian New Year, which usually falls on September 11 [1].

Among 230 to 280 species of the genus Biden around 20 of them are found in Ethiopia of which *B. macroptera* is known only from Ethiopia [1,2].This annual plant is mainly seen from September to November. The plant grows well in most Ethiopian areas known with local names Adeyabeba (Amharic), Adela (Kembata), Keelloo (Oromifa) and Gelgelle–Meskel (Tigrigna) [1, 3]. Understanding of chemical profile of such medicinal plants is a useful guide in community health care and drug development [4]. The most common bioactive constituents of plants include steroids, terpenoids, carotenoids, flavonoids, alkaloids, tannins, glycosides and large amount of essential oils [5].

Traditionally, *B. macroptera* is used as a medicinal herb to treat Athletes foot in which the fresh leaves put on fire and rubbed on the affected part. The flowers and leaves of this plant are also used to remove pus from infected wounds and to treat different infections on the face. It is also used as a rich source of honey for Ethiopian beehives [1,3, 6]. The compound that is responsible for yellowish orange color of the flower of *B. macroptera* is lutein, important in leather coloring [1].



Lutein

The essential oil of leaves and flowers of *B. pilosa* contains caryophyllene, sabinene, *α*–pinene, *α*-copaene, and so on [7,8]. Some of the compounds reported from *B. alba* are humulene, eugenol and caryophyllene oxide [8]. The main components of the essential oil of *B. tripartita* are alpha-pinene (15.0%), beta-bisabolene (9.3%), p-cymene (6.0%), hexanal (5.7%), linalool (4.6%), p-cymene-9-ol (3.4%), beta-

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elemene (2.6%) and geraniol (0.8%) [9,10]. The content of essential oil of the aerial parts of *B. frondosa* shows the presence of caryophyllene oxide (20.50 %), borneol (17.66 %), 4-terpineol (14.56 %), α-terpineol (6.28 %), β-cedrene (6.94 %), spathulenol (4.07 %) and caryophyllene (3.97 %) [11]. Therefore, the general objective of this study was to conduct a comparative chemical analysis of essential oils isolated from the leaves and flowers of *Bidens macroptera* extracted using steam-distillation.

Materials and Methods

Apparatus and Instruments

The apparatus/instruments used in the study were rotary evaporator, GC-MS, steam distillation and separatory funnel.

Chemicals and Solvents

Anhydrous sodium sulphate, sodium chloride and chloroform were used.

Collection of plant material, identification, and sample preparation

The fresh leaves and flowers of *B. macroptera* were collected locally from the field around Bethel district in Kolfi-Keranyo sub-city, Addis Ababa. The plant was collected during the beginning of the dry season in October, 2017. Identification was done and voucher specimen was deposited at the National Herbarium of Ethiopia (Addis Ababa University). The samples were air dried and packed with plastic bags (100 g each). Dried leaves and flowers of *B. macroptera* were separately ground and stored for further use.

Extraction of Essential oils from Bidens macroptera leaves and flowers

Steam distillation (4 h) of the plant parts (50 g each) to isolate essential oils was made at the Department of Chemistry, Debre Berhan University and GC-MS analysis was conducted at JIJE Analytical Testing Service Laboratory (Addis Ababa). The aqueous extracts collected in the flask (150 ml) were subjected to phase separation using separatory funnel and chloroform. The organic phases separated from the aqueous layers were dried by adding small amount of anhydrous sodium sulphate and filtered using suction filtration. The solvent was removed by using rotary evaporator to afford essential oils, labeled as 1-1A and 1-1C. All samples were preserved at 4^{o}C in a refrigerator until GC-MS analysis.

