



# A NATIVE STUDY ON GERANIUM PLANTATION AND PRODUCTION OF GERANIUM OIL EXTRACTION BY USING STEAM DISTILLATION

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**Abstract:** The present work has been studied on investigation of harvesting conditions of Geranium plantation. Geranium (*Pelargonium graveolens* L.) commonly known as rose-scented pelargonium, rose-scented geranium or rose geranium is one of the many fragrant species of *Pelargonium*, belonging to the family Geraniaceae. Geranium oil is one of the top 20 essential oils in the world, which has wide application in perfumery, cosmetics and flavor industry etc. It forms a part of many high-grade perfumes, antifungal, insect repellent and antibacterial activity; thus, it has extensive use in medicinal and agrochemical field. In literature, several authors were used different traditional extraction methods; such as soxhlet extraction, hydro distillation, solvent extraction and steam distillation etc. In this work, author has used the most promised technique as steam distillation for geranium oil extraction. The purpose of this work is to investigate the suitable conditions of geranium harvesting and method of suitability for extraction of geranium with higher yield in limited facilities and lower cost. Finally, author has conducted detailed analysis on soil for harvesting conditions of geranium plants and characterization of geranium oil by using GC-Analysis.

**Index Terms** - Geranium Leaves; Steam Distillation; Oil; Gas Chromatography.

## 1. INTRODUCTION

Geranium is a highly adaptable, drought tolerant, perennial aromatic herb cultivated under varied agro climatic conditions in India [1]. Geranium oil obtained by steam distilling the fresh biomass has a variety of uses in high grade perfumery. India produces about 20 tones of geranium oil every year and imports another 20 tones for internal consumption. Therefore, there is a need to increase the domestic production of geranium oil. Geranium oil is widely used in the soap, perfumery, and cosmetic industries [2]. The oil is described to have a fine rosy odor with pronounced fruity minty undertone and a rich long lasting, sweet rosy dry out. It is stable in slightly alkaline medium also. It is very versatile oil for perfumery due to its exquisite odor and its ability to blend with all floral and oriental bouquets. It is also used for isolation of rhodionol which forms a part of the most high grade perfumes. Geranium oil has also become important skin care oil because it is good in opening skin pores and cleaning oily complexions. This oil has also been found to have use in reducing pain due to post-herpetic neuralgia as well as treating dysentery, hemorrhoids, inflammation, heavy menstrual flows, and even cancer. The premier steps in isolating biologically active compounds from plant resources include: extraction [3], isolation, toxicological and clinical evaluation [4]. Thus, the study of medicinal plants starts with extraction procedures that play a critical role to the extraction outcomes [3]. Essential oils are so termed because they represent the very essence of odour and flavor of the plants from which they are extracted [5].

In literature, several authors have been worked on evaluation and selection of extraction methods are dependent on the study objectives, samples and target compounds. Volatile substances are generally present at low concentrations and must be extracted from the plant matrix before they can be analyzed. They are known to be thermally sensitive and vulnerable to chemical changes, thus adequate care is required in selecting an extraction method. Loss of some volatile compounds, low extraction efficiency, degradation of unsaturated or ester compounds through thermal or hydrolytic effects and toxic solvent

residue in the extract are some of the challenges encountered when using different extraction methods [6]. These shortcomings have led to the consideration of the use of new green extraction techniques and procedures that may contribute to environmental preservation by reducing the use of solvents, fossil energy and generation of hazardous substances [6]. However, the high capital cost of these alternatives and the level of expertise required to operate the instruments effectively, has precluded their wide acceptance [7] such that soxhlet extraction and steam distillation methods are still widely accepted options in the laboratory.

In this project, Geranium oil is to be extracted using steam distillation (8-12). Steam distillation is an important extraction method for the recovery of oil from plants and takes advantage of the volatility of a compound to evaporate when heated with steam and the hydrophobicity of the compound to separate into an oil phase during condensation (13-15). The process uses heating of plant material using steam which is supplied from steam generator. Heat is the main factor determining how effectively the plant material structures break down and burst and release the aromatic components or essential oil. The extracted oil is to be tested with HPLC to confirm the quality of the product. In this work, the author aims to study on the native study of geranium plantation and its favorable conditions. To continuing the study on Geranium Oil extraction by using steam distillation method. This work will help in evaluating the suitable conditions of geranium plantation and also carried out the detailed characterization of extracted geranium oil by using GC analysis.

