

Research Progress of Essential Oils for Insomnia

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Abstract: Traditional insomnia medications can cause headaches, dizziness and drowsiness, while aromatherapy has a long history of treating insomnia, with essential oils being a relatively new field. Essential oils, as volatile oils extracted from plants, contain a large number of sesquiterpenes, and many researchers have found that sesquiterpenes are the main component of essential oils for insomnia. The available research has found that essential oils for insomnia are effective by a variety of chemical components, targets and mechanisms of action. Therefore, this paper focuses on the main chemical components, targets, and mechanisms of action of the current essential oils for insomnia to provide a basis for future research on the treatment of insomnia with essential oils.

Keywords: Insomnia; Essential Oils; Active Ingredients; Mechanism

1. Insomnia background

Sleep is essential to human existence and has an indispensable meaning to human life^[1]. Insomnia is a condition in which the body is distracted by environmental changes, physical or mental illnesses, which can lead to persistent difficulty falling asleep, maintaining sleep and waking up easily^[2]. Insomnia not only affects people's productivity, but can also lead to a reduction in quality of life; studies have shown that insomnia is a warning sign and a risk factor for suicidal behaviour^[3]. Current epidemiological surveys of the general population in China show that 15% of the population suffers from chronic insomnia^[4]. Long-term insomnia can prevent the brain from resting, leaving it in a state of fatigue and memory loss, which can seriously affect people's lives, studies and work.

The main cause of insomnia is the stress of life, school and work^[5]. Traditional treatments for insomnia have been based on benzodiazepine and non-benzodiazepine sedative-hypnotics, which are associated with headaches, dizziness and drowsiness, as well as addiction^[6]. Long-term use of benzodiazepines can lead to drug dependence and persistent insomnia^[7]. Non-benzodiazepine sedative-hypnotics can cause respiratory depression^[8].

Essential oils are concentrated hydrophobic liquids containing volatile aromatic compounds extracted from plants. Lavender essential oil, sweet orange essential oil and sandalwood essential oil have a sedative-hypnotic effect and are administered by inhalation to treat insomnia, thus acting as an anti-anxiety and anti-depressant^[9]; Valerian essential oil is administered orally to treat insomnia; compounded essential oils can improve the quality of sleep after PCI for coronary heart disease^[10]; Lavender essential oil can improve sleep quality and sleep efficiency in post-menopausal women with insomnia^[11], Lavender essential oil can also be used to treat diabetes through acupuncture. In addition, the preparation of lavender essential oil as a cream can prolong the release time of lavender essential oil, solving the problem of its short duration of action, thus playing a role in the treatment of insomnia^[12], the essential oil for the treatment of insomnia compounds are shown in Table 1.

Table 1 Compounds in essential oils for insomnia

Serial number	Compound name	Compound molecular formula	References
1	Dibutyl phthalate	C ₁₆ H ₂₂ O ₄	[9]
2	Graphene	C ₁₅ H ₂₄	[9] [10] [15]

3	Geranyl acetate	$C_{12}H_{20}O_2$	[9] [21]
4	Linalool	$C_{10}H_{18}O$	[9] [15] [21]
5	α -Pinoresinol	$C_{10}H_{18}O$	[9] [15] [21]
6	Pinoresin-4-ol (4-pinoresinol)	$C_{10}H_{18}O$	[9] [15] [21]
7	D-Limonene	$C_{10}H_{16}$	[9] [21]
8	Linalyl acetate	$C_{12}H_{20}O_2$	[9] [21]
9	α -Pinene	$C_{10}H_{16}$	[9] [21]
10	Nerolidol	$C_{10}H_{18}O$	[21]
11	Myristyl acetate	$C_{16}H_{32}O_2$	[21]

Figure 1 Structure of compounds in essential oils for insomnia

2. The main ingredients of essential oils for insomnia

It was found that a variety of components in various essential oils had some sedative-hypnotic effect, and it was speculated that it may not be a single substance that caused the sedative-hypnotic effect. Zhong Y et al. analyzed a combination of calming essential oils consisting of aromatic drugs with sedative-hypnotic effects, such as lavender essential oil, sweet orange essential oil and sandalwood essential oil, and found that dibutyl phthalate, geraniene, geranyl acetate, linalool, α -pinene alcohol and pinen-4-ol played a key role in the treatment of insomnia; the highest chemical components traced by GC-MS were D-limonene, linalyl acetate and α -pinene, which were also closely associated with the treatment of insomnia. Wang W et al. analyzed the essential oil of Valerian and found that nerolidol, geraniol and myristyl acetate played a key role in the treatment of insomnia by the volatile oil of Valerian^[13]. Wang C et al. analyzed the essential oil of incense and found that the sesquiterpenes isolated from incense were the most potent compounds, including geraniol, cardinales and eucalyptus terpenes, and predicted that cardinal sesquiterpenes may be the main medicinal components exerting sedative activity^[14]. Xu Y et al. analyzed the essential oil of lavender and found that linalool, linalyl acetate, α -pinoresinol, 4-pinoresinol, D-limonene, α -pinene and geranyl acetate played a key role in the treatment of insomnia^[15]. From the above findings, it is easy to see that the active ingredients in essential oils for insomnia are mostly sesquiterpenes. We can also conclude from the results of the above studies that essential oils are synergistic in the treatment of insomnia.

