

Chemical Composition and Physico-Chemical Analysis of Eucalyptus Globulus Leave and Oil

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Abstract: *Eucalyptus globulus* grows well in different parts of the world. More than 300 species of this genus have been shown to contain volatile oil. Essential oil contains many hundred chemical elements and this advanced mixture of compounds offers the oil its characteristic fragrance and flavor. The investigation has been carried out to know the chemical composition, Physico-Chemical properties of essential oils and *Eucalyptus globulus* leave grown at Ankober woreda, Ethiopia. To extract the essential oil, the fresh leaves of *Eucalyptus globulus* were subjected to hydro distillation for 3 hours using a Clevenger-type apparatus and the percent yield was 2.1%. Physico-chemical properties such as refractive index (1.451), relative density (0.925), optical rotation (+8°), Solubility, color and odour were determined. Physico-chemical analysis of *Eucalyptus globulus* leaves such as total ash, water soluble ash; acid insoluble ash, moisture content and pH were found to be (6.09), (2.18), (2.22), (35.32) and (5.43) respectively. The composition of essential oils of *Eucalyptus globulus* were analyzed using Gas Chromatography-Mass Spectroscopy (GC-MS). A total of twenty volatile components were identified in this work. The main components of the essential oils are Alpha-Pinene (25.55%), D-Limonene (5.687%) and Eucalyptol (55.43%).

Keywords: Eucalyptol, Eucalyptus Globulus, Essential Oil, GC-MS, Physico-Chemical

1. Introduction

Eucalyptus globulus commonly known as blue gum grows well in different parts of the world and has been known of its rich ethno medicinal and therapeutic importance [1]. *Eucalyptus globulus* is an evergreen tallest tree and leaves are leathery in texture, hang obliquely or vertical shape [2].

Eucalyptus globulus is an extremely adaptable species which grows well on a variety of soils and in a variety of climates. In Ethiopia, it succeeds everywhere in the highlands and does best at altitudes from 1800-2600m on loamy soils [3]. The genus *Eucalyptus* comprises over 600 species of trees; more than 300 species of this genus have been shown to contain volatile oil in their leaves [4].

Eucalyptus globulus oil has a history of wide application; as a pharmaceutical, antiseptic, repellent, flavoring, fragrance and industrial uses [2]. The main uses of the oil is for the pharmaceutical industry (those that are rich in 1, 8-cineole), perfumery (those that are rich in citronellal) and for industrial use (those that have piperitone and α - phellandrene as their

main constituents [4].

Essential oils are liquid merchandise of steam or water distillation of plant components (leaves, stems, bark, seeds, fruits, roots and plant exudates). An essential oil may contain many hundred chemical elements and this advanced mixture of compounds offers the oil its characteristic fragrance and flavor [5].

The main components of essential oils of *Eucalyptus globulus* are monoterpenes (1, 8-cineole, p-cymene, citronellal, citronellol, limonene, α -phellandrene, β -phellandrene, α -pinene, β -pinene, trans-pinocarveol, terpinolene, α -terpineol, α -thujene) and sesquiterpenes (β -caryophyllene, β -eudesmol, globulol, spathulenol and viridiflorol). The chemical profile and main components of oils from eucalyptus leaves varied significantly between species to species. The monoterpenes, 1, 8- cineole and α -pinene, are the main components in most species, while, *E. citriodora* is rich in citronellal (49.5-87%) and citronellol (8-20%). The content of 1, 8-cineole in eucalyptus oils ranges from 10-90% [6]. The extraction products may vary in quality, quantity and in composition according to climate, soil

composition, plant organ, age and vegetative cycle stage [7].

Eucalyptus globulus essential oils are gaining increasing interest due to their varied commercial applications particularly as insect repellents, fragrant and traditional medicines. Despite the commercial prospects, till now only limited eucalyptus species have been studied in Ethiopia. Considering that the chemical composition, physicochemical properties of eucalyptus oils and leaves analysis has been carried out to find the feasibility for the extraction of medicinal quality eucalyptus oil.

2. Materials and Methods

2.1. Preparation of Plant Material

Fresh leaves of *Eucalyptus globulus* were collected and air-dried in the shade to protect from the direct sun light. The dried leaves were stored in paper bags until subjecting to hydro distillation and physico-chemical analysis. The identity of the plant specimen was confirmed by botanist at the department of biology in Debre Berhan University.

2.2. Extraction of Essential Oils

Extraction of oil from *Eucalyptus globulus* leaves were carried out by a hydro-distillation. Dried leaves (100 g) were weighed and hydro distilled for three hours using full glass Clevenger-type apparatus. The oil sample obtained from hydro distillation was freed from water by adding anhydrous sodium sulfate and stored in sealed vials at 4°C until the analysis was made.

2.3. Chemical Composition Identification

Determination of the chemical composition of the extracted essential oil from *Eucalyptus globulus* was carried out by Gas Chromatography-Mass Spectroscopy (GC/MS). GC/MS analysis was performed with HP5890 series II coupled with mass spectrometry HP5972 series detector and an electron ionization system, equipped with a capillary column HP5 (30 m, 0.53 mm, 0.25 µm films). The carrier gas was helium, with a gas flow of 0.5 mL/min. Oven temperature was kept at 50°C for 4 minutes and programmed to 280°C at a rate of 3°C/minutes. Injector temperature was 250°C and the detector temperature was 280°C. Mass spectra were taken at 70 eV. The identification of the components separated by GC-MS was made by comparing the obtained mass spectra for each component with the values stored in mass spectra library Wiley 275L and HP CHEM /database. The results were further confirmed by comparison of their retention indices of the compounds with that of literature data.

