



The effect of aromatherapy with lavender (*Lavandula angustifolia*) on serum melatonin levels



R. Velasco-Rodríguez^a, M.G. Pérez-Hernández^a, J.A. Maturano-Melgoza^a, Á.G. Hilerio-López^a, A. Monroy-Rojas^b, B. Arana-Gómez^c, C. Vásquez^{d,*}

^a Universidad de Colima, Facultad de Enfermería, Colima, Colima, Mexico

^b Universidad Autónoma Metropolitana (campus Xochimilco), División de Ciencias Biológicas y de la Salud, Mexico City, Mexico

^c Universidad Autónoma del Estado de México, Facultad de Enfermería y Obstetricia, Toluca, State of Mexico, Mexico

^d Universidad de Colima, Centro Universitario de Investigaciones Biomédicas, Colima, Colima, Mexico

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ABSTRACT

Objective: Physiologically, blood melatonin levels decrease as a person ages and the older adult commonly presents with insomnia and other types of sleep disorders. Alternative therapies can be used to attenuate sleep disturbances. The aim of the present study was to analyze the effect of aromatherapy with lavender on serum melatonin levels in the noninstitutionalized older adult (OA).

Design and setting: A pre-experimental, quantitative study with a pre-test – post-test design was conducted on 67 OAs that included both sexes.

Main outcome measures: Serum melatonin levels were measured before and after eight sessions of aromatherapy with lavender that lasted 4 weeks. The results were expressed as mean \pm standard deviation of melatonin levels (pg/ml). The differences were compared using the Student's *t*-test and statistical significance was set at a $p \leq 0.05$.

Results: Blood melatonin levels significantly increased in the total population after the intervention with aromatherapy (pg/ml): 102.3 ± 33.4 VS 132.5 ± 42.3 , $p = 0.000004$. There were significant differences in the pre-test and post-test phases in the women and men measured as separate groups ($p = 0.00005$ and $p = 0.026$), respectively. However, those differences were not observed when the measurements were compared between the two sexes, before ($p = 0.64$) or after ($p = 0.31$) the intervention.

Conclusion: Aromatherapy with lavender essential oil similarly favors an increase in blood melatonin levels in both older adult men and women.

1. Introduction

There is much documented evidence that associates the quality of life of older adults with their sleep patterns, and without a doubt, melatonin plays an important role.^{1–6}

The scientific name of melatonin is N-acetyl-5-methoxytryptamine. It is a hormone that is released by the pineal gland and has numerous organic functions that include acting as an antioxidant and regulating menstruation and digestive activity. It is probably most widely associated with sleep induction, through the regulation of the sleep/wake cycles that in turn are influenced by the light/dark cycles. The regulating effect of melatonin on the circadian cycle makes it ideal for treating any type of insomnia. Two examples are alterations of the

natural sleep rhythm in travelers with jet lag and in workers that have irregular shifts.^{7,8}

According to data for 2015 from the United Nations Organization (UNO), the number of persons ≥ 60 years of age increased substantially in the majority of countries and regions worldwide, and that growth is expected to accelerate in the coming decades.^{9,10}

The above signifies that societies around the world currently have larger populations of older adults than in previous years. That situation will contribute to the increase in chronic disease burden and multimorbidity in older adults, with the consequent saturation of healthcare services¹¹ and will also favor the increase in medication use and the risk for polypharmacy.^{12,13}

Therefore, it is imperative to implement healthcare strategy

* Corresponding author at: Centro Universitario de Investigaciones Biomédicas, Universidad de Colima, Avenida 25 de julio # 965, Colonia Villa San Sebastián, C.P. 28040, Colima, Colima, Mexico.

E-mail address: clemvas@ucol.mx (C. Vásquez).

