Linalool: Human health tier II assessment

21 April 2016

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
1,6-Octadien-3-ol, 3,7-dimethyl-	78-70-6
1,6-Octadien-3-ol, 3,7-dimethyl-, (S)-	126-90-9
1,6-Octadien-3-ol, 3,7-dimethyl-, (R)-	126-91-0

Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to

human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit:**www.nicnas.gov.au**

Disclaimer

ACRONYMS & ABBREVIATIONS

Grouping Rationale

Linalool is a terpenoid alcohol that is biosynthesised from different plant species as the enantiomers: *d*-linalool (or (*S*)-isomer) (CAS No. 126-90-9) and *l*-linalool (or (*R*)-isomer) (CAS No. 126-91-0). Commercial linalool generally exists as the racemic form *dl*-linalool (CAS No. 78-70-6) (OECD, 2002). While linalool has different enantiomeric forms and specific natural sources will have specific enantiomers present, little information is available as to whether 'linalool' is truly racemic or if one or the other enantiomers is generally found (PubChem). Available animal and human toxicity studies rarely specify the isomeric composition of linalool; therefore, the data in this assessment are for unspecified linalool unless stated otherwise.

The pure enantiomers possess different and distinct odour properties: *d*-linalool has a herbaceous smell and *l*-linalool has a woody, lavender odour (OECD, 2002; Ozek et al., 2010).

Import, Manufacture and Use

Australian

No specific Australian use, import, or manufacturing information has been identified.

International

The following international uses have been identified through the European Union (EU) Registration, Evaluation and Authorisation of Chemicals (REACH) dossiers; the Organisation for Economic Cooperation and Development (OECD) Screening information data set International Assessment Report (SIAR); Galleria Chemica; the Substances and Preparations in the Nordic countries (SPIN) database; the European Commission Cosmetic Ingredients and Substances (CosIng) database; the

United States (US) Personal Care Product Council International Nomenclature of Cosmetic Ingredients (INCI) Dictionary; Household Products Database; and the US National Library of Medicine's Hazardous Substances Data Bank (HSDB).

The chemicals have reported cosmetic uses as fragrance ingredients. Linalool (CAS No. 78-70-6) and *l*-Linalool (CAS No. 126-91-0) are included in the list of fragrance ingredients used in consumer goods published by the International Fragrance Association (IFRA).

The chemicals are components of natural essential oils, aromatic herbs and spices (including lavender, coriander, basil and bergamot) with many uses including in traditional medicines (OECD, 2002).

The chemicals have reported domestic/commercial uses including in:

- adhesives (binding) agents;
- cleaning and bleaching agents;
- paints, lacquers and varnishes;
- lubricant and additives; and
- odour agents.

The chemicals have reported non-industrial uses including in:

- non-agricultural pesticides and insecticides; and
- processed food and beverages.

Restrictions

Australian

No known restrictions have been identified.

International

The chemical (CAS No. 78-70-6) is listed on the following (Galleria Chemica):

- EU Cosmetics Regulation 1223/2009 Annex III—List of substances which cosmetic products must not contain except subject to the restrictions laid down (must be indicated in the list of ingredients when the concentration exceeds 0.001 % in leave-on products and 0.01 % in rinse-off products); and
- New Zealand Cosmetic Products Group Standard—Schedule 5: Components cosmetic products must not contain except subject to the restrictions and conditions laid down.

Existing Worker Health and Safety Controls

Hazard Classification

The chemical is not listed on the Hazardous Substances Information System (HSIS) (Safe Work Australia).

Exposure Standards

Australian

No specific exposure standards are available.

International

The following exposure standards are identified for the chemical (CAS No. 78-70-6) (Galleria Chemica).

Time weighted average (TWA) of:

- 111–150 mg/m^3 (20–25 ppm) in Canada, Estonia and Sweden; and
- 5 mg/m^3 in Russia.

Short-term exposure limits (STEL) of:

- 300 mg/m^3 (50 ppm) in Estonia and Sweden.

Health Hazard Information

Except where specifically stated, the test substance is *dl*-linalool.