## 2. MATERIALS AND METHODOLOGY:

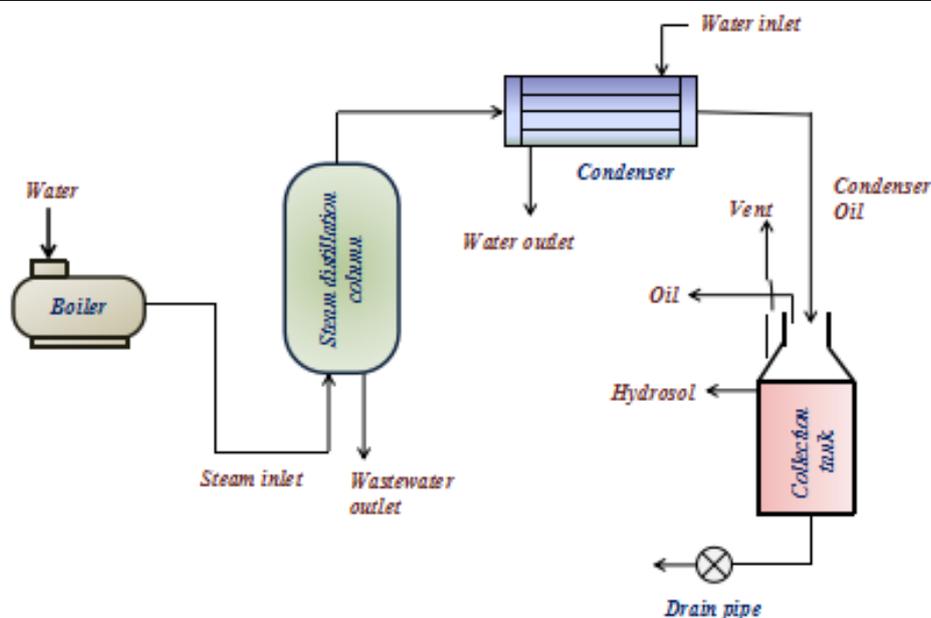
**2.1. Materials:** Geranium Leaves (collected from the different forms near to Nashik, See Table 1), Water, Wood charcoal (collected from the near to Nashik). Steam Generator and various equipments of steam distillation column are fabricated with stainless steel.

**2.2. Methodology:** An investigation in the present research paper is targeted to produce maximum yield of geranium oil using steam distillation. Time of cutting is determined mostly the state of growth of geranium plants. Economic production is likely three cuts have taken a year and assessment depends on the oil content of the plants at each CUT.

The geranium varieties will be collected from the different farms of our institute (Makhmalabad farm: 1500 Kg; Babhaleshwar farm: 5750 kg; Sukhane Farm: 6500 Kg) the plants will be dried and will be used in the distillation unit as shown in figure 1. Recovery of oil from variety of geranium plants from different farms will be studied and testing oil will be done.

**Table 1** Different type of Geranium Farms

Name of Farm	Name of variety
Makhamalabad	JB
Bableshtar	JB
Sukhane	JB
Makhamalabad	VK
Babhaleshtar	VK
Sukhane	VK
Babhleshtar	CL
Sukhane	CL
Makhamalabad	CL



**Figure.1.** Extraction methodology of Geranium Oil by using steam distillation

**Figure. 1** represents the extraction methodology of geranium oil from geranium leaves by using steam distillation. This method having various sections, such as boiler, steam distillation column, condenser and collection tank etc. The geranium leaves are collected from the several farms of our institute mentioned **Table 1** and properly dried geranium leaves were inserted into the steam distillation tank. The steam generation is carried out by using boiler at a temperature about 100-200 °C and steam was passed into the steam distillation tank for extracting the geranium oil from geranium leaves.

After completion of extraction process, wastewater was removed from the bottom of the steam distillation tank and extracted oil sent to the condenser for reducing the temperature of the oil. Here, two separate pipes make it possible for hot water to exit and cold water to enter the condenser. This process makes the vapor cool back into liquid form. Steam and oil vapor condense into liquid in condenser are collected in the separator. The extracted geranium oil sent to a collection tank. The waste impurities are separated and drained through the bottom of collection tank.

