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Review

Inhalation and Topical Application of Rose Essential Oil – A Systematic Overview of *Rosa damascena* Aromatherapy

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Abstract: The purpose of this systematic overview is to establish the impact of inhalation and topical application of *Rosa damascena* essential oil in aromatherapy practice. A bibliometric analysis using the different scientific databases was conducted to examine scientific documents related to "rose aromatherapy" and "*Rosa damascena* aromatherapy". Microsoft Excel and VOSviewer software were used to extract and visualize information. Founded on a review of 93 papers, the scent of rose essential oil has applications in aromatherapy for reducing anxiety, alleviating pain, improving sleep quality, as well as alleviating physiological symptoms during menopause and PMS. It aids in mitigating stress and reducing stress and reducing depression and fatigue, for relaxation and improving cognitive function, among other benefits. Ultimately, rose essential oil is safe and suitable for self-administration via inhalation or topical application, either alone or with other essential oils.

Keywords: *Rosa damascena*; essential oil; pain relief; anxiety reduction.

1. Introduction

Aromatherapy is the therapeutic use of essential oils [1]. However, aromatherapy cannot cure the disease, but it is effective in alleviating the symptoms that accompany the disease such as stress, anxiety, depression, nausea and vomiting, pain, etc. [2]. Inhalation is the most popular and safe method for administering essential oils. It is an effective way to change emotions or state of mind, suitable for treating physical or mental disorders, as well as other functions under the control of the autonomic nervous system [3, 4]. For this purpose, essential oils can be applied as room scents via lamp diffusion method, aroma candles, room sprays, etc. [5], or personal inhalers such as vapour balm, lipstick-sized nasal inhaler, or simply by direct inhalation (from a piece of gauze, tissue, or cotton pad) [2]. Another widely used method in aromatherapy for essential oils is topical application, primarily through massage [6]. Apart from these two methods, there is a third approach to applying essential oils in aromatherapy practice, which involves oral consumption. However, oral use should be done under the supervision of professionals [7].

Roses have been known since ancient times, among Mesopotamian, Assyrian, Minoan, Egyptian, and Chinese civilizations as ornamental plants [8]. They also used roses as edible and medicinal plants and produced "*Rosaceum Oleum*" by macerating fresh rose petals in olive oil [9]. The process of obtaining essential oil from roses was discovered in the 7th century, marking the rise of roses as an important agricultural herb [10]. Although the Damask rose (*Rosa damascena* Mill.) is considered a superior essential-oil-bearing rose, other scented roses are also used for essential oil production [11, 12]. Today, Bulgaria and Turkey stand out as the most significant producers of rose essential oil, rose water, absolute, and concrete. These are important raw materials for the perfume, cosmetics, and pharmaceutical industries [11, 13].

Taking into account that the content of rose oil in fresh flowers is relatively low (0.3–0.4 mL/kg), industrial distillation today requires a process called cohabitation (re-distillation of hydrosol) [14, 15]. By mixing the primarily obtained essential oil with the redistilled (second or indirect) oil, rose otto (attar) is prepared [16]. This blend exhibits a much more natural and more decadent aroma compared to the primary oil [17]. Rose Otto is usually available in the commercial market. The scented water (which remains after re-distillation of hydrosol), which mainly contains phenyl-ethyl alcohol, is known as rose water [18]. Moreover, pure rose oil is very expensive, but in aromatherapy practice, it is commonly used diluted in the concentration of 1-10% in jojoba, sweet almonds, or evening primrose oil [19-27].

The aim of this paper is to conduct a comprehensive review of the application of rose essential oil, renowned in aromatherapy for its pleasant smell. The focus is on its application through inhalation and massage. Furthermore, doses and blending with other essential and fatty oils are also investigated in this review. In addition, the potential aromatherapeutic application of rose water is also reviewed in this paper. Previous review papers have been published on the traditional and phyto-pharmacological uses of damask rose [28-30], its efficacy in essential oil aromatherapy [31-32], and its effects on treating anxiety, depression, and stress [33, 34], improving sleep quality [35], alleviating pain severity [36-38], as well as its application in treating burn patients [39]. There was no intention to duplicate these studies, but rather to provide a comprehensive overview of the use of rose essential oil in aromatherapy practice, specifically focusing on inhalation and topical application.

2. Materials and Methods

Science Direct, Web of Science, PubMed, and SID databases were reviewed in English (abstract or full text) in November 2023 without limiting the search by date and using queries "rose aromatherapy" and "*Rosa damascena* aromatherapy" in the title, abstract and keywords. The collected publications were evaluated and categorized according to an annual number of documents and distribution across countries. Microsoft Excel was used to process the data and generate graphical representations for easy interpretations (Figures 2 and 3). For keyword analysis and visualization, VOSviewer was utilized, a computer program designed for displaying large bibliometric maps in an easy-to-interpret manner.

3. Results

To identify trends in *Rosa damascena* essential oil use in aromatherapy, the VOSviewer program was used to represent the author and index keywords. To perform a general analysis, a search was conducted 102 times in the titles and abstract (Supplementary Table 1). As observed in Figure 1, Rose aromatherapy according to abstracts, was distributed in seven different clusters. In the red cluster, the words "*Rosa damascena*" and "sleep quality" were the most frequently mentioned. Some words with less occurrence, such as "improvement", "adult" and "child" also occurred. The terms with the highest frequency in the violet cluster corresponded to "nurse" and "job stress". In the light blue cluster, dominates words such as "inhalation", "stress" and "depression", while in the dark blue cluster are "pain intensity", "pain anxiety" and "burn patients". The most frequent terms in the green cluster were "labor", "labor pain", "active phase" and "blood pressure". In the yellow cluster, the most frequently used words are "massage", "menstrual pain" and "primary dysmenorrhea".