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alternatives to the existing ones (generally allopathic medicine) in an effort to improve the quality of life of the older adult, by treating the multi-morbidity characteristics of that group, including sleep disorders, but without causing health risks. Aromatherapy with essential oils could be one of those alternative approaches. In the last few decades, the use of complementary medicines and alternatives, such as aromatherapy, has become relevant, due to advances reported in scientific studies and acceptance by populations seeking a more integrated approach to their health problems.^{14–16}

The present study was conducted on noninstitutionalized adults 60 years of age or older from a community in Colima, Mexico. After giving their informed consent, the participants underwent aromatherapy with lavender essential oil to evaluate its effects on blood melatonin levels before and after the intervention.

2. Methods

2.1. Design

A quantitative, pre-experimental study with a pre-test – post-test design was conducted on a group of noninstitutionalized older adults (NIOAs) of both sexes.

2.2. Participants

Through nonrandomized sampling, persons of either sex (37 women and 30 men), 60 years of age or older, were included in the study, based on the official guidelines (NOM-167-SSA1-1997) of the health authorities of the State of Colima, Mexico.¹⁷ *Inclusion criteria:* only physically and mentally active older adults that signed the statements of informed consent on their own volition were included in the study. Subjects with allergies, respiratory illnesses, or conditions that could be exacerbated by aromatherapy mist were excluded. The *elimination criteria* were: subjects that did not attend all the sessions of aromatherapy (n = 8), subjects that voluntarily declined to continue in the study, and subjects that presented with an adverse reaction during the intervention with aromatherapy, as well as blood samples that at the time of their collection, transport, or processing were hemolyzed or did not meet the standards of the official regulations (NOM-003-SSA2-1993) for the use of human blood and its components for therapeutic purposes.¹⁸

The present project was approved by the research and ethics committee of the School of Nursing of the *Universidad de Colima* and strictly followed the national and international official guidelines for health-related research involving humans.^{19,20}

Blood samples were drawn from the study subjects at 2 stages to quantify blood melatonin levels. The study initially was made up of 87 subjects, but 20 were eliminated because they did not meet the selection criteria, leaving a total of 67 older adults recruited from 2 senior centers for recreation and socialization, located in the city of Colima, in the Mexican state of the same name. It is important to underline that the study focused on noninstitutionalized older adults, meaning persons not living in nursing homes or any type of assisted living that could influence their sleep patterns, and in turn, their melatonin levels.

2.3. Aromatherapy intervention

2.3.1. Essential oil

Essential oil from 100% pure lavender, genus *Lavandula* and species *angustifolia*, of Bulgarian origin, produced by the essential oil manufacturer Aura Casia™ through the steam distillation of fresh flowers was utilized. A normal-sized dropper bottle with 0.5 liquid ounces of essential oil was used, the equivalent of 15 ml and a concentration of 14.17 g of lavender essential oil. Said compound is approved by the US Food and Drug Administration (FDA) as a generally safe substance level (Level GRAS, 1832.2).

2.3.2. Device utilized

Aromatherapy was administered via inhaling, utilizing an electric ultrasonic cool mist diffuser (*Zaq Dew Litemist Aromatherapy Essential Oil Diffuser*), with a capacity to hold 80 ml of water, measuring 7.1 × 4.2 in., and with 12 W of power. The device disperses the lavender oil into the atmosphere through an ultrasonic process that produces a cool mist. That condition is necessary so that the active principle of the essential oil is not altered.

Dose of the essential oil utilized: In each aromatherapy session, 5 drops, the equivalent of 236 mg of lavender essential oil, were diluted in 20 ml of distilled water placed in the diffuser. Thus, the final concentration of the essence dispersed into the atmosphere was 2.95 mg, and the older adults were in contact with it for 30 min.

2.3.3. Physical area

The room in which the aromatherapy was carried out had the following characteristics: 7.0 × 7.0 m, clean, no furniture, adequate lighting, windows and doors in good condition to prevent the essence from escaping, no noise or distractors, and room temperature of 24 °C and 34% humidity. No fans or air-conditioning were used, to prevent the dispersion of the essence. The room was cleaned daily with soap and water only, to prevent the accumulation of odors, and the study subjects were instructed not to wear perfume or deodorant on the day of the intervention so that the perception of the lavender essence would not be altered.

