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Medicinal Flowers: Nature's Healing Blooms

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ABSTRACT

Flowers have been cherished for their beauty and fragrance throughout human history. However, their significance extends beyond aesthetics, as many of these blossoms possess remarkable healing properties. And it delves into the world of botanical medicine, shedding light on the rich tradition of using flowers to treat a myriad of physical and emotional ailments. Various flowers and their therapeutic properties in traditional and alternative medicine. The idea that flowers from the natural world can be used for healing and wellness purposes. The utilization of medicinal flowers as a source of natural healing has been a fundamental practice across cultures and time periods. The extensive role that medicinal flowers play in maintaining human health and well-being. Medicinal flowers often referred to as "nature's pharmacy", have been employed for their therapeutic properties for centuries. They offer a diverse range of bioactive compounds, from essential oils and antioxidants to anti-inflammatory agents and analgesics. This wide spectrum of healing attributes makes medicinal flowers a valuable resource in traditional and alternative medicine systems.

Keywords: Medicinal flowers; Herbal therapy; Phytochemicals; Ornamental plants; Ethnobotany

INTRODUCTION

Medicinal flowers: Angiosperms plants have specific part called flower, which can be grow individually or in clusters giving rise to an inflorescence. Flowers are of commercial importance due to their beautiful colors, fragrance and shapes. But now people are getting awarded to their traditional uses and flowers with intoxicating aroma and beauty are of commercial importance [1]. Since, with the beginning of human civilization, flowers have been one of the key sources of medicine and those flowers are called as medicinal flowers now globally, trend is shifting towards the usage of ornamental flowers with medicinal properties. These are those flowers whose oils or flower extract possess the medicinal properties. Despite tremendous developments in allopathy during the 20th century, flowers continue to be a key source of medications in both the traditional and modern systems of medicine around the globe. The use of medicinal flowers continues to gain recognition and acceptance within contemporary healthcare systems and holistic wellness practices, and introduction to the world of medicinal flowers, emphasizing their historical roots, diverse applications, and their crucial role in promoting health and healing in the present day. The study of medicinal flowers offers an exciting and profound trip into the natural world of healing, whether you are a seasoned herbalist, a healthcare professional, or simply interested about the therapeutic potential of nature's blooms [2].

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LITERATURE REVIEW

Chamomile

It is one of the oldest therapeutic flowers known to humans belongs to the compositae/daisy family with two common varieties Roman chamomile and German chamomile with scientific name *Chamaemelum nobile* and *Chamomilla recutita* respectively. Flower products are used for human ailments such as gastrointestinal problems, rheumatic pain, hemorrhoids, ulcers, wounds, inflammation, muscle spasms, menstruation problems, drowsiness and heavy fever and their constituents/ ingredients show antispasmodic, antiseptic, anti-cancer, anti-inflammatory properties (**Figure 1**) [3].

Figure 1: Chamomile flower.

Oil extraction: The inflorescence of diploid plants contains 0.4 to 1% oil. In order to extract oil, flower heads are taken off and let them to dry in sheltered space with fresh air 14 to 20 days at a temperature below 32℃. This reduces the moisture content of the flower tissues by 12% and helps prevent infection. Chamomile oil is extracted by 'hydro distillation' method. Fresh oil following hydro distillation can have colors ranging from bright blue to deep green; however it turns dark yellow when stored. Storage of oil takes place in dark room under N_2 at 4℃ [4].

Bio active constituents of Chamomile: Approximately 120 secondary metabolites, comprising 28 terpenoids and 36 flavonoids, have been identified in chamomile. The terpenoids α-bisabolol and its oxide, which include chamazulene and acetylene derivatives, are the main components of German Chamomile. Roman Chamomile is primarily composed of angelic and tiglic acid esters, such as farnesene and α-pinene, and contains less chamazulene. The primary bio-active components are α-bisabolol, bisabolol oxides A and B, chamazulene or azulenesse, farnesene, and spiro-ether quiterpene lactones, hydroxycoumarins, flavanoids (apigenin, luteolin, patuletin, and quercetin), coumarins (herniarin and umbelliferone), terpenoids with flavonoids like apigenin, quercetin and patuletin as glucosides [5].