Toxicokinetics

The chemical is readily absorbed via oral, dermal and inhalation exposure. Following oral administration in rats, the chemical was rapidly absorbed through the gastrointestinal tract and metabolised. The major metabolites were identified as 8-hydroxylinalool and 8-carboxylinalool. The excretion was via urine (60 %, rapid process), in expired air as carbon dioxide (23 %, intermediate rate) and in the faeces (15 %, delayed). Delayed excretion in the faeces (36–48 hours after administration) suggested entero-hepato-biliary recirculation (OECD, 2002; REACH).

The chemical is auto-oxidised when exposed to air, forming two stable hydroperoxides: linalool-7-hydroperoxide (7-hydroperoxy-3,7-dimethyl-octa-1,5-diene-3-ol) and linalool-6-hydroperoxide (6-hydroperoxy-3,7-dimethyl-octa-1,7-diene-3-ol). These hydroperoxides readily form adducts with skin proteins and are responsible for the skin sensitising properties of the chemical in both animal and human studies. Subsequent oxidation of the hydroperoxides in the human skin produces the electrophilic epoxides (6,7-epoxy-linalool), which contributes to the allergenic properties. Apart from auto-oxidation, epoxides can also be formed by cytochrome P450 catalysed biotransformation in human skin (SCCNFP, 2003; Meesters, Duisken & Hollender, 2007).

Acute Toxicity

Oral

The chemical has low acute toxicity in animal tests following oral exposure.

The median lethal doses (LD50) range from 2790–3120 mg/kg bw in rats and mice. Sublethal signs of toxicity in mice include neurological effects (hypomotility with ataxia, sedation, depression) and breathing difficulties. Observations in rat studies included increased absolute and relative liver weights and decreased microsomal protein content (OECD, 2002; HSDB).

Dermal

The chemical has low acute toxicity following dermal exposure.

The reported dermal LD50s were 5610 mg/kg bw in rats and range from 2000–5610 mg/kg bw in rabbits (HSDB).

Inhalation

The information available is not sufficient to derive a conclusion on acute inhalation toxicity of the chemical.

A median lethal concentration (LC50) of >5620 ppm (35.5 mg/L) has been reported for avian species (details not available) (OECD, 2002).

In an inhalation study (non-guideline), mice exposed (whole body) to the chemical vapour at 3.2 mg/L for 90 minutes had no mortalities. The LC50 was >3.2 mg/L. Decreased motility in mice was reported (REACH).

Observation in humans

An electroencephalography (EEG) study was conducted in adults aged 20–26 to investigate the sedative and sensory properties of several isomers of the chemical. The concentrations used were not reported. Decreasing β-waves indicative of sedation were observed in individuals exposed to *l*- and *dl*-linalool, while the contrary was observed for *d*-linalool (HSDB).

Corrosion / Irritation

Skin Irritation

The available information indicates that the chemical is a skin irritant which warrants hazard classification.

In three skin irritation studies conducted according to the OECD Test Guideline (TG) 404, the chemical was applied (semi-occlusively) on the skin of albino rabbits (n = 3–4) for four hours, with observation up to seven days. Erythema was observed until day seven, with a mean value (24–72 hours) of two in one test (score = 2 in all four rabbits tested). In the other two tests, a score of two was recorded for 2/3 test subjects. Desquamation (peeling skin) was reported from days one to seven. The mean score for oedema was <1.4 in all three tests. The Primary Irritation Index was calculated to be >3 in two studies and >2 in one. Based on the observations, the chemical was considered to be irritating to the skin (OECD, 2002; REACH).

In other skin irritation studies conducted in rabbits (doses of 100-500 mg, with 24 hours exposure), 4/5 studies reported the chemical causing skin irritation (OECD, 2002). Irritation scores were not available.

Eye Irritation

Based on the available data, the chemical is not considered to be an eye irritant.

In an eye irritation study (OECD TG 405), the undiluted chemical (0.1 mL) was instilled into the conjunctival sac of one eye of Vienna White rabbits (n = 3) and observed for up to 15 days. After one hour, all animals displayed well-defined chemosis and conjunctival redness, and increased eye discharge. Other effects observed were constricted pupils, loss of hair at the margins of the eyelids and corneal tissue, marginal vascularisation of the cornea, and eyelid retractions. The mean scores for all timepoints post application (24, 48 and 72 hours) were 0.4 for chemosis, 0.6 for iritis, 1.0 for corneal effects and 2.3 for conjunctival redness. Effects were fully reversible within 15 days. The chemical was only mildly irritating to the eyes of rabbits (HSDB, REACH).