GC-MS Analysis of Essential oils

The chemical composition of essential oils was analyzed by Agilent 7890B Gas Chromatograph equipped with a 5977A MSD using HP-5 MS column (30 m, 0.25 mm internal diameter, 0.25 mm film thickness) which was coated by 5% phenyl 95% methyl polysiloxane as the stationary phase. The syringe was washed with 8 µL of chloroform and 2 µL of the essential oil was injected through auto sampler and analyzed with the HP-5 MS column. Column temperature was programmed as follows: 50 ºC, this was held for 6 min, raised at the rate of 4 ºC/min to 76 ºC, and this was held for 4 min, raised at the rate of 4 ºC/min to 190 ºC, and then raised at the rate of 30 ºC/min to 270 ºC, which was held for 6 min. Other operating conditions were as follows: carrier gas, He (99.999 %), with a flow rate of 1 ml/min; injector temperature, 260ºC; split ratio, 20:1. Mass spectra were recorded at 70 eV and the mass range was from 40 to 400 *m*/*z* amu, ion source temperature 230 ºC and quadruple temperature 150 ºC. The constituents were identified by comparison of their mass spectra with those of NIST02 library data and their retention times of the compounds with literature data.

Results and Discussion

4. 1 Yield of Essential Oils

Steam distillation of air dried leaves of *B. macroptera* (50 g) yielded green yellowish oil (1-1A, 2.37g, 4.74%) whereas that of the flowers of the plant (50 g) afforded higher amount of similar colored oil (1-1C, 3.24g, 6.48%) and these essential oils were subjected to GC-MS analysis in order to understand their chemical constituents.

4. 2 Chemical composition of Bidens macroptera *Leaves Essential oil*

GC-MS analysis of 1-1A showed different chemical components representing more than 75% of the steam distilled total oil. Some of the chemical constituents of the EOs isolated from the leaves of *B. macroptera* by steam distillation are presented in Table 1.

Table 1. Chemical composition of leaf EO of *B. macroptera*

S/N	List of compounds in essential oils	RT	Conc. in % SD
1.	Eucalyptol/ 1,8-cineol	14.36	9.72
2.	Benzeneacetaldehyde	14.98	1.18
3.	Linalool	18.84	2.03
4.	Phenylethyl alcohol	19.35	0.21
5.	Trans-4-thujanol	20.16	0.82
6.	Terpinen-4-ol	23.16	0.77
7.	Trans-Sabinol	24.28	4.63
8.	β- citronellol	25.52	7.75
9.	Geraniol	26.63	45.37
10.	Thymol	28.56	1.42
11.	Eugenol	30.61	1.50
12.	Caryophyllene oxide	38.66	2.83
13.	α –Terpineol		1.21

The components of the leaf essential oil isolated by steam distillation include geraniol (45.37%), 1,8-cineol (9.72%), β-citronellol (7.75%), trans-sabinol (4.63%), caryophyllene oxide (2.83%), and linalool (2.03%). The concentrations of the major components of the essential oils obtained by this method were comparable to a similar work [9].

Chemical composition of EOs from *B. macroptera* flowers

GC-MS data analysis of the essential oils extracted from the flowers of *B. macroptera* displayed the identifications of the following components (Tables 2).

Table 2. Chemical components of EO extracted from the flowers of *B. macroptera*

S/N	List of compounds in essential oils	RT	Conc. in %
1	Eucalyptol	14.34	5.44
2	Benzeneacetaldehyde	14.96	1.18
3	Linalool	18.83	1.47
4	Phenylethyl Alcohol	19.33	0.09
5	Trans-4-thujanol	20.14	0.23
6	Alpha–Terpineol	23.90	0.67
7	Trans-sabinol	24.26	2.03
8	m-cymene	13.93	2.13
9	Geraniol	26.59	22.62
10	Caryophyllene oxide	38.66	4.50
11	Thymol	28.57	2.80
12	Eugenol	30.62	0.99

Comparison of the dominant constituents of the leaf and flower essential oils obtained by steam distilation includes geraniol (22.62%), 1,8-cineole (5.4%), and caryophyllene oxide (4.5%) [12,13].

Conclusion and Recommendations

In this study, the chemical compositions of essential oils isolated from the leaves (4.74%) and flowers (6.49%) of *B. macroptera* by steam distillation were investigated. The GC-MS analysis resulted in the identification of compounds representing much of each of the total oil obtained from leaves/flowers. The chemical constituents of the essential oil obtained from the flowers of *B. macroptera* were more diversified than the leaves. The major components identified in *B. macroptera* essential oils were geraniol, eugenol, linalool, eucalyptol, trans-4-thujanol and trans-sabinol. In this study, variations of principal chemical components were observed among essential oils isolated from the leaves and flowers by using steam distillation.

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Conflict of interest

The authors have no conflict of interest.

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