

# The Medical Benefits of Vetiver Essential Oil

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**Abstract:** Vetiver essential oil (VEO) has been used century ago for religious and medical purposes. Vetiver plants are cultivated in tropical and subtropical countries. VEO contains sesquiterpenes compounds. VEO can be applied to treat neurological, psychiatric, dermatological, and musculoskeletal disorders. VEO has low toxicity and no carcinogenic effect. VEO has some pharmacological mechanism in medical treatments. The possible mechanisms are gamma aminobutyric acid (GABA) potentiation, antioxidant, antiinflammation, anti-stress, tissues regeneration, anti-microbe, and cytotoxic against cancer. VEO can be applied as topical and oral treatment.

## 1 INTRODUCTION

Vetiver essential oil (VEO) has been used century ago in north India then spreading to Southeast Asia, China, Middle East, West Africa, and Europe. VEO is used for religious and medical purposes (Maffei, 2002). VEO is made from distillation process of Vetiver plant (*Vetiveria zizanioides*). Vetiver plant in Indonesia is known as *akar wangi* or *narwastu*. Vetiver plants have been cultivated in Java island, especially West Java region. Indonesia is the top rank 3 producer in the world, after India and Haiti.

VEO has fragrant odour and pharmacological effects. Several studies report the effect of VEO as antioxidant, anti-inflammatory, anti-microbe, and neuroendocrine modulator. VEO has high economic value, because its property is not only for fragrance but for medicine. This paper will discuss the benefits of VEO for human health and the pharmacological mechanisms.

### 2.1 The History of Vetiver Plant and Essential Oil

The origin of Vetiver plant is north India. It is called *Khas Khas*. There are several names in Sanskrit, namely Virana, Lamajjaka, Lamaja, Bala, or Turushka-danda (turushka = fragrant compound, danda = stem). Vetiver plant is known as Saewaendara or Vettyveer in Sri Lanka. Vetiver

plants were spread from Sri Lanka to Europe then called Vetiver until now. Vetiver plants are cultivated in tropical and subtropical countries, e.g. Southeast Asia (Indonesia, Malaysia, Burma, Thailand, Laos, Philippines), China (south region), Middle East (Iran), Africa (Nigeria, Ethiopia, Ghana, Senegal, Sierra Leone, Reunion, South Africa, Zambia, Zimbabwe), South America (Puerto Rico, Haiti, Costa Rica, Honduras, Guatemala, Mexico) (Maffei, 2002). Vetiver is called as *akar wangi*, *larasetta*, or *usar* in Indonesia. Botanical name of Vetiver is *Vetiveria zizanioides* (L.) Nash, *Andropogon muricatus* (Retz), *Andropogon zizanioides* (L.) Urban, *Chrysopogon zizanioides* (L.) Roberty, or *Phalaris zizanioides* L. (Tisserand and Young, 2014).

The root and leaf (stem) of Vetiver plant have some benefits. The root is proceeding to produce essential oil. The raw root has benefits as room or container fragrance and bio pesticide. The leaf (stem) can be used for animal food and handicraft. The Vetiver plants are useful in soil erosion prevention, soil conservation and restoration. The root of Vetiver reach until 2 m in depth. The main producers in the world are India, Haiti, and Indonesia, however the best quality are from Reunion and Haiti (Maffei, 2002).

VEO has been used on Ayurveda medicine in South Asia (India, Pakistan, Sri Lanka, Nepal). VEO used into religious purposes because it was belief to

avoid evil and its fragrance has relaxing effect in praying. Traditional medicine used VEO to draw out evil from sick person. The root of Vetiver was stirred and drunk as treatment for fever, digestive illness, and diarrhoea. VEO was rubbed onto skin to treat burn wound (Maffei, 2002).

## 2.2 Vetiver Essential Oil Characteristics

VEO contains sesquiterpenes and hydrocarbon compounds. Sesquiterpenes precursor is farnesyl diphosphate. Basic structure sesquiterpene consist of 15 atoms carbon. Sesquiterpenes have large molecules and less volatile. Hydrocarbons are hydrophobic (Tisserand and Young, 2014). VEO contains more than 75 sesquiterpenes, namely monocyclic sesquiterpenes, bicyclic sesquiterpenes, tricyclic sesquiterpenes, and tetracyclic sesquiterpenes (Maffei, 2002).

The compounds of VEO list are available in Table 1. The maximum topical (dermal) application is 15% (from Java-Indonesia, China, Brazil, Mexico) because they contain isoeugenol. VEO from Haiti, India, Reunion, and El Salvador does not contain isoeugenol. Isoeugenol is weak acid which is corrosive for cells and tissues (Tisserand and Young, 2014). However, study by Champagnat et al. (2005), reported that VEO compositions from 9 countries, namely Brazil, China, Haiti, India, Indonesia, Madagascar, Mexico, Reunion, El Salvador) were not significantly different. VEO compositions were relatively homogeneous with the main compositions were khusimol,  $\beta$ -vetivenene and  $\beta$ -vetispirene. The main compound was sesquiterpene (Champagnat et al., 2006).