Lavender

Lavender, botanically known as Lavendula Linn., a member of family Lamiaceae, consists of approximately 25-30 species and is indigenous to many Asian regions, the Mediterranean region, and to Tropical Africa. The genus is inclusive of all the tiny shrubs, herbaceous plant, annuals and subshrubs. For millennia, it has been underutilization as a botanical treatment. Also, it produces an extremely potent essential oil with notes of sweetness. Three species of lavender which are extensively used for oil extraction are *Lavendula angustifolia*, *L. latifolia* and *L. intermedia*. Lavender oil finds its uses in various cosmetic and perfume industry. In addition, it's essential oil is also known to cure issues like irritability, stress, anxiety, headaches, depression, cold etc. Due to its micro-bicidal properties, it is becoming more and more popular in Europe as an aerosol for cleaning homes, offices, and public spaces (**Figure 2**) [6].

Figure 2: Lavender flower.

Oil extraction of lavender: Traditionally, distillation using steam has been used to extract lavender essential oil. However, new techniques for extraction of oil have become standard in recent years. The essential oil of lavender can be extracted by two methods, viz, supercritical CO_2 extraction method and hydro-distillation method. Both these methods have their own benefits in terms of the essential oil yield [7].

Supercritical CO_2 extraction method: Collect and finely grind the plant's aerial parts. This methodology involves the use of liquid carbon dioxide and ethanol. A deep tube draws carbon dioxide from the source cylinder, and a cooling device condenses it after it passes through a dryer. After that, the extractor receives the CO_2 *via* a specific double syringe pump. A vessel of 400 ml acts as an extractor, which is set up in an oven providing a precise temperature control. Supercritical CO_2 is expelled from the extractor through a micro-metering valve that regulates the system's pressure discharge.

Mix the ground sample along with ethanol and place the mixture in a glass followed by placing the glass in the extractor. Prior to extraction, heat the extractor in an oven for

1 hour. The following parameters were used for the extraction process:

- Temperature: 45℃
- Pressure: 200 bar
- Flow rate of liquid carbon dioxide: 10 ml/min
- A static extraction of 1.5 hours followed by dynamic extraction of 0.5 hours.
- Finally, collect the obtained extract in a 4 ml glass vial filled with ethanol.

The essential oil extracted by this method consists of chemical compounds as listed below: Linalyl acetate (73.53%), lavandulyl acetate (7.47%), trans-caryophyllene (3.69%), j-farnesen (1.99%), terpendiol (1.81%), t-cardinene (0.81%), others (3.03%). This method is advantageous as this method is non-toxic and high-quality oil is extracted at a lower price [8].

Hydro-distillation method: This methodology involves the use of a Clevenger-type apparatus. The ground plant material is fed to the hydro-distillation chamber for about 5 hours by making the use of Clevenger apparatus. After collecting the volatile distillate over a regular pentane, it is chilled for approximately about a week up-till the time of analysis and medical trials.

The essential oil extracted by this method consists of chemical compounds as listed below: j-pinene (35.91%), lavandulyl acetate (14.14%), geranyl acetate (7.39%), trans-caryophyllene (6.69%), trans-ocimen (4.8%), neryl acetate (3.89%), j-farnesene (3.44%), j-myreene (2.22%), linalyl acetate (2.21%), β- pinenoxide (2.18%), t-cardinene (1.42%), sabinaketon (1.30%), limonen (1.12%), cis-ocimen (0.95%), α-terpinolene (0.79%), linalool (0.71%), j-chamigren (0.53%).

Rose

There are about 18000 cultivars and 200 species under the genus Rosa. But quite a few of them have a distinctive scent that finds its application in the perfume industry. Out of them, *Rosa damascena* Mill. is the most valued, aromatic oil producing species. Often called as Damask rose or Bulgarian rose, it is valued for preparing rose water, gulkand, rose oil, rose attar, gulroghan etc. Other important oil yielding species are *Rosa bourboniana, Rosa centifolia, Rosa gallica* and *Rosa alba*. Himroz and Him Jwala are two important varieties of *Rosa damacena* developed from IHBT. Nonetheless, it is also used in cosmetic and perfume industry and also finds its uses in various pharmaceutical industries as well. Rose oil has anti-bacterial properties against *Shigella dysenteriae* and *Mycobacterium tuberculosis*. Rose flowers have astringent, aphrodisiac, antidepressant, and antispasmodic properties [9]. It is also used in liquors, food materials, food coloring and contains laxative properties (**Figure 3**).