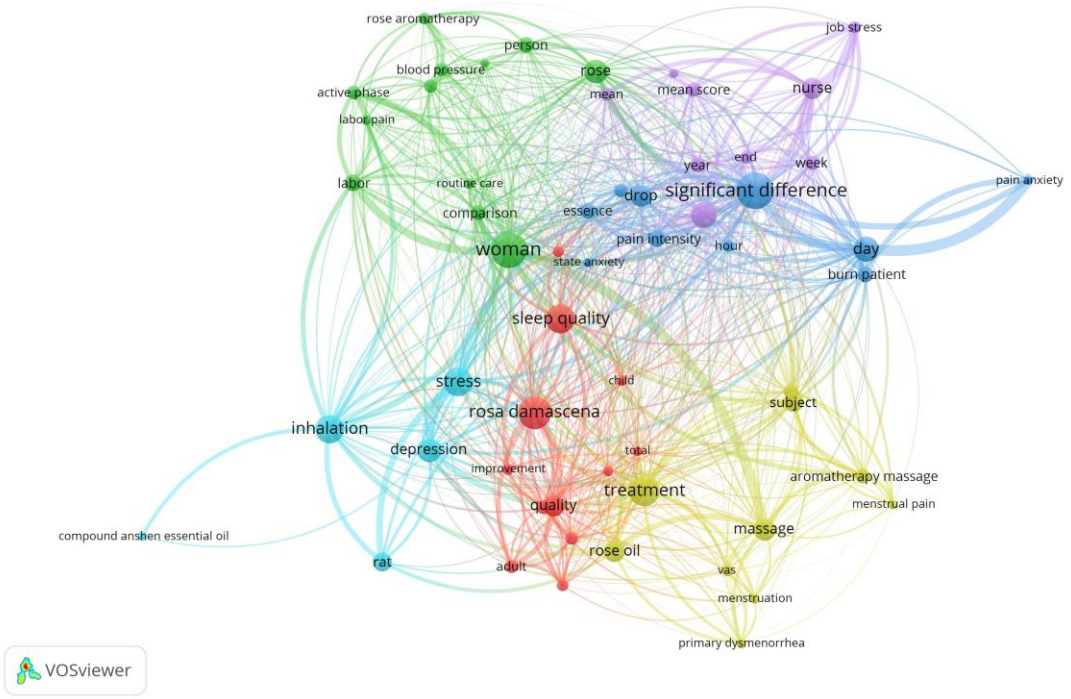

Figure 1. Co-occurrence analysis of the terms in "*Rosa damascena* aromatherapy" research according to abstract. The frequency of occurrence is represented by the size of the circle beneath each word. Different colours were employed to depict distinct clusters of highly related keywords, facilitating their categorization. The VOSviewer software was utilized to represent the term cloud, with data collected from the Scopus database.

Over the past decade, there has been a significant increase in interest in the use of rose essential oil in aromatherapy, especially during the COVID-19 pandemic (2019-2021) (Figure 1; Supplementary Table 1). The majority of the studies focusing on rose aromatherapy were conducted in Iran (63), followed by Turkey (11), Indonesia (6), Japan (3), Egypt (2), South Korea (2), Brazil, China, Germany, India, UK and Thailand (Table 1). This distribution can be attributed to the cultural significance of the rose, particularly in Iran and other Islamic countries, where it is known as the "Flower of Prophet Mohammad" [40].

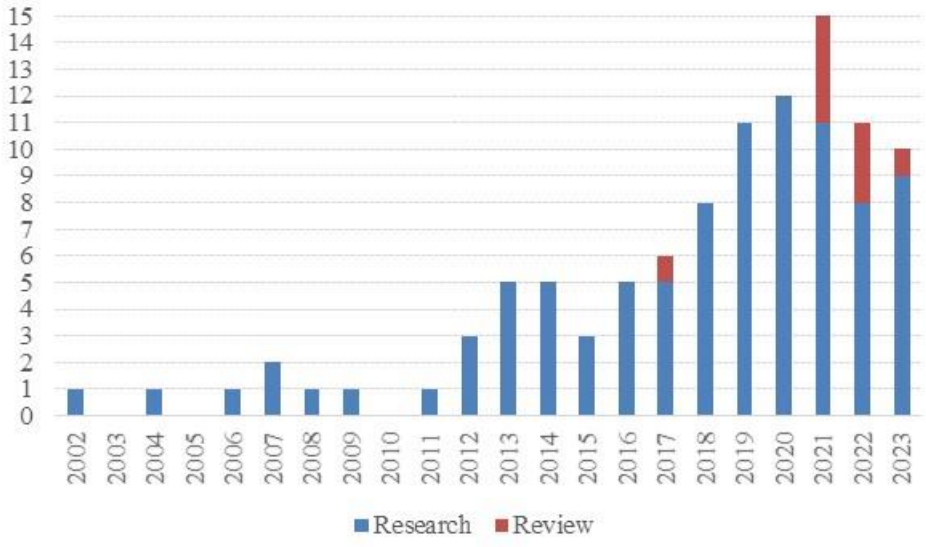

Figure 2. Trends in rose aromatherapy during the years (2002-2023).

Based on a review of 93 papers, that include animal studies, controlled clinical trials, and quasi-experiments, it is clear that rose essential oil possesses significant potential in both topical application and inhalation aromatherapy (Table 1).

Table 1. Review of research studies on the effects of rose aromatherapy (the results are listed according to the year of publication, from the oldest to the newest, and within one year in alphabetical order).