2.3.4. Procedure

Fifteen minutes before the subjects entered the area of aromatherapy, the intervention room was permeated with the lavender essence at the dose mentioned above (5 drops of essential oil in 20 ml of distilled water), by placing the diffuser in the center of the room. A homogeneous dispersion of the aroma was thus maintained that was perceived throughout the entire physical area. Two members of the working team served as olfactory sensors. The older adults were then asked to enter the intervention area. The permeation conditions were achieved after numerous trials, and the length of time the essence stayed in the atmosphere was approximately 45 min. It should be mentioned that the older adults were asked not to undertake any physical activity before attending the aromatherapy session that could make them sweat, and consequently alter the environmental aroma.

2.3.5. Number and duration of the sessions

Two aromatherapy sessions were carried out per week for 4 weeks. Each session lasted 30 min. Total exposures: 8.

2.3.5.1. Blood melatonin determination. Blood melatonin levels were measured before the first aromatherapy session and after the final eighth session. The study subjects fasted for 8 h, after which 5 ml of venous blood was drawn from them and placed into 5 ml plastic test tubes with gel to separate the serum (yellow closure plug, BD Vacutainer™). The tubes were transported to the laboratory in a thermal container with frozen gel packs to ensure proper conditions. The samples were then centrifuged at 3000 rpm to separate the blood serum, which was placed in polypropylene microtubes and stored at –75 °C for later analysis. Melatonin levels were measured through competitive enzyme-linked immunoassay, utilizing the ELISA (Lifespan Biosciences; Inc. Seattle, WA 98121) technique. Once the enzyme reaction was completed, absorbance was immediately measured at 450 nm on a microplate reader (Biorad, Imark).

The Immuno-Diag Melatonin™ kit (Immuno-Diagnostics Co.) was used in the present study.

2.3.5.2. Statistical management. Descriptive statistics were carried out to analyze the sociodemographic variables of the study subjects. Blood melatonin measurements were expressed as mean ± standard deviation in pg/ml. To determine the efficacy of aromatherapy with

lavender on blood melatonin levels, the paired Student's *t*-test was employed for the pre-test and post-test comparison of the melatonin measurement in the women and the men as separate groups, and the non-paired Student's *t*-test was utilized to compare the pre-test and post-test measurements between the women and men. Significant differences with both tests were shown by a $p \leq 0.05$. The data analysis was performed using the 2010 Office Excel (Microsoft Co.) program.

3. Results

3.1. Sociodemographic characteristics of the participants

Sixty-seven older adults (30 men and 37 women) were studied. Their mean age was 69.1 ± 6.4 years, with a minimum of 60 and a maximum of 85 years. Only 15% of the older adults supported themselves by working, 50% were married, and 28.1% were widowers/widows. A total of 59% ($n = 40$) had a basic education (primary and secondary school) and 6.25% ($n = 4$) had a university education.

3.2. Pre-aromatherapy and post-aromatherapy measurement of melatonin

3.2.1. In the total population

The blood sample extraction for the pre-test melatonin measurement was carried out at 9:00 am before aromatherapy session 1, fifteen minutes before entering the intervention room. The post-test melatonin measurement was performed the day after the last aromatherapy session at the same time as the initial session (9:00 am). The experimental conditions described in the Methods section were strictly maintained in each of the eight sessions.

The comparative levels of melatonin in the total population ($n = 67$) after 8 aromatherapy sessions are shown in Fig. 1. The older adults presented with a mean melatonin level of 102.3 ± 33.4 pg/mL before the first aromatherapy session, compared with a mean melatonin level of 132.5 ± 42.3 pg/mL after the eighth session. The difference between the two measurements was statistically significant ($p = 0.000004$) (Fig. 1).