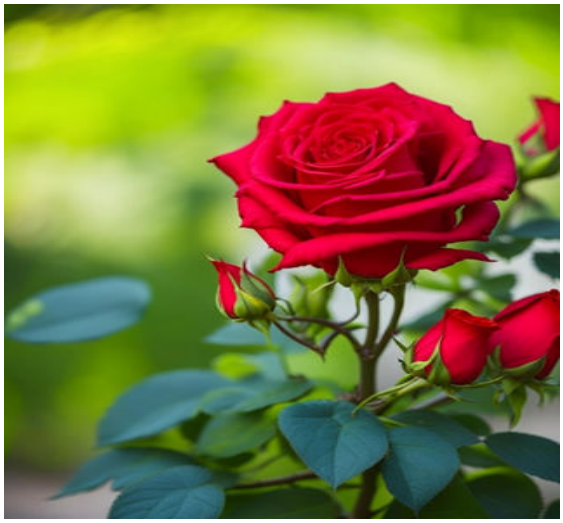

Figure 3: Rose flower.

Oil extraction of rose: There are several methodologies involved in the extraction of essential oil or rose. These methodologies include distillation and supercritical CO_2 extraction method. Out of them, distillation is the most widely accepted and the most economical method.

Distillation: Using this technique, the rose petals are heated in stills by either passing steam through them or immersing them in boiling water [10]. The plant material's cell structure ruptures and degrades as the steam rises, causing the release of essential oil from them. The molecules thus released, in combination with the steam, rise and pass through a condenser, held at a temperature of 35-45℃, which acts as a cooling tank. After passing through the condenser, they change their state to liquid and thus get collected in a specialized tank called the Florentine. Because water and oil have different specific gravities and essential oil is lighter than water, it floats on the surface and thus it becomes easy to separate. The entire process continues for 90 minutes and is usually performed in stills made of copper. This copper still can accommodate 500 kg of flowers along with 1500 liter warm water. Typically, 3000-4000 kg of rose petals yields 1 kg of essential oil. Subsequently, the essential oil yield varies in between 0.03-0.04%.

Supercritical CO_2 extraction method: These days, this technique is also successfully used to extract rose essential oil. Carbon-dioxide extracted oils are considered to be superior, pure and extremely similar to the natural essential oils (**Table 1**) [11].

Table 1: Chemical components and their relative concentration (%) in rose essential oil obtained using various techniques

Constituent	Hydro-distillation (%)	Supercritical CO_2 extraction (%)
Monoterpene hydrocarbons	38	28
Linalyl acetate	3-5	24
Linalool	38	35
Nitrogen derivatives	<0.5	2
Sesquiterpene derivative	4	<2

Periwinkle

Periwinkle, botanically known as *Catharanthus roseus* is a member of Apocynaceae family. Being a native of the Madagascar region, it has now outspread to the regions of India, China, Indonesia, Philippines, Israel, USA, Africa etc. Amongst the few medicinal plants as mentioned in folk medicinal literature, periwinkle finds a prime place and its mention is as early as 2nd BC [12]. The height of the plant varies in between 20-80 cm, with different blossom colours like pink, white or purple. Nirmal and Dhawal are important white flowered cultivars. It has found its application also in the human disease management. It manages the high sugar levels in the human blood, used as an anti-oxidant, also possess wound healing capabilities. Also, it is known to be anti-cancerous (**Figure 4**).

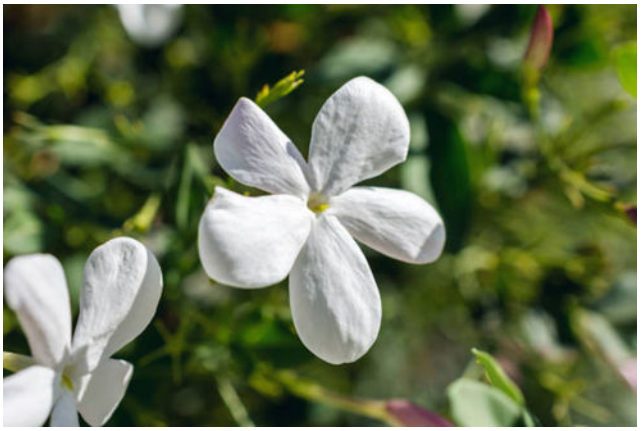

Figure 4: Periwinkle.