In another eye irritation study (OECD TG 405), New Zealand White rabbits (n = 6/dose) were instilled with 0.1 mL of the chemical (undiluted, 30 %, 10 % or 3 % in groundnut oil) into one eye of each rabbit. Observations were made for up to seven days. Only the undiluted chemical was found to be moderately irritating to the animals, but the effects were reversible within seven days. The mean scores for the undiluted chemical at all timepoints post application (24, 48 and 72 hours) were 0.2 for chemosis, 0.4 for iritis, 1.0 for corneal opacity and 2.3 for conjunctival redness. No adverse effects were observed for the other concentrations (REACH).

Observation in humans

The available human data indicate that the chemical causes slight skin irritation and at most, moderate eye irritation.

In three patch tests, the chemical did not irritate skin when applied (occlusively) at concentrations up to 20 % in petrolatum for 48 hours. In two other tests, the chemical (48 mg in one test and at 32 % in acetone in another) was reported as mildly irritating to the skin (OECD, 2002). No other details are available.

In a study with anosmic (loss of sense of smell, n = 4) and normosmic (normal sense of smell, n = 4) human volunteers, the chemical caused eye irritation at a vapour concentration of ~320 ppm (2019 mg/m^3) in two-thirds of the subjects. The threshold for nasal pungency in the anosmic humans was found to be close to this concentration. The chemical was concluded to be, at most, a moderate eye irritant in this study (OECD, 2002; HSDB).

Sensitisation

Skin Sensitisation

The chemical, in its highly purified form, might be a weak skin sensitiser. The chemical is auto-oxidised when exposed to air. This oxidised form is a potent skin sensitiser (see **Toxicokinetics**). Similarly to limonene (NICNAS), this is considered sufficient to warrant hazard classification for the chemical.

A local lymph node assay (LLNA) (OECD TG 429) was conducted using the commercially available chemical (97 % purity re-purified to 98.6 % purity) at concentrations of 0, 25, 50 or 100 % on CBA mice. The undiluted chemical caused positive skin reactions; however, this could also be attributed to its irritation properties (see **Irritation: Skin**). The commercially available chemical was shown to be a weak skin sensitiser with a calculated EC3 (effective concentration needed to produce a three-fold increase in lymphocyte proliferation) value of 30 %, whereas purification reduced the sensitising potential (EC3 of 53 %). For the undiluted chemical, the stimulation indices (SI) obtained were 8.3 (original) and 4.9 (purified) (REACH). Although the study authors indicated that skin sensitisation could be caused predominantly by the impurities present in the commercially available chemical, even the purified form of the chemical gave an SI value above the threshold value (SI > 3).

Another mouse LLNA assay was performed with air-exposed samples containing oxidation products of the chemical. Positive responses were observed with a higher maximum SI (=12.7) (REACH).

In a Freund’s complete adjuvant test (OECD TG 406) in guinea pigs (n = 15/dose), the pure chemical (97 %) and oxidised form (air-exposed for 10 weeks, containing ~80 % of the chemical) were used to evaluate the skin sensitising potential. No skin sensitisation was observed for the pure chemical. For the oxidised form, significant responses were found at challenge concentrations of 2.6, 5.1 and 10.3 %, but not at 1.0 %. The authors of this study concluded that the chemical in its pure form was a non-sensitiser and the allergenic properties resulted from its exposure to the air (REACH).

Observation in humans

Several human patch tests (n > 2000) have resulted in the pure chemical (10–20 % concentrations) having extremely weak to no sensitising potential. Data are available from different European clinics (Germany, Austria and the Netherlands). Positive reactions were consistently below 1 % for subjects not pre-sensitised, and nearly 10 % for subjects pre-sensitised to fragrance compounds (OECD, 2002). A case report of a positive result in a 52-year-old man exposed to various cosmetic products that contained the chemical as a fragrance ingredient has been published (OECD, 2002).