**2.3. Characterization of the Soil:** The harvesting of geranium plants need to check the soil test analysis. The Soil analysis has been conducted by using ECe (Electrical Conductivity Extraction), Nashik. In this analysis the soil test will provide the pH, % Organic carbon, %CaCO<sub>3</sub>, and existence of N, P, K etc.

**2.4. Characterization of Geranium Oil:** The obtained Geranium Oil was characterized by using Gas Chromatography (GC-). GC analysis is a widely used technique for the field-based analysis of organic compounds present in a variety of matrices such as water, soil, soil gas, and ambient air. GC analysis with photoionization detection (PID) has been used extensively to characterize and remediate sites contaminated with volatile organic chemicals (VOCs). Likewise, gas chromatographs coupled with an electron capture detector are used for analysis on sites contaminated with halogenated compounds such as polychlorinated biphenyls (PCBs) or chlorinated pesticides.

In the next section, authors are discussed about geranium harvesting favorable conditions and detailed analysis of soil, extracted geranium oil etc.

### 3. RESULTS AND DISCUSSIONS:

**3.1. Formation of Geranium Plants:** Geranium harvesting is to take nearly about 4-6 months, after transplanting when there is sparse flowering, leaves start turning light green color and exhibit a change from lemon like odor to that of roses. Though the change in color and odor is the criterion for harvesting conditions of soil. Thus, it requires careful observations and analysis to decide the stage of harvesting of geranium plants (16).

The author has decided to plant the several varieties of geranium plants at different farms of our institute (Makhmalabad farm: 1500 Kg; Babhaleshwar farm: 5750 kg; Sukene Farm: 6500 Kg). Therefore, the author have been tested the soil of mentioned farms above. The detailed analysis of soil test report has been mentioned in the **Table 2**. It gives the detailed examination of soil

like pH, EC, %Organic Carbon, %CaCO<sub>3</sub> and also presents the various minerals like Nitrogen, Phosphorous and Potassium etc (17).

**Table 3** presents the summary of harvested geranium plants at different farms wise and herbage quantity variety as Makhmalabad, Bableshtar, Sukhane, Makhmalabad, Babhaleshtar, Sukhane, Babhleswar, Sukhane, Makhmalabad etc. Among all the farms, Babhaleshtar farm provides the highest herbage quantity about 2000 kg, Sukhane 1750 kg, Bableshtar 1500 kg and Makhmalabad 250 kg etc. Therefore, the author concludes that **Table 2** mentioned soil properties are feasible for geranium harvesting.

**3.2. Production of Geranium Oil Extraction by using steam distillation:** The Geranium Leaves are used for extracting the oil by using steam distillation process. This process is the best process, which gives better quality of oil and maximum distillate will get within 3 to 4 hours by using the methodology mentioned in **Figure 1**. In this process is the immiscible liquids (water) and used for purifying the liquids which decompose their boiling points. Steam distillation method is used to for separating the volatile organic compounds from plant essentials (18). This process is the most popular method among all extraction methodologies. It is used to extract the isolate essential oil from plants for use in natural products. This will occur when the steam vaporizes the plant materials and volatile compounds; those compounds are undergone through condensation and collection process. The received oil is taken out, cleaned and stored either in aluminum jars or amber colored bottles showed in **Figure 2**. The recovery of oil from grass ranges from 0.3 to 0.6 percent. It takes about four hours for the completion of recovery of the oil.

**Table 2** Soil Analysis Report

Sr. No.	Crop/Survey No	pH	EC dSm <sup>-1</sup>	Organic Carbon (%)	CaCO <sub>3</sub> (%)	Ava.N Kg/ha.	Ava.P Kg/ha.	Ava.K Kg/ha.
1	Geranium Babhaleshtar (Plot - 9)	7.6	0.3	0.16 (Very low)	5.4	141.12 (Low)	3.36 (Very low)	270 (High)
2	Geranium Sukhane (825/09)	7.34	0.3	0.58 (Moderate)	3.7	125.44 (Very low)	5.82 (Very low)	293 (High)
3	Geranium Makhmalabad 269	7.05	0.17	0.62 Moderately High	2.9	125.44 Very low	7.2 low	148.0 (low)
4	Geranium Makhmalabad 270	7.35	0.32	0.65 Moderately High	3.5	141.1 low	7.3 low	151.05 Medium