Reference	Country	Design	Treatments	Participants	Application/dose	Results
[41]	Japan	Experimental study	1.peper, 2.estragon, 3.fennel, 4.grapefruit, 5.rose, 6.patchouli, 7.control	43 healthy females	EO dissolved at a concentration of 2% in triethyl citrate, applied to a piece of absorbent cotton fatted under the subject's nose to inhale for 3 min	Decrease sympathetic activity, and decrease adrenaline concentration
[42]	Brazil	Animal study	1.aromatherapy, 2.control	Adult male rats	Inhalation of different concentrations of rose EO: 1, 2.5, and 5% w/w for 7 min	An anxiolytic effect similar to diazepam
[43]	Iran	*In vitro* study on guinea pig tracheal chain	1.rose ethanolic extract, 2.rose essential oil, 3.saline (negative control), 4.theophylline	N/A	Except for control, the investigated concentration was: 0.25, 0.5, 0.75, and 1.0 %	Relaxant effects
[44]	UK	Animal study	1.aromatherapy, 2.diazepam	Gerbils	Inhalation via an electric vapouriser and aroma stone	Anxiolytic effects
[45]	Turkey	Animal study	1.aromatherapy, 2.control	14 Male Wistar rats	Inhalation	Improving learning and memory
[19]	South Korea	Pilot-controlled clinical trial	1.aromatherapy, 2.control	52 climacteric women	Massage on the abdomen, back, and arms with EO blend: lavender, rose geranium, rose, and jasmine in almond and primrose oils, once a week for 8 weeks	Effective treatment of menopausal symptoms such as hot flushes, depression, and pain in climacteric women
[20]	Thailand	Clinical study	1.aromatherapy, 2.control (sweet almond oil)	40 healthy volunteers	1 ml of 20% rose EO in sweet almond oil by self-massage for 5 min, then covered by plastic film	Relaxing effect (decreased breathing rate, blood oxygen saturation, and systolic blood pressure)
[21]	South Korea	Clinical trial	1.self-aromatherapy massage, 2.placebo, 3.control	55 female nurses	Self-massage with 3% EO blend (*R. centifolia*, *R. damascena*, clary sage, rose geranium, and ginger in a ratio of 0.5:0.1:1:1:1)	Decrease menstrual pain and the level of anxiety

					diluted in almond, jojoba, and evening primrose oil (8:1:1)	
[46]	Japan	Animal and human study	N/A	Male Wistar rats and 27 healthy women	Inhalation	In rats and humans chronic stress-induced disruption of the skin barrier can be limited or prevented by inhalation rose EO
[1]	Turkey	Experimental study	1.control, 2.formaldehyde (FA), 3.FA+rose EO	21 albino Wistar rats	Inhalation rose EO	Protective effects against testicular damages caused by FA
[47]	Iran	Clinical trial study	1.aromatherapy+foot bath, 2.foot bath, 3.control (routine care)	120 nulliparous women	Inhalation during 10 minutes at the beginning of the active phase and the beginning of the transitional phase	Reduce anxiety
[48]	Turkey	Double-blind, randomized placebo-controlled study	1.conventional therapy+placebo, 2.conventional therapy+rose	80 patients with renal colic	Inhalation of 2% rose EO via electronic vapourizer	Reduce renal colic pain
[49]	Iran	Randomized clinical trial	1.aromatherapy, 2.control	80 primiparous women	Inhalation and foot bath with rose EO for 10 min at the beginning of the active phase and then at the onset of the transitional phase of labor	Improve the quality of maternal and neonatal health
[22]	Egypt	Randomized blind clinical trial of cross-over design	1.aromatherapy massage, 2.placebo (massage)	95 nursing students suffering of primary dysmenorrhea	Massage with EO blend: cinnamon, clove, rose, and lavender in almond oil	Alleviate menstrual pain, its duration, and excessive menstrual bleeding
[50]	Turkey	Animal study	1.control, 2.chronic mild stress (CMS), 3.CMS+rose orally, 4.CMS+rose inhalation	32 male rats	Inhalation 0.15 ml/kg for 28 days	Protective effects on oxidative stress in depression
[23]	Iran	Randomized clinical trial	1.aromatherapy massage, 2.massage, 3.control	87 postmenopausal women	Aromatherapy massage for 30 min twice a week for 4 weeks with EO blend (lavender, geranium, rose, and rosemary in a ratio 4:2:1:1 diluted in almond (90%) and evening primrose oil (10%) at a final concentration of 3%	Improve physiological symptoms during menopause (depressive mood, irritability, anxiety, mental exhaustion)

[51]	Iran	Randomized controlled trial	1.aromatherapy, 2.control	60 patients hospitalized in the coronary care unit	Inhalation of 3 drops of rose EO via a piece of paper towel placed near pillow during night time for 3 days	Improve sleep quality
[52]	Japan	Clinical study	1.orange, 2.rose, 3.control	20 female students	Inhalation for 90 s	Induces physiological and psychological relaxation
[53]	Iran	Randomized clinical trial	1.aromatherapy, 2.control	80 primiparous women	Inhalation and foot bath with rose EO	Relief labor pain
[24]	Iran	Randomized controlled trial	1.rose EO massage, 2.unscented almond oil massage, 3.massage only group	75 students	All three groups received massage on their first day of menstruation in two subsequent cycles	Reduce the severity of primary dysmenorrhea
[54]	Germany	Patient-blinded, randomised crossover, pilot trial	1.aromatherapy, 2.control	27 depressed female inpatients (18-49 year)	Inhalation during the night for 3 consecutive nights	Positive influence on mood and sleep quality
[55]	Iran	Randomized clinical trial	1.aromatherapy, 2.blindfold	60 patients hospitalized in cardiac care unit	Inhalation of rose EO during 3 nights	Improve sleep quality
[56]	Iran	Double-blind, placebo-controlled clinical trial	1.aromatherapy, 2.control (almond oil)	64 children (3-6 years)	Inhalation from the eye pad from the 30 cm distance	Reduce postoperative pain in children
[25]	Iran	Randomized controlled trial	1.self-massage with almond oil, 2.self-massage with rose, 3.control	75 students with primary dysmenorrhea	Massage with 5 drops of 4% rose EO in almond oil for 15 min	Reduce severity of primary dysmenorrhea
[57]	Iran	Randomized clinical trial	1.aromatherapy, 2.control (distilled water)	60 preterm neonates	Inhalation of 2 drops of 10% rose EO from the pad eye located at a distance of 30 cm from the head	Reduce apnea attacks, bradycardia, and SpO_2 in preterm infants
[58]	Iran	Randomized clinical trial	1.aromatherapy, 2.control	50 patients with second and third-degree burn wounds	Inhalation 5 drops of 40% rose EO diluted in water	Relief pain intensity
[59]	Iran	Randomized controlled trial	1.aromatherapy, 2.control	120 postmenopausal women (45-55 years)	Inhalation 2-3 drops EO blend: lavender, fennel, geranium, and rose	Improve sexual function in postmenopausal women
[60]	Iran	Single-blind randomized clinical trial	1.aromatherapy massage, 2.inhalation aromatherapy, 3.control	90 patients with burns	Inhalation with EO blend (rose and lavender), Massage with lavender EO	Reduce anxiety and pain
[61]	Turkey	Randomized clinical research trial study	1.diclofenac sodium (75 mg i.m.)+saline, 2.diclofenac sodium+rose aromatherapy	100 patients (19-30 years) with primary dysmenorrhea	Inhalation of 2% rose EO via an electric vaporizer	Rose aromatherapy is effective as adjuvant to conventional treatment methods