Clinical studies have shown a direct association between contact dermatitis and the oxidised chemical or its hydroperoxide fraction. In a European multi-centre study (2002–2003) conducted on 1511 consecutive patients, 1.3 % showed positive reactions to the oxidised chemical and 1.1 % to the hydroperoxide fraction. A study conducted in 2010–2011 involving 2900 dermatitis patients at nine centres in six countries (Spain, Denmark, Sweden, the United Kingdom, Australia and Singapore) revealed a positive rate of 6.9 % to a patch test following exposure to the oxidised chemical (6 % in petrolatum) (SCCP, 2012; Swedish Chemicals Agency, 2014).

Some studies were conducted on oxidised lavender oil containing 35–40 % of the chemical as *l*-linalool as the main component. Lavender oil is susceptible to oxidation and hydroperoxides were the identified primary allergens. In a nine-year study in Japan (1990–1998), the number of positive patch test reactions to lavender oil was reported to increase annually among patients with a suspected cosmetic allergy. This was associated with the increased use of aromatherapy with lavender oil in Japan. In three other case studies, sensitisation was resolved after complete avoidance of lavender oil (Swedish Chemicals Agency, 2014).

Repeated Dose Toxicity

Oral

Based on the data available, the chemical is not considered to cause serious damage to health from repeated oral exposure.

In a repeated dose oral toxicity study (OECD TG 407), Sprague Dawley (SD) rats (n = 10/sex/dose) were administered coriander oil (containing 72.9 % of the chemical as *d*-linalool), by oral gavage at doses of 160, 400 or 1000 mg/kg bw/day, for 28 days. One female and one male from the high dose group were found dead on days two and nine, respectively. Clinical effects observed were treatment-related increases in total protein and serum albumin levels in males (400 mg/kg bw/day) and in both sexes at the highest dose; and increased serum calcium in males (1000 mg/kg bw/day). Kidney lesions were reported in the high-dose males only, and were reported to be due to alpha-2µ-globulin nephropathy which is not relevant to humans. Prominent liver effects (increased liver weights in both sexes and periportal cytoplasmic vacuolisation in females) and stomach effects (thickening of the mucosa and erosion) were observed at doses ≥400 mg/kg bw/day. Stomach lesions were considered to be due to the irritant properties of the chemical. A no observed adverse effect level (NOAEL) of 160 mg/kg bw/day was established (OECD, 2002; REACH).

In another repeated dose toxicity study, male Wistar rats were administered the chemical (gavage) at 500 mg/kg bw/day for 64 days. No deaths occurred. Effects observed were limited to biochemical changes in liver enzymes, and a slight increase in liver weights after day 30. These effects were considered as a physiological adaptation to metabolise the chemical, rather than a toxicological response. The NOAEL was determined to be 500 mg/kg bw/day (OECD, 2002).

Dermal

The chemical is not considered to cause serious damage to health from repeated dermal exposure.

In a repeated dose dermal toxicity study (OECD TG 411), the chemical was applied topically to SD rats (n = 20/sex/dose) at doses of 250, 1000 or 4000 mg/kg bw/day for 91 days. Mortalities (nine females and two males), neurotoxicity (lethargy, depressed motor activity), depressed food consumption (males), increased liver weight (both sexes) and kidney weight (females only) were observed in the high dose group. Slight erythema was observed in all animals, and persisted until week 13 in the high dose group. A treatment-related increased incidence of squamous epithelial hyperplasia was observed, ranging from very slight in the controls to slight/moderate in the high dose group. An NOAEL for local effects of 250 mg/kg bw/day was established (REACH), while no systemic toxicity effects were reported at 250 or 1000 mg/kg bw/day.

Inhalation

No data are available.

Genotoxicity

Based on the available data, the chemical is not considered genotoxic.

The chemical gave mostly negative results in several in vitro assays (OECD, 2002; REACH):

- negative results in several bacterial reverse mutation assays with strains of *Salmonella typhimurium* and *Escherichia coli*, with or without metabolic activation;

- mixed results in two recombination assays with *Bacillus subtilis* (positive at a concentration of 10 µL/disc and negative at 17 µL/disc);
- no induction of chromosomal aberrations in Chinese hamster ovary (CHO) cells, with or without metabolic activation, and Chinese hamster lung V79 (CHL) fibroblast cells without metabolic activation; and
- negative results in an L5178Y mouse lymphoma cell forward mutation assay, with or without metabolic activation.