Oil extraction from periwinkle: The essential oil from periwinkle can be extracted by the use of steam distillation method. This method involves the weighing of appropriate quantity of the sample, to be used for extraction, followed by keeping them in the distillation unit of a Clevenger's apparatus. Now add some distilled water to this unit. Heat the unit by using a heating mental unit for 4 hours [13]. The steam carries away all the volatile compounds with it and then further condensation is done. The specific gravity of the oil being less than that of water floats over it and thereby oil is separated from water. The oil thus obtained can further be dried over anhydrous Na_2SO_4. The chemical constituents of essential oil of periwinkle contain:

Flowers of pink-coloured cultivars: Monoterpene hydrocarbons (39%), diterpenes (33.4%) and fat derivatives (15.3%). But on the contrary, its leaf oil contains fat derivatives of (76.1%).

Flowers of white-coloured cultivars: Monoterpene hydrocarbons (41.6%), oxygenated counterpart (12.3%) and alkanes (22.3%).

Jasmine

Jasminum grandiflorum, a belongs to Oleaceae family and is a highly valued plant due to its varied applications in various fields. The gentle fragrance present in the blossoms of jasmine is used in various perfume industry. *Jasminum sambac* and *Jasminum auriculatum* are other important oil yielding species of jasmine and Arka Surab, CO_1 Pitchi and CO_2 Pitchi are important varieties of *Jasminum grandiflorum* for concrete production (concrete recovery 0.25 to 0.32%) [14]. It is used to calm the labor pains, used as an expectorant for sensitive skin, coughing etc. Also, they are used as a food flavoring. Furthermore, the scent can be explained as exotic, fragrant and comforting. The liquid essential oils are typically distilled from different plant sections that contain potent aromatic components (**Figure 5**).

Figure 5: Jasmine flower.

Oil extraction in jasmine: There are different ways by which essential oil can be extracted from it. These methods include: Supercritical fluid extraction method, solvent extraction, steam distillation, enfleurage etc. however, amongst all the above stated methods, supercritical fluid extraction method is the most popular technique because it produces exceptionally high-quality oil with a better and more pleasant aroma and all the essential components can be easily extracted out by this method. The sample is firstly dried for 2-3 days under room temperature and then it is finally grinded [15]. In this method,

extraction is carried by heating and pressurizing the liquid carbon dioxide, which is made to pump out from the reservoir. After entering the extraction chamber, supercritical carbon dioxide and co-solvent come in contact with solid particles. Following their removal from the extractor, the co-solvent, the solute and carbon dioxide precipitate in the separators, where carbon dioxide turns gaseous.

Chemical constituents of Jasmine oil: The major constituents of Jasminum grandiflorum oil are Benzyl acetate (37%), Benzyl benzoate (34.7%) and linalool (9.6%).

Tuberose

Polyanthes tuberosa belonging to the family Asparagaceae is an ornamental crop grown commercially for loose flowers and oil extraction due to its medicinal properties. Tuberose flowers are highly fragrant and contain 0.08 to 0.14% concrete which is extracted from single type cultivars on commercial scale [16]. Tuberose essential oil is used in many medications for lowering sadness, anxiety, and tension because of its remarkable properties. It also contains anti-inflammatory and anti-spasmodic properties.

Oil extraction: Tuberose essential oil is extracted by using two methods *i.e.* Enfleurage and solvent extraction method.