						for pain relief associated with primary dysmenorrhea
[62]	Iran	Non-randomized clinical trial	1.aromatherapy, 2.control	80 elderly patients underwent knee arthroplasty surgery	Inhalation of 3-4 drops of rose EO and 5 cc normal saline	Reduce postoperative pain in the elderly
[63]	Iran	Clinical trial	1.aromatherapy, 2.control	60 patients under hemodialysis treatment	Inhalation 3 drops of 2% rose EO attached to the patient collar	Decrease depression, anxiety, and stress in hemodialysis patients
[64]	Iran	Quasi-experimental study	1.lavender, 2.rose, 3.control	37 nurses working in the emergency department	Inhalation	Decrease fatigue rate in work environments
[65]	Iran	Clinical trial	1.rose, 2.lavender, 3.control	90 hemodialysis patients	Inhalation of 3 drops of EO from the piece of cloth attached to the patient's collar	Improve cognitive function
[26]	Iran	Randomized controlled clinical trial	1.topically rose EO, 2.placebo, 3.control (no intervention)	120 women with pregnancy-related lower back pain	Topically application of 7 drops rose EO diluted in 100 cm^3 almond oil without massage 2 times daily for 4 weeks	Reduce pregnancy-related low back pain intensity
[66]	Iran	Clinical trial	1.aromatherapy, 2.control	60 elderly individuals with chronic musculoskeletal pain	Inhalation via linen handkerchief with 3 drops of rose EO during 3 weeks	Reduce pain
[67]	Indonesia	Quasy-experiment with one group pre-test post-test with control	1.aromatherapy, 2.control	30 elderly with hypertension	Inhalation of 2 drops of rose EO from the tissue during 3 consecutive days	Lowering blood pressure in elderly with hypertension
[**68**]	Iran	Clinical trial	1.rose, 2.lavender, 3.combination, 4.control (distilled water)	120 primiparous women	Inhalation 0.1ml EO (concentration 1.5%) +2ml distilled water from the gauze attached to the collar	Reduce pain severity
[69]	Iran	Randomized clinical trial	1.aromatherapy, 2.control (normal saline)	110 nulliparous women	Inhalation of 2 drops of rose EO from the cotton gauze attached to the patient's collar	Reduce pain severity and anxiety

[70]	Iran	Clinical trial	1.aromatherapy, 2.control (sesame oil)	70 nursing students	Inhalation EO blend: 7 drops of 10% lavender and 3 drops of 10% rose poured on a non-absorbent pad placed 20 cm from the student	Decrease vital signs, effective for mitigating exam anxiety
[71]	Iran	Triple-blind randomized clinical trial	1.aromatherapy, 2.control (sweet almond oil)	64 female students with premenstrual syndrome	10 drops of 4% rose EO were placed on a pad and inhaled for 5 min from a distance of 30 cm for 5 days	Reduce the severity of psychological and physical symptoms of PMS
[72]	Iran	Experimental pre-test/post-test evaluation	1.aromatherapy	30 children (5-12 years) with sleep disorder	Inhalation of 5 drops of 10% rose EO on a cotton ball before sleep for 20 min	Decrease resistance to sleep, nightmares, and waking up during the night
[73]	Iran	Clinical trial	1.lavender, 2.rose, 3.control (distilled water)	60 primiparous women	Inhalation every 15 minutes during the active phase of labor	Decrease pain severity
[74]	Turkey	Prospective, randomized controlled trial	1.control, 2.placebo, 3.rose	99 patients undergoing septorhinoplasty/rhinoplasty	Inhalation via ultrasonic nebulizer for 15 min before intervention	Reduce preoperative anxiety
[75]	Iran	Randomized clinical trial	1.rose, 2.Benson relaxation technique, 3.combination, 4.control	132 burn patients	Inhalation 5 drops of 40% rose EO	The combination of rose aromatherapy and Benson relaxation technique has synergistic effects in reducing pain anxiety
[76]	Iran	Single-blinded randomized clinical trial	1.aromatherapy, 2.control	66 patients undergoing CABG surgery	Inhalation 3 drops of 4% rose EO 10 min night before intervention	No effect
[77]	Iran	Randomized clinical trial study	1.aromatherapy, 2.control	60 nurses from the emergency department	N/A	Reduce anxiety
[78]	Iran	Double-blind clinical trial	1.rose (4%), 2.neroli (0.5%), 3.control (sweet almond oil)	95 students	Inhalation 10 drops of EO on the eye pad and place it at a distance of 30 cm from the nose for 5 min	Effective in improving the symptoms of PMS (more effective than neroli)