**Table 3** Herbage Quantity Variety and Farm Wise

Name of Farm	Name of variety	Harbage (Kg)
Makhmalabad	JB	250
Bableshtar	JB	1500
Sukhane	JB	1500
Makhmalabad	VK	500
Babhaleshtar	VK	2000
Sukhane	VK	1750
Babhleswar	CL	1250
Sukhane	CL	1750
Makhmalabad	CL	250



**Figure 2.** Collection of geranium oil obtained from steam distillation

**Table 4** Comparison of oil extracted per tonne

Name of Farm	Name of variety	Batch	ML of oil extracted	ML of oil extracted per tonne
Makhamalabad	JB	1(250 kg)	160	640
Bableshwar	JB	3	1200	800
Sukhane	JB	3	1135	756.6
Makhamalabad	VK	1	215	430
Babhleswar	VK	4	655	327.5
Sukhane	VK	3	1180	786.6
Babhleswar	CL	2	210	105
Sukhane	CL	3	980	653
Babhleswar + Makhamalabad	CL	1	120	240



**Figure 3.** Appearance of extracted geranium oil samples

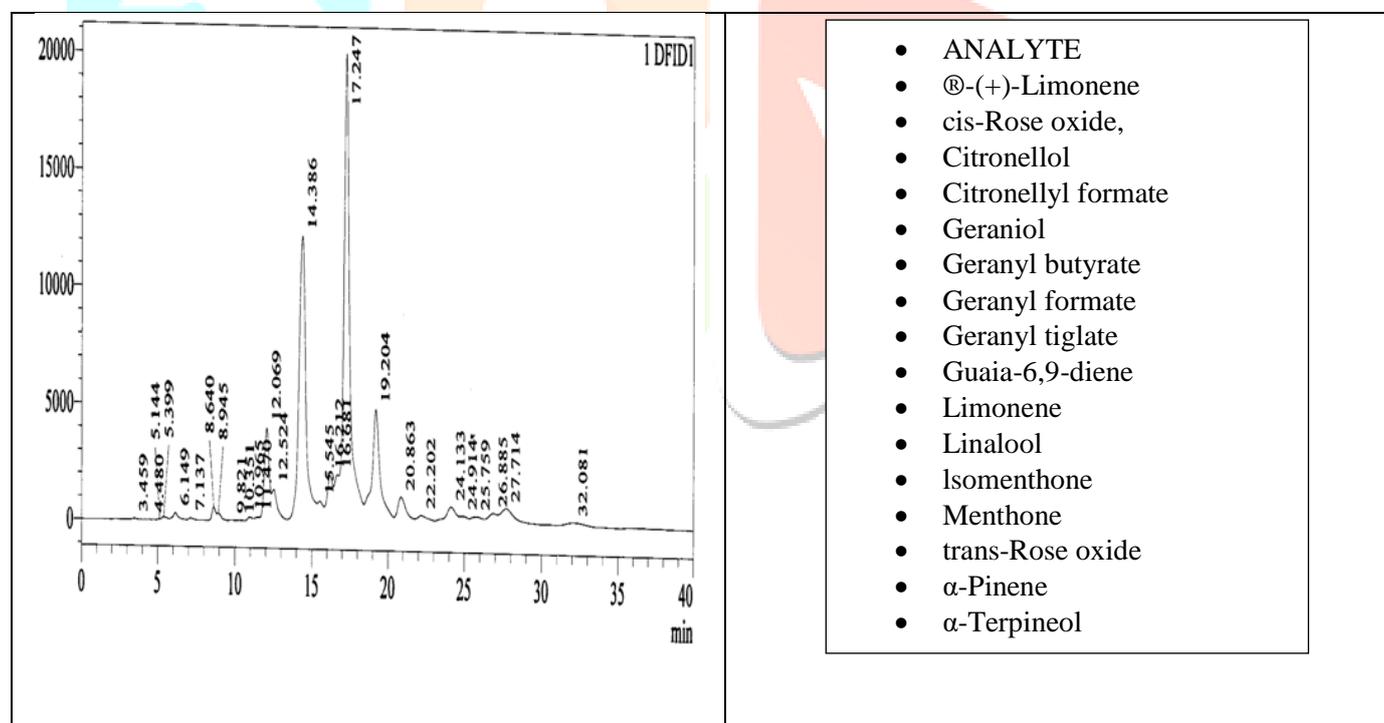
1. RES. LAB., 2. B.O. INTERNATL., 3-5. OUR SAMPLES-JB, VK, SMW

**Table 4** represents the comparison of oil extracted per tonne. Among all the farms, Bableshwar farm produced 1200 ml, Sukhane farm 1180 ml and Sukhane 1135 ml were extracted from large amount of geranium oil. The ML of oil extracted per ton of Bableshwar farm produced 800 ml, Sukhane farm 786.6 ml and Sukhane 756.6 ml etc. The extracted geranium oil is mostly colorless and has a slight light green color to it. The oil has a watery viscosity. The appearance of the oil samples is showed in **Figure 3**.

**3.3 Characterization of Extracted Geranium Oil:** The extracted geranium oil characterized with GC analysis of their active ingredients. Most of the components in essential oils belong to monoterpenoids, sesquiterpenoids or oxygenated terpenes [7]. Gas chromatography (GC) is a method for analysing gas, liquid, and solid materials (components that are vaporized by heat). It's used to separate the chemical components of a sample mixture and then detect them to see if they're present or not, as well as how much of them there are. The compounds in the sample, including the solvent components, are heated and vaporized within the sample injection unit once it is injected into the GC system. The mobile phase, also known as the carrier gas, goes from the sample injection unit through the column and finally to the detector in a GC system. The carrier gas transports the vaporized target components to the column from the sample injection device. The mixture of compounds is divided into its individual components as it enters the column, and the amount of each compound is then measured by the detector (19).