Study by Kadarohman et al. (2013), reported VEO quality from organic and non-organic Vetiver plants. The quality of organic was better than non-organic. Physically, organic VEO was more concentrate and no black spot. Chemically, VEO organic contains less pesticide residue and higher level of vetiverol (Kadarohman et al., 2013). The different cultivations show no significant difference in VEO composition. Study by Pripdeevch et al. (2006), reported that cultivation in normal soil, normal soil plus microbes, and semi hydroponic, then extracted by steam distillation and solvent extraction apparatus, showed no significant difference in VEO composition (Pripdeevch et al., 2006).

There are not any dangerous effects that caused by VEO. Acute (few hours until days) and subacute (45-90 days) exposures do not show significant

toxicity. Skin hypersensitivity can occur but it is very rare and the incidence is 0.5%. The acute oral toxicity ( $LD_{50}$ ) is  $> 5g/kg$  and dermal toxicity is  $> 5g/kg$ . VEO does not show carcinogenic effect (Tisserand and Young, 2014).

Table 1: The composition of vetiver essential oil.

Khusimol (zizanol)	3,4 – 13,7%
Vetiselinenol (isonootkatol)	1,3 – 7,8%
Cyclocopacamphan-12-ol (epimer A)	1,0 – 6,7%
$\alpha$ -Cadinol	0 – 6,5%
$\alpha$ -Vetivone (isonootkatone)	2,5 – 6,4%
$\beta$ -Vetivenene	0,2 – 5,7%
$\beta$ -Eudesmol	0 – 5,2%
$\beta$ -Vetivone	2,0 – 4,9%
Khusenic acid	0 – 4,8%
$\beta$ -Vetispirene	1,5 – 4,5%
$\gamma$ -Vetivenene	0,2 – 4,3%
$\alpha$ -Amorphene	1,5 – 4,1%
(E)-Eudesm-4(15),7-dien-12-ol	1,7–3,7%
b-Calacorene	0–3,5%
g-Cadinene	0–3,4%
(Z)-Eudesm-6-en-11-ol	1,1–3,3%
g-Amorphene	0–3,3%
Ziza-5-en-12-ol	0–3,3%
b-Selinene	0–3,1%
(Z)-Eudesma-6,11-diene	0–2,9%
Salvial-4(14)-en-1-one	0–2,9%
Khusinol	0–2,8%
Cyclocopacamphan-12-ol (epimer B)	1,1–2,7%
Selina-6-en-4-ol	0–2,7%
Khusian-ol	1,5–2,6%
d-Amorphene	0–2,5%
1-epi-Cubenol	0–2,4%
Khusimene (ziza-6(13)-ene)	1,1–2,3%
Ziza-6(13)-en-3b-ol	0–2,3%
Ziza-6(13)-en-3-one	0–2,3%
2-epi-Ziza-6(13)-en-3a-ol	1,0–2,2%
12-Nor-ziza-6(13)-en-2b-ol	0–2,2%
a-Vetispirene	0–2,2%
Eremophila-1(10),7(11)-diene	0,9–2,1%
Dimethyl-6,7-bicyclo-[4,4,0]-deca-10-en-one	0–2,0%
10-epi-g-Eudesmol	0–1,8%
a-Calacorene	0,4–1,7%
(E)-Opposita-4(15),7(11)-dien12-ol	0–1,7%
Prekhusenic acid	0–1,6%
13-Nor-eudesma-4,6-	0,6–1,5%

dien-11-one	
Isovalencenol	0–1.5%
Spirovetiva-1(10),7(11)-diene	0–1.5%
2-epi-Ziza-6(13)-en-12-al	0–1.5%
(E)-Isovalencenal	0.7–1.4%
Preziza-7(15)-ene	0.6–1.4%
(Z)-Eudesma-6,11-dien-3b-ol	0–1.4%
Intermedeol (eudesm-11-en-4-ol)	0–1.3%
Isoeugenol	0–1.3%
Isokhusenic acid	0–1.3%
Elemol	0.3–1.2%
Eremophila-1(10),6-dien-12-al	0–1.2%
Juniper camphor	0–1.2%
Khusimone	0.5–1.1%
Eremophila-1(10),4(15)-dien-2a-ol	0–1.1%
Eremophila-1(10),7(11)-dien-2b-ol	0–1.1%
(Z)-Isovalencenal	0–1.1%
allo-Khusiol	0–1.1%
Methyl-(E)-eremophila-1(10),7(11)-dien-12-ether	0–1.1%
(E)-2-Nor-zizaene	0–1.1%
(Z)-Eudesm-6-en-12-al	0–1.0%
Funebran-15-al	0–1.0%

### 2.3 Pharmacological Effects of Vetiver Essential Oil

Traditional medicine in South Asia especially India used dried root, infused root or stem/leaf in boiling water, to treat illness e.g. headache, fever, diarrhoea, dysentery, malaria, epilepsy, snake bite, burn. Vetiver root treat patient by cooling and calming effect. VEO has some pharmacological effects, e.g. antioxidant, antiinflammation, antifungal, anti-parasite, antibacterial, hepatoprotective, antidepressant, antianxiety, antihyperglycemia (Zahoor et al., 2018).