[79]	Iran	Randomized controlled clinical trial	1.rose (5%), 2.rose (10%), 3.control	54 cancer patients	Inhalation 5 drops from cotton ball for 20 min before sleeping for 2 weeks	Improve sleep quality
[80]	Turkey	Randomized 4-arms placebo-controlled study	1.lavender, 2.rose, 3.ginger, 4.placebo (water)	184 patients underwent general anaesthesia	Inhalation for 5 min 2 drops of EO onto gauze pad	Aromatherapy reduces postoperative nausea and vomiting. However, rose EO shows weak activity
[81]	Iran	Clinical trial	1.aromatherapy, 2.control	62 hypertension patients	Inhalation of 3 drops of rose EO twice a day for two weeks from a piece of cotton	Aromatherapy decreases systolic blood pressure, therefore it is an effective supplementary treatment for hypertension
[82]	India	Randomized controlled trial	1.lavender, 2.rose, 3.control	72 orthodontic patients	Inhalation via candle warmer for 15 min	Reduce anxiety among orthodontic patients
[83]	Indonesia	Quasi experiment pre-test/post-test	1.rose 2.relaxation (foot soaking in warm water)	30 postoperative patients	N/A	Reduce postoperative pain
[84]	China	Animal study	1.control, 2.model, 3.diazepam, 4.low-dose aromatherapy, 5.medium-dose aromatherapy, 6.high-dose aromatherapy	48 mices	Inhalation during 7 consecutive days for 60 min 1% EO blend (lavender, sweet orange, sandalwood, frankincense, neroli, rose, and agarwood in ratio 10:4:2:1.6:1.2:1:0.6) diluted in Tween 80 solution	EO blend namely Anshen possesses sedative and hypnotic effect
[85]	Iran	Double-blind randomized clinical trial	1.lavender, 2.rose, 3.control	90 mothers with C-section	Inhalation cotton ball with 3 drops of EO at a distance of 10cm for 30 min	Reduce post-caesarean overt anxiety and pain intensity (better than lavender)
[86]	Iran	Double-blind randomized placebo trial	1.aromatherapy, 2.control (almond oil)	60 patients undergoing inguinal hernia repair surgery	Inhalation of 5 drops of rose EO on a cotton ball and attached to a patient collar or pillow	Relieving mild to moderate postoperative pain
[87]	Iran	Quasi-experimental study	1.aromatherapy, 2.control	80 elderly patients (60-90 years) after	Inhalation of 4 drops rose EO and 5ml	Reduce postoperative

				knee replacement surgery	normal saline from the gauze	anxiety in elderly patients
[88]	Iran	Single-blind randomized controlled clinical trial	1.aromatherapy, 2.control (distilled water)	98 patients undergoing coronary angiography	Inhalation 5 drops of 40% rose EO for 20 min before intervention	Decrease anxiety
[89]	Iran	Double-center randomized controlled trial	1.routine care, 2.placebo (water), 3.rose, 4.lavender	160 patients undergoing open-heart surgery (OHS)	Inhalation cotton swab with 3 drops (0.2 ml) EO	Reduce extubation time, surgical site pain severity, and anxiety in patients undergoing OHS
[90]	Indonesia	Quasi-experiment with pre-test/post-test design	1.lavender, 2.rose, 3.control	54 women giving birth	N/A	Decrease pain intensity, in the first phase of labor (but lower than lavender)
[91]	Iran	Clinical trial	1.aromatherapy, 2.control	90 patients undergoing abdominal surgery	Inhalation for 20 min, 1h before intervention	Decrease anxiety
[92]	Iran	Randomized controlled trial	1.progresive muscle relaxation, 2.aromatherapy, 3.control	90 patients undergoing general surgery	Inhalation for 20 min, 1h before intervention	Reduce anxiety, stress, and depression in patients undergoing general surgery
[93]	Iran	Single-blind randomized clinical trial	1.aromatherapy, 2.placebo (distilled water), 3.control	120 patients with burns less than 30%	Inhalation 6 drops of 40% rose EO	Reduce pain intensity and state anxiety in burned patients
[94]	Indonesia	Quasi experiment with pre-test/post-test designs	1.rose, 2.lavender	30 postoperative patients	Inhalation for 20 min 5 drops of EO via humidifier	Reduce pain in postoperative patients
[95]	Iran	Randomized controlled study	1.aromatherapy+warm foot bath, 2.warm foot bath, 3.control (routine labor care)	120 primiparous women	Inhalation for 10 min at the beginning of the labor and in the transition phase	Decrease pain severity
[96]	Iran	Clinical trial	1.aromatherapy, 2.control	60 patients at intensive care unit	Inhalation of 3 drops of 10% rose EO from gauze for 20 min 3 times daily	No effect
[97]	Iran	single-blind randomized clinical trial	1.rose, 2.control (water)	98 patients undergoing coronary angiography	Inhalation 5 drops of 40% rose EO for 20 minutes	Decrease stress and anxiety severity and improve hemodynamic parameters of patients undergoing coronary angiography