Enfleurage method: Tuberose oil was extracted using two different methods of enfleurage: cold and hot. In cold enfleurage, 100 ml of palm wax is poured into each rectangular glass tray after it has been heated to 80℃ for two hours. When the palm wax is cooled down at room temperature fresh flowers of tuberose are put in rectangular tray and covered with another tray of wax [17]. Every day, fresh flowers were placed in place of those ones. The saturation point in cold enfleurage method is 2500 g flowers/200 ml palm wax. While using the hot enfleurage method, 400 ml of palm oil and flowers are allowed to heat at a temperature of 60℃ for 0.5 hours, after that cooled down to normal temperature. Leave palm oil containing flowers overnight at 8-10℃ and again heat up the oil at 60℃ and fresh flowers are poured by removing the previous ones. The saturation point in hot enfleurage method is 500 g flowers/400 ml palm oil. Due to heat used in this method the absolute yield from the tuberose petals in hot enfleurage is higher than cold one. However the absolutes from both hot and cold enfleurage contain palm oil and palm wax respectively which was extracted by ethanol. Compared to palm oil, palm wax used in cold enfleurage is more easily extracted by ethanol.

Solvent extraction: Since hexane and petroleum ethers are potent non-polar solvents that are frequently used in solvents to extract oils, they were utilized to extract the scents from tuberose flowers. In this flowers are soaked in 1 liter of solvent for 1 hour and after that solvent were evaporated which leaves the concrete behind. After that, alcohol is used to remove tuberose absolute from concrete [18]. Concrete arrived from cold enfleurage, hot enfleurage, hexane and petroleum ether extractions are 0.317%, 6.5808%, 0.0279% and 0.0182% respectively.

Chemical constituents of tuberose oil: Major compounds of enfleurage absolutes are methyl benzoate, methyle salicylate, indole, E-citral, methyl anthranilate, methyl isoeugenol, beta farnesene, 2,4-decandien-1-al, Z-3-hexenyl 2-oxopropanoate, 1-tetradecene, nerolidol, 2-heptadecanone, benzyl benzoate. Major compounds of solvent extracted absolutes are Z-3-hexenyl 2-oxopropanoate, methyl eugenol, methyl isoeugenol, E-methyl isoeugenol, 7-decen-5-olide, ecosanol, pentacosane, heptacosane, alpha-farnesol, methyl anthranilate. Among them methyl benzoate (30.17%) is considered as the major compound as it possesses pleasant smell and mostly used in perfume industry.

Calendula

Since time immemorial, *Calendula officinalis* has been utilized as a popular therapeutic herb. It is also referred to as pot marigold or English marigold and a member of Daisy family. The Ayurvedic and Unani medical systems have documented the therapeutic properties of *Calendula officinalis*. Antioxidants are found to be abundant in calendula petals. It has been demonstrated that calendula extract eliminates superoxide and hydroxyl radicals produced by photo reduction of riboflavin. Its extracts are having cytotoxic, antihelminthic effects, genotoxic and antigenotoxic effects, neuroprotective effects, cardiovascular effect, anti-inflammatory effects, heptaprotective, gastroprotective effects (**Figure 6**).

Figure 6: Calendula flower.

Preparation of extract: The active components were extracted from fresh Calendula flower tips. Extraction was carried out in accordance with standard pharmacopoeia. For this, 450 milliliters of ethyl alcohol were used to extract 700 grams of calendula flowers. The alcohol was combined with the substance in a wide-mouth bottle. In order to stop evaporation, the jar was sealed and stoppered. It was kept at room temperature in a dark area for two weeks while being shaken every day. The residue was then extracted using clean linen and added to the pour out clear liquid and alcohol was used to make the volume 1 L. In a shaker water bath at 42°C, the *Calendula officinalis* tincture was evaporated until it was completely dry and yield of 1.1 g was determined.

Chemical constituents: It included a variety of chemical components, including as amino acids, polysaccharides,

essential and volatile oils, tannin, quinines, coumarins, carotenoids, flavonoids, steroids, triterpenes, triterpendiol esters, saponins, and many more chemical groups. About 4.5% of amino acids are found in the flowers that were extracted from the ethanol extract of the flowers.

RESULTS

The research presented in this paper highlights the diverse medicinal properties and extraction methods of several key medicinal flowers. Each flower studied chamomile, lavender, rose, periwinkle, jasmine, tuberose, and calendula exhibits unique therapeutic attributes and extraction processes. Below are the summarized results:

Chamomile: Chamomile (*Chamaemelum nobile* and *Chamomilla recutita*) contains around 120 secondary metabolites, including terpenoids and flavonoids. The oil extraction yields varied from bright blue to deep green when freshly extracted, turning dark yellow upon storage. Its therapeutic properties include antispasmodic, antiseptic, anti-cancer, and anti-inflammatory effects. The primary bio-active compounds are α-bisabolol, chamazulene, and flavonoids like apigenin and quercetin.