2.4. Physico-Chemical Analysis of Eucalyptus Globulus Leaves

The powder sample of *Eucalyptus globulus* leaves were subjected to evaluate its moisture content, pH, total ash, water soluble ash and acid insoluble ash.

2.4.1. Moisture Content

A mass of 1 g of the powdered plant material was spread in a thin layer in the crucible of the moisture balance apparatus. Temperature was set at 100°C. Plant material was kept under this temperature until the moisture content attained a constant value [8].

2.4.2. Determination of Ph Levels

One gram of sample was measured by an electrical balance and then transferred into 25 ml conical flask; 25 ml of distilled water was added and heated on hot plate to boil and left to cool down. The aqueous herbal extracts were filtered into 25 ml volumetric flask and filled by distilled water to the mark and was determined by using a calibrated pH meter [9].

2.4.3. Total Ash, Water Soluble Ash, Acid Insoluble Ash

Total ash, water soluble ash and acid insoluble ash was carryout according to World Health Organization Quality control methods for herbal materials [10].

2.5. Physico-Chemical Analysis of Essential oils

The Physico-chemical properties such as refractive index, relative density, optical rotation, Solubility, color and odour were determined according to standard analytical methods recommended by Association of Official Analytical Chemists (AOAC) and British pharmacopoeia [11, 12].

3. Results and Discussion

The percentage yields of essential oil obtained from the hydro distillation of the leaves of *Eucalyptus globulus* was 2.1% (v/w based on the fresh leaves). There are many literatures that report about *Eucalyptus globulus* essential oil yields in different countries; for example, 0.8-1.21%, 1.87%, 0.08-3.5% and 1.1% of essential oil are found in Ethiopia, Algeria, Bangladish, and India, respectively [13-15].

The leaf sample of *Eucalyptus globulus* and essential oils were tested for relevant physicochemical parameters and the results are presented in Tables 1 & 2 below.

Table 1. Physico-chemical characteristics of *Eucalyptus Globulus* leaves.

Physicochemical parameter	values
Total ash	6.09
Water soluble ash	2.18
Acid insoluble ash	2.22
Moisture content	35.32
PH	5.43

Table 2. Physico-chemical characteristics of *Eucalyptus Globulus* essential oil.

Physico-Chemical Characteristics	Value
Relative density	0.925
Refractive index	1.451
Optical rotation	+8°
Appearance	Colorless liquid
Odour	Aromatic
Solubility	Soluble in alcohol
Color	Colorless

From the result it was found that the characteristic

properties of the oil, such as odour, solubility, color, relative density, optical rotation and refractive index were more or less in good agreement with the reported results in the literature [3, 14]

The chemical composition of *Eucalyptus globulus* essential oil is shown in Table 3 below. Based on the GC/MS result, a total of twenty volatile components were identified from the essential oil. The main components of the essential oils are Alpha-Pinene (25.55%), D-Limonene (5.69%) and Eucalyptol (55.43%).

Table 3. Percentage composition of the volatile oils of *Eucalyptus globulus*.

NO.	RT	compound	%
1	6.149	Alpha-Pinene	25.55
2	7.349	Beta-Pinene	0.81
3	7.820	Beta-myrcene	0.54
4	8.275	Alpha-Phellandrene	0.29
5	9.023	P-Cymene	0.57
6	9.198	D-Limonene	5.69
7	9.522	Eucalyptol	55.43
8	10.335	Gamma-terpinene	0.43
9	11.492	α -Terpinolene	0.35
10	13.543	Isopinocarveol	0.43
11	14.568	Pinocarvone	0.24
12	15.800	Alpha-terpineol	0.57
13	22.744	α -Terpineol acetate	3.22
14	25.186	Alpha-Gurjunene	0.23
15	26.416	Aromandendrene	2.11
16	27.279	Alloaromadendrene	0.48
17	28.692	Viridiflorene	0.30
18	31.209	Epiglobulol	0.47
19	32.188	(-)-Globulol	1.84
20	32.457	Ledol	0.25

These results show that the volatile oil has a particular quantitative and qualitative chemical composition. The major component was Eucalyptol followed by Alpha-Pinene and D-Limonene while α -Terpineol acetate, Aromandendrene, and (-)-Globulol are minor components of *Eucalyptus globulus* oil. Eucalyptol determines the business value of the oil and its significance as a raw material for diverse industries.

4. Conclusion

In this study physicochemical analysis and essential oil composition of *Eucalyptus globulus* essential oil grown in Ankober woreda was analyzed. The result showed that Eucalyptol (55.43%) is major constituent which is aromatic in nature and may be used as an important raw material for perfumery industries. This work also provides useful information about physicochemical properties of *Eucalyptus globulus* leaves and oils. However, our results are preliminary contributions to establish standard values of chemical profile and physicochemical parameters for local product.

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