[98]	Iran	Randomized clinical trial	1.lavender, 2.rose, 3.control	97 patients undergoing coronary artery bypass graft (CABG) surgery	Inhalation during 5 consecutive nights	Positive effects on sleep quality of CABG patients
[99]	Iran	Randomized controlled trial	1.aromatherapy, 2.control	60 nurses	Inhalation of cotton swab impregnated with 2 drops of 40% rose EO	Reduce occupational stress in nurses
[100]	Iran	Randomized clinical trial	1.aromatherapy, 2.placebo	80 patients with acute myocardial infarction	Inhalation of 3 drops of rose EO three times a day for 3 days	Reduce anxiety
[101]	Iran	Single-blinded clinical trial study	1.aromatherapy, 2.control (sesame oil)	70 nursing students	Inhalation for 10 min EO blend: 7 drops of 10% lavender and 3 drops of 10% rose, poured on a non-absorbent pad placed 20cm from the nose	Reduce anxiety
[102]	Iran	Randomized controlled trial	1.aromatherapy, 2.control (distilled water)	60 patients hospitalized in the cardiac care unit	Inhalation 5 drops of 40% rose EO	Reduce anxiety and increase sleep quality
[103]	Iran	Quasi-experimental study	1.rose, 2.*Citrus aurantium*	60 elderly people	Inhalation of 10% rose EO from the pillow for three nights before sleeping	Improve sleep quality
[104]	Iran	Quasi-experimental study	1.rose, 2.*Citrus aurantium*	60 elderly people	Inhalation of 10% rose EO from the pillow for three nights before sleeping	Reduce anxiety
[105]	Iran	Clinical trial	1.aromatherapy, 2.control	70 patients undergoing gastrointestinal endoscopy	Inhalation of 2 drops of 10% rose EO from a cotton ball attached to the patient's collar	Reduce pre-endoscopic anxiety of the patients
[106]	Turkey	Randomized controlled experimental study	1.aromatherapy, 2.control	131 students	Inhalation via diffuser: 3 drops pure rose EO for 30 min	Rose EO did not affect immediate learning (working memory), but, it can help to remember previously learned information more

						easily during continuous application
[107]	Iran	Randomized double-blinded, parallel-group controlled trial	1.sweet orange, 2.rose, 3.placebo (distilled water)	120 undergoing open abdominal surgery	Inhalation of 4 drops of gauze attached to the collar for 30 min	Effective in reducing pain severity after open abdominal surgeries (but less effective than sweet orange)
[108]	Iran	Cross-over study	1.aromatherapy, 2.metoclopramide	40 women with pregnancy nausea and vomiting	Inhalation during 5 days	Decrease anxiety and depression in patients with pregnancy nausea and vomiting
[109]	Indonesia	Pre experiments approach, one group pre-test/post-test design	1.aromatherapy	28 menopausal women	N/A	Lowering blood pressure in menopausal women
[110]	Iran	Randomized clinical trial	1.aromatherapy, 2.control (saline)	60 operating room nurses	Inhalation for 10 min	Reduce anxiety and job stress and improve accuracy among operating room nurses
[111]	Iran	Randomized controlled trial	1.aromatherapy, 2.control	74 patients receiving hemodialysis	Inhalation of 3 drops each night for one month	Reduce the severity of fatigue in patients receiving hemodialysis
[112]	Iran	Controlled-randomized trial	1.aromatherapy, 2.control	38 preoperative patients	Inhalation of 3 drops of rose EO from cotton ball for 30 min	Reduce preoperative anxiety level
[113]	Iran	Randomized, non-blinded, parallel-group controlled trial	1.aromatherapy, 2.placebo (paraffin oil)	80 operating room personnel	Inhalation of 2 drops for 10 min at the beginning of the morning shift, then attach absorbent cloth impregnated with 5 drops for 30 consecutive nights.	Reduce state anxiety and improve sleep quality
[27]	Egypt	Quasi-experiment with pre-test/post-test design	1.aromatherapy massage, 2.massage (control)	74 menopausal women	Back and arm massage for 20 min with EO blend: lavender, clary sage, jasmine, and rose in almond oil, twice a week for 5 weeks	Effective in easing somatic menopausal symptoms
[114]	Turkey	Randomized controlled trial	1.Su Jok, 2.aromatherapy,	120 women who had Cesarean delivery	Inhalation for 30 min 3 drops of EO	Effective in reducing post-Cesarean pain

			3.aromatherapy+Su Jok, 4.control		blend (lavender, rose, and eucalyptus) were put on gauze and fixed to the patient's collar with a bandage	
[115]	Iran	Randomized clinical trial	1.aromatherapy, 2.control	100 patients undergoing lower extremity orthopaedic surgery	Inhalation of 2 drops from napkin for 10 min before intervention	Reduce anxiety and pain
[116]	Iran	Interventional study	1.breast milk, 2.*Lavandula stoechas*, 3.rose, 4.control	100 preterm infants	N/A	Decrease preterm infants' venipuncture pain
[117]	Turkey	Comparative mixed-method design	1.hand-holding, 2.rose, 3.control	126 patients	Inhalation of 2 drops of EO via the inner side of surgical face mask	Reduce pain associated with peripheral intravenous catheter insertion
[118]	Turkey	Randomized controlled clinical trial	1.aromatherapy, 2.control (standard analgesics)	86 women with primary dysmenorrhea symptoms	Inhalation of rose EO (2ml) dissolved in ethyl alcohol (20ml) and distilled water (78ml) from a piece of paper handkerchief	Effective in pain relief in primary dysmenorrhea
[119]	Iran	Randomized placebo-controlled trial	1.lavender, 2.rose, 3.placebo	118 nurses	Inhalation for 2 hours a day for four weeks	Relieving symptoms of job stress and improving comfort at the workplace
[120]	Iran	Clinical trial	1.aromatherapy, 2.control	75 eligible mothers	Inhalation 5-10 min of 10% rose EO for 10 consecutive nights	Reduce anxiety in mothers of premature infants
[121]	Iran	Cross-over clinical trial study	1.aromatherapy, 2.breast milk odor	40 neonates	Inhalation of two drops of rose EO	Reduce pain and crying due to blood sampling in neonates
[122]	Iran	Randomized controlled trial	1.aromatherapy, 2.placebo (water)	60 burn patients	Inhalation 5 drops of 40% rose EO	Reduce anxiety and improve sleep quality
[123]	Indonesia	Pre-experimental design with a two-group pre-test/post-test approach	1.aromatherapy, 2.control	40 maternity mothers	Inhalation 4 drops rose EO into the water via an ultrasonic diffuser	Reduce pain severity during 1st active phase of labor

4. Discussion

It is known that olfactory through inhalation of odors has diverse physiological effects on the human brain, endocrine, and immune systems [41]. According to the data presented in Table 1, the most common applications of rose essential oil in aromatherapy practice are for pain relief (33 papers) and for reducing anxiety (referring to 33 papers). Additionally, it is commonly used for improving sleep quality (10 papers), mitigating stress (7 papers), reducing depression (6 papers), alleviating physiological symptoms during menopause and PMS (5 papers), relaxation (4 papers), lowering blood pressure, decrease breathing rate and blood oxygen saturation (4 papers), improving life quality and well-being (3 papers), improving cognitive function (2 papers), decreasing fatigue (2 papers), improving sexual function (2 papers), and one paper refers reducing apnea attacks, bradycardia and SpO_2 of preterm infants, while in three papers, there is no activity or weak activity of rose essential oil in aromatherapy (Figure 3).