3.2.2. Data based on sex

3.2.2.1. Comparison within each sex. The pre-test and post-test comparison of the melatonin measurements in the women ($n = 37$), analyzed through the paired Student's *t*-test, is shown in Fig. 2. The mean melatonin level before aromatherapy was 101.8 ± 33.1 pg/mL and it was 134.2 ± 41.6 pg/mL after the eighth session. The difference between the two measurements was statistically significant ($p = 0.00005$) (Fig. 2).

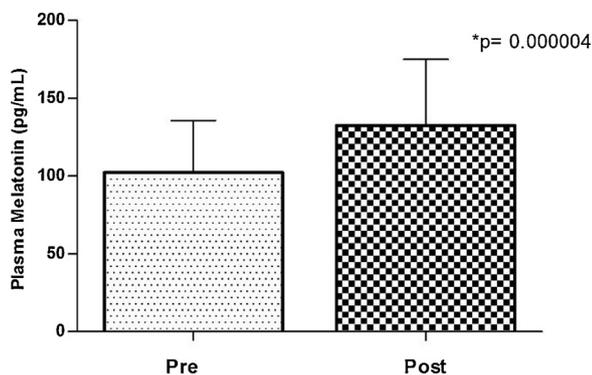


Fig. 1. The effect of aromatherapy with lavender on plasma melatonin levels in an older adult population. Older adults presented a mean melatonin level of 102.3 ± 33.4 pg/mL before the aromatherapy sessions, compared with a mean melatonin level of 132.5 ± 42.3 pg/mL after the final session ($p = 0.000004$).

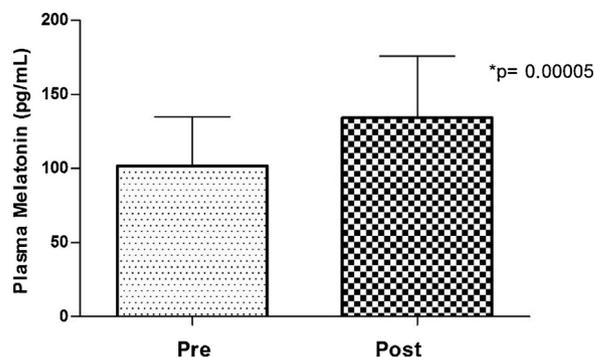


Fig. 2. Effect of aromatherapy with lavender on plasma melatonin in older adult women. In older adult women, the mean melatonin level before aromatherapy was 101.8 ± 33.1 pg/mL and it was 134.2 ± 41.6 pg/mL after the eighth session ($p = 0.00005$).

Melatonin levels measured in the men ($n = 30$) produced the following values: Initial melatonin 103.9 ± 35.3 pg/mL VS final melatonin 127.3 ± 45.4 pg/mL. The difference between the pre-test and post-test measurements was also significant, but at a lower value ($p = 0.026$) (Fig. 3).

3.2.2.2. Comparison between the sexes. A comparative analysis of the pre-test and post-test melatonin measurements was also carried out between the two sexes, utilizing the non-paired Student's *t*-test. The melatonin levels before aromatherapy were 101.8 ± 33.1 pg/mL for the women VS 103.9 ± 35.3 pg/mL for the men ($p = 0.64$). The melatonin levels after aromatherapy were 134.2 ± 41.6 pg/mL for the women VS 127.3 ± 45.4 pg/mL for the men ($p = 0.31$). Significant differences were not observed when the measurements were compared between the two sexes.

4. Discussion

The main contribution of the present study is that aromatherapy with lavender essential oil similarly favored an increase in blood melatonin levels in both older adult men and women.