VEO has antifungal effect against *Aspergillus fumigatus*, *Microsporium canis*, *Trichophyton, interdigitale*, *T. mentagrophytes*, *T. rubrum*, *Candida albicans*, *Aspergillus nigra*, *Aspergillus clavatus* (Zahoor et al., 2018; Petersen, 2014). VEO has antibacterial effect against *Mycobacterium tuberculosis*, *Mycobacterium smegmatis*, gram positive bacteria (*S. aureus*, *B. subtilis*), and gram negative bacteria (*P. aeruginosa*, *E. coli*). VEO can kill mosquito larva *Aedes aegypti* and lethal to *Trichomonas vaginalis* (Petersen, 2014). VEO has antiparasitic effect e.g. against nematode. Study by Jindapunnapat et al. (2018), showed nematotoxic

effect against *Meloidogyne incognita*. VEO cause mortality of *Meloidogyne incognita* 40-70% (Jindapunnapat et al., 2018).

The nervous system mainly brain can be affected by VEO. VEO can travel across blood brain barrier. VEO has benefits in case seizure, migraine, anxiety, tremor, post-traumatic stress disorder (PTSD). Study by Gupta et al. (2013), showed ethanol extract of *Vetiveria zizanioides* has anti-convulsion effect. Oral dose Vetiver extract 200 mg/kg and 400 mg/kg could prevent convulsion. This effect was similar to oral phenobarbital 20 mg/kg. The anti-convulsion mechanism perhaps through gamma aminobutyric acid (GABA). GABA is inhibitory neurotransmitter which prevent convulsion (Gupta et al., 2013).

VEO has sedative and calming effect. VEO is used to reduce stress, anxiety, and depression. VEO induces relaxation and sleep via GABA potentiation. Sesquiterpenes have a role to stimulate GABA. VEO is useful to treat jetlag (Chomchalow, 2000). GABA stimulates limbic system in brain in order to calm and relax. VEO decreased anxiety and depression score on Hamilton Anxiety Rating Scale (HAM-A) and Hamilton Depression Rating Scale (HAM-D). VEO reduced stress hormone level e.g. cortisol. Several studies showed the benefits of VEO to treat hyperactivity children in Attention Deficit Hyperkinetic Disorder (ADHD). VEO is useful to treat emotional conditions and distress e.g. apathy, desperate, disconnected, scattered, unladen, want to escape, crisis (MacDonald, 2013). Study by Saiyudthong et al. (2014), reported inhalation aromatherapy VEO against rat's anxiety behavior. Inhalation 2.5% VEO was similar to diazepam 1 mg/kg i.p. to reduce anxiety behavior and increased c-fos protein expression in lateral division of central amygdaloidal nucleus (Saiyudthong et al., 2015). Amygdala is a part of limbic system in brain which has function to regulate mood and emotion.

VEO has anti-inflammatory and antioxidant effects. VEO has been used to treat rheumatism, muscular and joints illness. VEO enhances blood flow and oxygenation to tissues (Chomchalow, 2000). VEO becomes one of oils composition to treat musculoskeletal pain (Parris, 2017).

VEO has benefits for skin problems. VEO rejuvenates skin, relieves acne, normalizes oily skin, moisturizes dry skin, reduces tyrosinase enzyme activity (inhibit melanogenesis / skin pigmentation), decreases lipid peroxidation (decreases malondialdehyde level), increases endogenous antioxidants (superoxide dismutase, catalase, glutathione peroxidase). Nowadays VEO has been

applied to skincare products (Chomchalow, 2000; Burger et al., 2017; Peng et al., 2014).

VEO is cytotoxic to cancer cells. Study by Powers et al. (2018), showed the cytotoxic effect of VEO against breast cancer cells (Powers et al., 2018). VEO also had cytotoxic effect against mouth epidermal carcinoma and colon cancer cells (Tisserand and Young, 2014). It seems promising, however it still need further investigations about the exact mechanisms.

### 2.3 Potency of Vetiver Essential Oil in Health Industry

VEO has promising role in health or medical treatment. VEO can be applied in many products e.g. ointment, balm, cream, shampoo, soap, and aromatherapy. Indonesia is rank as the third biggest producer in the world however it needs to improve high quality, especially to treat smoky burn smell and pesticide contamination. VEO can be useful for children until elderly. VEO can be developed as topical and oral products.

## 4 CONCLUSIONS

VEO has benefits as antifungal, antibacterial, anti-parasite, anti-convulsion, sedative, antianxiety, antidepressant, antioxidant, antiinflammation, analgesic, skin antiaging, and cytotoxic against cancer. VEO can be useful in to treat neurological, psychiatric, dermatological, and musculoskeletal disorders.

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