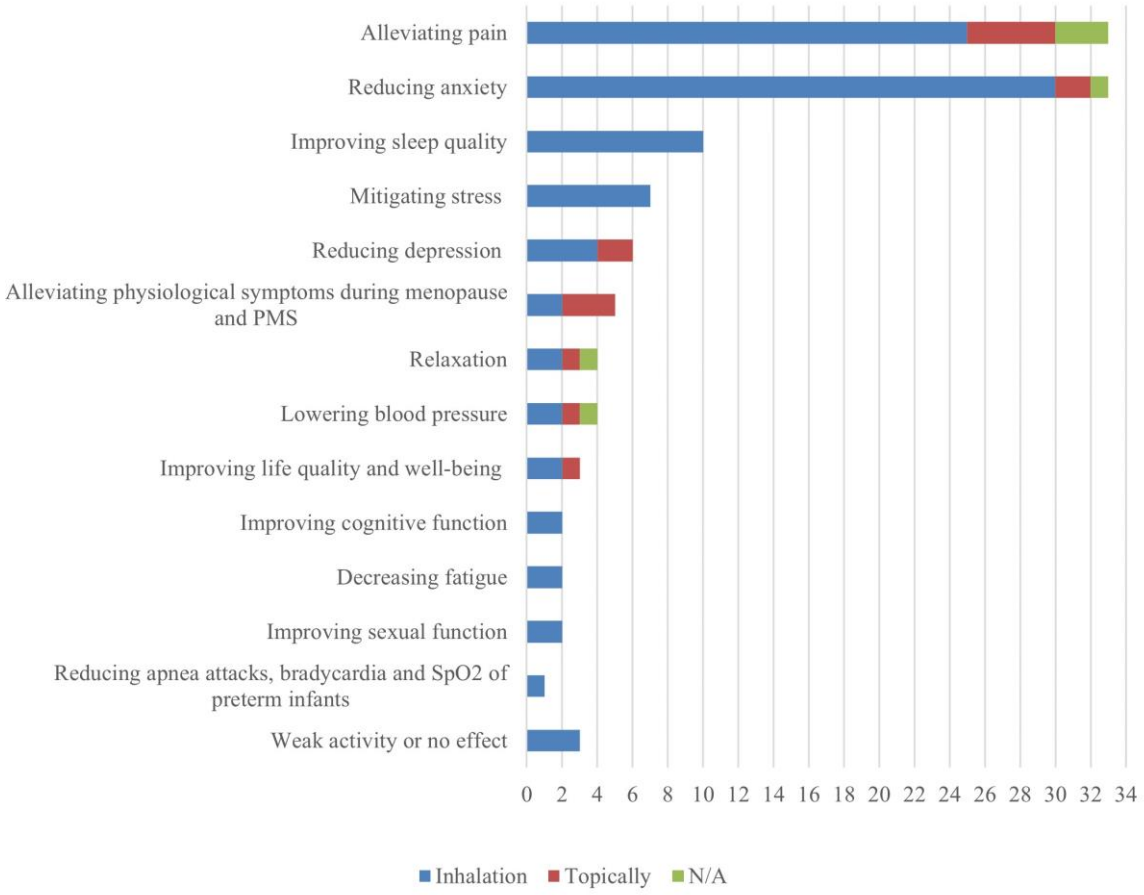

Figure 3. Summary of research studies on the effects of rose aromatherapy according to Table 1 (some activities are mentioned in one paper multiple times). Other activities include lowering blood pressure, improving male sexual function, and reducing apnea attacks, bradycardia, and SpO_2 in preterm infants.

There are several systematic reviews and meta-analyses of rose aromatherapy that summarizes anxiolytic, antidepressant, and anti-stress effects, as well as improving sleep quality [33, 34, 35, 39], and pain [36, 37, 38]. This indicates that rose essential oil can be successfully applied to burn patients to alleviate pain intensity after dressing and help reduce pain-related anxiety [58, 60, 75, 93, 122], systematically reviewed by Farzan et al. 2023 [39].

Based on our review of papers dealing with rose aromatherapy, it can be concluded that the largest number of papers refer to alleviation of various types of pain (Figure 4a), such as postoperative pain (10 papers; [56, 62, 83, 85, 86, 89, 94, 107, 114, 115]), labor pain (7 papers; [53, 68,

69, 73, 90, 95, 123]), menstrual pain (6 papers; [21, 22, 24, 25, 61, 118]), burns (4 papers; [58, 60, 75, 93]), intervention pain such as venipuncture, blood sampling or peripheral intravenous catheter insertion (3 papers; [116, 117, 121]), musculoskeletal pain such as chronic pain in elderly individuals or pregnancy-related low back pain (2 papers; [26, 66]) and renal colic pain (one paper [48]). Rose essential oil can be applied as an effective aromatherapy treatment for reducing anxiety (Figure 4b). A review conducted by Guo et al. 2020 [124] identifies rose essential oil as the third most commonly used aroma preparation for significantly improving preoperative anxiety, following lavender and citrus. According to our review, 11 papers refer to the aromatherapy application of rose essential oil for anxiety reduction during the preoperative and postoperative period [74, 85, 87, 88, 89, 91, 92, 97, 105, 112, 115], among burn patients (4 papers; [60, 75, 93, 122]), work-related stress among nurses [77, 110, 113], menstrual and menopausal anxiety [21, 23], pregnancy and maternity anxiety [108, 120], labor anxiety [47, 69], exam anxiety among students [70, 101], cardiac patients [100, 102], hemodialysis [66], orthodontic patients [82], elderly [104], and two animal studies [42, 44].