It has been described, that the quality of life of persons older than 60 years of age increasingly depends on the quality of sleep, among many other factors. But, if a poor quality of sleep is not treated, it can result in other systemic physiologic alterations, in particular cognitive ones.²¹ The adequate diagnosis and treatment of sleep disorders can improve quality of life and safety for older adults and their families.²²

Melatonin, commonly known as the "sleep hormone", regulates the circadian cycle and is associated with the light/dark periods that directly affect sleep induction.⁸ Its production undergoes modifications

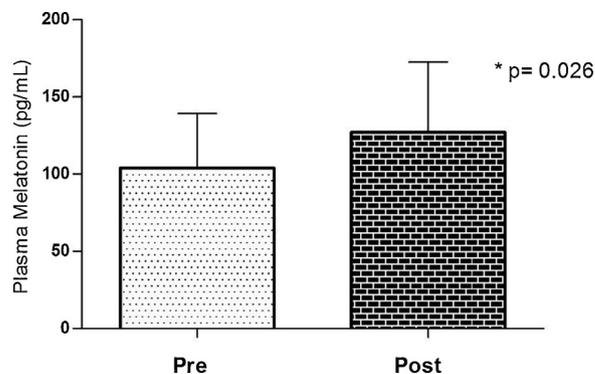


Fig. 3. Effect of aromatherapy with lavender on plasma melatonin in men. Initial melatonin was 103.9 ± 35.3 pg/mL and final melatonin was 127.3 ± 45.4 pg/mL ($p = 0.026$). Similar results were observed in the women.

throughout life. It is known that the greatest production peak in humans is in newborns and children up to puberty, after which its production gradually decreases to a minimum secretion in the older adult.⁷ Said decrease could partially explain many of the sleep disorders that older adults present with at that stage of life.^{1–6} Rather than presenting alone, those disorders are generally accompanied by other physical or psychologic comorbidities that deteriorate quality of life in the older adult.²³ Accordingly, it is common for persons to resort to medications to alleviate their symptoms, but often various pathologies coexist with sleep disorders, leading to the problem of polypharmacy, with its known consequences.^{12,13} Even though the objective of the present work was not to demonstrate that melatonin has a sleep-inducing effect and its quality and sleep patterns were not evaluated, melatonin would be expected to influence sleep induction, given that said association has been previously described.⁸

In response to that problem, alternative therapies are now implemented by healthcare professionals (nurses and general physicians) in an effort to provide a different approach in the treatment of numerous types of discomfort experienced by older adults.²⁴ Aromatherapy based on essential oils is one such alternative, whose application and therapeutic effects should be studied with the methodological rigor that modern-day science demands, taking into account anatomic and physiologic changes, as well as the self-regulation responses that characterize older adults.²⁵

Lavender (*Lavandula angustifolia*) was utilized in the present study and its active compounds are linalyl acetate and β -linalool, which because of their sedative, analgesic, and anxiolytic properties, have been used as alternative therapy in the treatment of pain, anxiety, and stress.^{26–28} The anxiolytic effect of lavender has been reported to be due to its inhibition of the voltage-dependent calcium channels primarily in the neurons of the hippocampal region.²⁹ Additional studies indicate that autonomic activation is suppressed with the use of lavender.²⁷ Aromatherapy has also been described to favor the excretion of endorphins into the plasma, and as a result, possibly reducing stress hormones.³⁰ Those phenomena could participate in the release of melatonin observed in our results.

Additionally, a small multicenter study evaluated the effects of aromatherapy with lavender on 24 older adults in assisted living facilities that suffered from anxiety and altered sleep patterns. The perceptions of the nursing personnel on the behavior of the patients, such as mood, activity, sleep quality, restlessness, and any change in medication use, were registered. According to the nurses' perception, 40% (n = 10) of the patients had a good/very good response to the intervention of aromatherapy with lavender.³¹

Even though the existing evidence shows promising results, data on the use of lavender in the treatment of behavioral problems in the older adult population, especially sleep disorders, must be thoroughly explained. The aim of our study was to evaluate the effects of the dispersion of lavender on melatonin concentrations in an apparently normal geriatric population. However, we recognize that the present protocol design was a limiting factor for our study, suggesting the need for a larger research, as well as future studies conducted on patients with sleep disorders. It should also be mentioned that in the present study no adverse effects were observed in the patients during the aromatherapy sessions.

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Declaration of Competing Interest

None.

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