Lavender: Lavender (*Lavandula* spp.) essential oil, extracted through supercritical CO_2 or hydro-distillation methods, shows high-quality oil with diverse applications in treating stress, anxiety, and respiratory issues. The supercritical CO_2 method produces oil with a higher concentration of linalyl acetate and lavandulyl acetate, while the hydro-distillation method yields a more complex chemical profile including j-pinene and linalool.

Rose: *Rosa damascena* and other species produce rose oil with a significant presence of linalool and benzyl benzoate. Rose oil has applications in cosmetics, perfumes, and medicine for its anti-bacterial, astringent, aphrodisiac, and antidepressant properties. The supercritical CO_2 extraction method is noted for producing purer oils compared to traditional distillation.

Periwinkle: *Catharanthus roseus*, or periwinkle, is used in managing high blood sugar levels, wound healing, and cancer treatment. The essential oil extraction by steam distillation yields monoterpene hydrocarbons and diterpenes, contributing to its medicinal properties.

Jasmine: *Jasminum grandiflorum* essential oil, extracted using supercritical fluid extraction, is rich in benzyl acetate and benzyl benzoate, contributing to its calming and expectorant properties. The supercritical method ensures high-quality oil with a pleasant aroma.

Tuberose: *Polyanthes tuberosa* oil is extracted using enfleurage and solvent extraction methods. Tuberose oil contains compounds like methyl benzoate and indole, useful for alleviating anxiety and inflammation. The hot enfleurage method yields higher amounts of essential oil compared to the cold enfleurage.

Calendula: *Calendula officinalis* extracts are rich in antioxidants and exhibit a wide range of therapeutic effects, including anti-inflammatory and gastroprotective properties. The extraction process with ethyl alcohol yielded a tincture with notable active compounds, including flavonoids and carotenoids.

DISCUSSION

The medicinal flowers discussed each offer unique therapeutic benefits, underscoring their historical and contemporary significance in both traditional and modern medicine. The variety of extraction methods, including steam distillation, hydro-distillation, supercritical CO_2 extraction, and enfleurage, illustrates the versatility and evolution of techniques used to harness the medicinal properties of these flowers.

Chamomile and lavender have long been recognized for their calming and anti-inflammatory effects, with modern extraction methods enhancing the purity and effectiveness of their essential oils. The rich terpene and flavonoid profiles of these flowers support their continued use in treating various ailments, from digestive issues to anxiety.

Rose oil, with its rich aroma and therapeutic properties, highlights the blend of medicinal and cosmetic applications. The choice of extraction method impacts the quality and composition of the oil, emphasizing the importance of method selection in maximizing therapeutic benefits.

Periwinkle and jasmine demonstrate the potential of medicinal flowers in cancer treatment and respiratory health, respectively. Their active compounds have shown promise in clinical applications, reinforcing the value of traditional botanical medicine.

Tuberose and calendula illustrate the diverse uses of flowers in managing mental health and inflammatory conditions. The different extraction methods employed reveal how the properties of these flowers can be optimized for various therapeutic purposes [19,20].

CONCLUSION

Medicinal flowers continue to be a crucial resource for natural healing and wellness. The research demonstrates that the therapeutic potential of flowers is vast, encompassing a range of bioactive compounds that offer significant health benefits. From ancient traditions to contemporary applications, these flowers are integral to both traditional and alternative medicine systems.

The effectiveness of medicinal flowers is closely tied to the extraction methods used, as different techniques yield oils with varying compositions and therapeutic properties. As interest in natural and holistic health approaches grows, the role of medicinal flowers in healthcare is likely to expand, offering valuable alternatives and complements to conventional treatments.

Future research should focus on exploring new extraction methods, understanding the full spectrum of bioactive compounds, and evaluating the efficacy of these medicinal flowers in clinical settings. Continued exploration of the intersection between traditional knowledge and modern science will enhance our understanding of these remarkable plants and their contributions to human health.

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