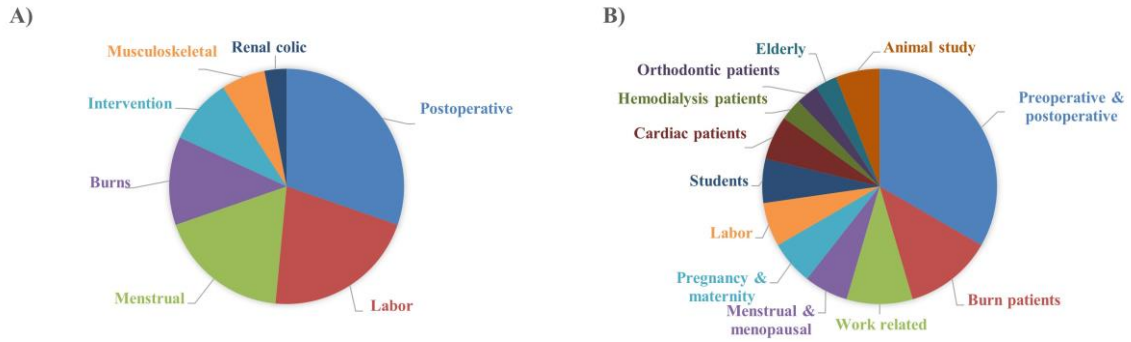

Figure 4. The benefits of *Rosa damascena* essential oil referenced in the papers (based on Table 1 and Figure 3) for A) Alleviation of various types of pain and B) Reduction of anxiety caused by various conditions.

Rose aromatherapy exhibits great potential in women's health, for treating menopausal symptoms [19, 23, 27, 59, 109], reducing menstrual pain [21, 22, 24, 25, 61, 118], and improving symptoms of PMS [71, 78]. Furthermore, rose essential oil is effective in reducing anxiety and labor pain [47, 53, 68, 69, 73, 90, 95, 123], decreasing anxiety and depression during pregnancy [108], alleviating pregnancy-related back pain [26], reducing post-Cesarean anxiety and pain intensity [85, 114], and mitigating anxiety in mothers of premature infants [120]. Moreover, aromatherapy using rose oil reduces apnea attacks, bradycardia, and SpO_2 of preterm infants [57], and decreases preterm infants' venipuncture pain [116]. It has also shown the potential to decrease resistance to sleep, nightmares, and nighttime awakenings in children with sleep disorders [72].

In addition, rose essential oil is effective in reducing renal colic pain in chronic kidney disease patients [48]. It has also shown the potential to improve cognitive function and decrease depression, anxiety, and stress in hemodialysis patients [63, 65]. Additionally, in the elderly, rose aromatherapy is effective in reducing pain and anxiety, improving sleep quality, and lowering blood pressure in elderly individuals with hypertension [62, 66, 67, 87, 103, 104].

The most common method for administering rose aromatherapy is through inhalation (referred to in 78 papers), followed by topical application (9), while in 6 papers aromatherapy method is not specified (Table 1). For inhalation, essential oil is mainly used in concentrations of 1-10%, sometimes up to 40%. The duration ranges from 90 seconds to 1 hour, or it may last all night. For massages, rose essential oil is used at a final concentration of 3-4%, and applied for 5-15 min. In aromatherapy, rose essential oil can be used alone or in combination with other oils (Figure 5). Floral oils such as clary sage [21, 27], neroli [84], lavender [19, 22, 23, 27, 59, 60, 70, 84, 101, 114], geranium [19, 21, 23, 59] and jasmine [19, 27], or spicy essential oil such as ginger [21], cinnamon [22], clove [22] and fennel [59], woody oils like sandalwood and agarwood [84], go well with rose oil in aromatherapy. Sweet orange (fruity note), frankincense (earthy), rosemary (herbal), and eucalyptus (medicinal) oils can be blended with rose oil effectively [23, 84, 114].

Figure 5. Essential oils that go well with *Rosa damascene.*

In addition to essential oil, rose water, is also a valuable raw material in aromatherapy practice [125]. For example, inhalation of rose water from absorbent cotton handkerchiefs before sleeping and before the dialysis process for a duration of 15-20 min over four weeks, noticeably reduces anxiety in hemodialysis patients [126]. Furthermore, the act of rubbing the palms of the hands and inhaling rose water for 3 min has a positive effect on reducing pain and anxiety in the patient after surgery [127]. Additionally, inhaling rose water during the phase of labor reduces pain severity in nulliparous women [128, 129]. Aromatherapy with rose water, performed for three consecutive nights among women during the puerperium period, has been observed to improve sleep quality [130]. Additionally, inhalation of lavender essential oil diluted in rose water via cloths on the mouths (10 breaths before sleeping) and then placed next to the pillow in pregnant women at 35-37 weeks, decreases postpartum depression [131].

5. Conclusions

In light of its aromatic attributes, safety profile, and facile application, rose oil emerges as a viable adjunctive or non-pharmacological modality for ameliorating anxiety, alleviating pain, attenuating physiological symptoms associated with menopause and premenstrual syndrome (PMS), enhancing sleep quality, mitigating stress, ameliorating depressive states, fostering relaxation, optimizing cognitive functions, diminishing fatigue, and affording relief across a spectrum of diverse conditions. Furthermore, avenues for future research should explore the precise mechanisms underlying the therapeutic effects of rose. A multidisciplinary approach encompassing pharmacological, neurobiological, and psychosocial perspectives should be instrumental in advancing the scientific understanding and clinical application of rose oil as a complementary therapeutic agent.

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