3. Oil administration methods

3.1 Massage

Massage for traditional Chinese medicine acupuncture points can effectively improve the quality of sleep, and its efficacy has been proven in clinical studies^[16]. The use of massage therapy with essential oils can effectively avoid side effects.

3.2 Sniffing

The aromatic substances in essential oils are inhaled nasally and act on the brain, promoting the release of neurological substances and thus regulating the body's vegetative nervous system, mobilising positive factors in the body and releasing various emotional messages to treat and prevent disease.

3.3 Aromatherapy

Aromatherapy mainly refers to the use of the scent of aromatic plants and the extraction of essential oils, which enter the body in various forms to achieve a toning effect. It is less likely to produce adverse reactions such as allergies and dizziness, so aromatherapy is more likely to be used. ^[17] .

4. The main targets of action of essential oils for insomnia

Yang et al. found that the treatment of insomnia with Sugammul-4 essential oil produces its effects through multiple components acting on multiple targets, with GABRA1, GABRA2, PTGS2, CAMC, NCOA2, SLC6A2, CHRM2, GABRA6, CHRM1, GABRA5, IL-6 as the main target proteins^[18]. Ren G et al. found that the compound tranquilizer essential oil also produced effects by acting on multiple targets, with ADRB2, DRD2, ESR1, KCNH2, NR1H4, NR1I2, NR1I3 and TRPV1 having good activity with docking molecules, with gastrodene having strong binding activity with NR1H4 and NR1I3^l. Wang Y et al. found that the lavender in the treatment of insomnia The effect of lavender in the treatment of insomnia was achieved by modulating the key targets ADRB1 and HLA-DRB1. From the above findings, it can be seen that the treatment of insomnia with essential oils is the result of the active compounds acting on multiple targets at the same time.

5. The main mechanisms of essential oils for insomnia

5-Hydroxytryptamine: 5-HT is a key mediator of neuronal signaling in the central nervous system, is involved in mammalian sleep processes, and leads to increased rapid eye movement (REM) sleep, non-rapid eye movement (NREM) sleep, and total sleep time, so its levels and function can have an impact on sleep.

Dopamine: one of the most abundant monoamine neurotransmitters in the brain. Huang Junshan et al. treated different insomnia patients with Song Yu An Shen formula and measured their plasma levels of 5-hydroxytryptamine and dopamine by high performance liquid chromatography, and found that the effect was due to an increase in 5-HT and a decrease in DA levels, thus improving sleep.

Norepinephrine: which is mainly distributed in the pontine blue spot, midbrain reticular formation and medullary reticular formation, has both excitatory and inhibitory effects on the central nervous system. The amount of NE in the brain during wakefulness is significantly higher than that during sleep.

Gamma-aminobutyric acid: is one of the inhibitory neurotransmitters in the central nervous system, which is widely distributed in the brain and spinal cord and is involved in the rapid inhibitory effects of postsynaptic neurons.

6. Summary and outlook

In summary, research into the components, modalities, targets and mechanisms of essential oils for the treatment of insomnia has revealed that the main components of essential oils for insomnia are linalyl acetate, linalool, sandalwood alcohol, D-limonene and stigmasterolene, and can also be used in combination with multiple essential oils to treat insomnia. There are many different ways of using essential oils such as acupressure, inhalation and aromatherapy, all of which have different effects. The target of action of essential oils for insomnia is determined by different receptors, and different ingredients act on multiple targets to treat insomnia; the mechanism of action of essential oils for insomnia is mainly on the

receptors of central neurotransmitters to treat insomnia.

Of course, there are still shortcomings in the current research on the treatment of insomnia with essential oils, such as the need for further improvement of experimental methods and the lack of objective and effective evaluation indicators; the lack of in-depth research on neurotransmitter receptors and their signaling pathways; and the lack of rigorous design of experimental protocols. All these shortcomings need to be improved in our future research. However, with the progress of science and technology, the in-depth research on the treatment of insomnia, and the deepening understanding of the mechanism of insomnia, we believe that the essential oil, as a new type of modern Chinese medicine, will be able to play a positive role in the development of medicine and health affairs of our country and the physical and mental health of all human beings.

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