Geranium oil sample is analyzed by Gas Chromatography (GC) as below. The functional groups are obtained from the extracted geranium oil are ANALYTE, ®-(+)-Limonene, Cis-Rose oxide, Citronellol, Citronellyl formate, Geraniol, Geranyl butyrate, Geranyl formate, Geranyl tiglate, Guaia-6,9-diene, Limonene, Linalool, Isomenthone, Menthone, Trans-Rose oxide,  $\alpha$ -Pinene, and  $\alpha$ -Terpineol etc. Among all, the main functional groups are (Cis-Rose oxide, Citronellol, Citronellyl formate, Geraniol, Geranyl butyrate, Geranyl formate, Geranyl tiglate) having geranium oil functional groups. The availability of these functional groups confirms that the obtained oil is geranium oil.

The increasing use of aromatherapy products is one of the driving factors for the geranium oil market in India. The high demand for aromatherapy products is driven by convenience and cost factors. The increasing disposable income in India has driven the adoption of aromatherapy products among the middle-income group. Moreover, the health benefits of aromatherapy are increasing the demand for home usage, thus benefiting the growth of the geranium oil market in India (18-20).



**Figure. 4.** Gas Chromatography Analysis of Geranium Oil

#### 4. CONCLUSIONS:

This study examines with ECE to explore soil analysis and finds that the selected farms have good features such as pH, EC, % Organic Carbon, % CaCO<sub>3</sub>, and other minerals such as Nitrogen, Phosphorous, and Potassium, among others. Babhaleshwar farm produces the most herbage, about 2000 kg, followed by Sukhane 1750 kg, Bableshtar 1500 kg, and Makhmalabad 250 kg. Geranium cultivation has become more cost-effective and profitable in this regard. Oil recovery from grass varies between 0.3 and 0.6%. The oil recovery process takes around four hours to complete. Because, when compared to other extraction technologies, setting up a steam distillation unit is simple.

Gas chromatography was used to evaluate the extracted geranium oil. ANALYTE, ®-(+)-Limonene, Cis-Rose oxide, Citronellol, Citronellyl formate, Geraniol, Geranyl butyrate, Geranyl formate, Geranyl tiglate, Guaia-6,9-diene, Limonene, Linalool, Isomenthone, Menthone, Trans-Rose oxide, -Pinene, and The primary functional groups with geranium oil functional groups are (Cis-Rose oxide, Citronellol, Citronellyl formate, Geraniol, Geranyl butyrate, Geranyl formate, Geranyl tiglate). Geranium oil is one of the world's top 20 essential oils, with applications in perfumery, cosmetics, and the flavour business, among others. It is found in many high-end perfumes and has antifungal, insect repellent, and antibacterial properties, making it useful in the medical and agrochemical fields.

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