In one in vivo micronucleus study, CD-1 mice received a single oral dose of the chemical at 500, 1000 or 1500 mg/kg bw. Cyclophosphamide (CP) was used as the control. The mice were euthanised and bone marrows were sampled at 24 hours post application, or at 48 hours for the highest dose. No increase in the frequency of micronucleated polychromatic erythrocytes was observed in the treated animals compared with the negative control. The chemical was not mutagenic (REACH).

Carcinogenicity

Based on the limited information available, the chemical is not considered to be carcinogenic.

No animal carcinogenicity studies are available with relevant routes of exposure. In a carcinogenicity study (non-guideline), A/He mice (n = 15/sex/dose) were intraperitoneally injected with the chemical (in 0.1 mL tricaprylin) at doses of 600 or 3000 mg/kg bw/day, three times/week for eight weeks. The animals were euthanised at week 24. No increased incidence of pulmonary tumours was observed up to the highest dose. The authors concluded that the chemical was negative for pulmonary tumour response under the conditions of this study (HSDB; REACH).

In a tumour-promotion study, female SD rats (n = 50) were administered the chemical (1 % in diet) for 20 weeks. 7,12-Dimethylbenz(a)anthracene (DMBA) was administered as a single dose to induce mammary tumours. The chemical did not significantly change tumour latency or affect the number of tumours observed compared with controls (OECD, 2002; REACH).

In another study, the tumour-promoting effect was investigated in mice exposed to the chemical (20 % in acetone), once a week for 13 weeks. Skin tumour formation was topically induced with 9,10-dimethyl-1,2-benzanthracene. A weak response was reported (REACH).

Based on the long history of human exposure to these chemicals as constituents of herbs used for flavouring and aromatic properties, no carcinogenic effects in humans are expected.

Reproductive and Developmental Toxicity

Based on the available data, the chemical is not considered to have reproductive or developmental toxicity.

In a combined reproductive and developmental toxicity study (OECD TG 421), female rats were administered coriander oil (containing 72.9 % of the chemical as *d*-linalool) by gavage at doses of 0, 250, 500 or 1000 mg/kg bw/day. The treatment period was from seven days premating to postnatal day (PND) four. In the first filial (F1) generation, excess salivation and increased body weight gain and food consumption during gestation were observed at all doses. At the highest dose, a significant number of dams had urine-stained abdominal fur during the premating period, and several rats displayed ataxia and decreased motor activity. Significant decreases in body weight gain and food consumption were also reported at this dose. For the offspring, adverse effects were only observed at the highest dose, with increased pup mortality and decreased litter size (in utero foetal deaths). In the absence of significant maternal toxicity, the reproductive and developmental parameters were not affected. The maternal and developmental NOAELs were established as 500 mg/kg bw/day (OECD, 2002; REACH).

In a developmental toxicity study conducted according to a US Food and Drug Administration (FDA) guideline, pregnant SD rats (n = 25/dose) were administered (gavage) the chemical in corn oil at 0, 250, 500 or 1000 mg/kg bw/day on gestational days (GD) 7–17. There were no maternal deaths, gross lesions or clinical symptoms that were considered related to the treatment. At the highest dose, reduced food consumption and mean body weight gains were observed during the dosing period. These effects were reversed during the post dosing (recovery) period. Developmental parameters (litter size and gross external, soft tissue or skeletal foetal alterations) were not affected up to the highest dose. The maternal and developmental NOAELs were 500 and 1000 mg/kg bw/day, respectively (HSDB; REACH).

Other Health Effects

Neurotoxicity

The chemical is a component in natural products (essential oils, aromatic herbs and spices), and used in traditional medicines specifically for sleep-inducing and anticonvulsant purposes (OECD, 2002).

A few acute and repeat dose toxicological studies in animals indicate some transient neurotoxic effects such as decreased motility with acute inhalation exposure to the chemical at 3.2 mg/L; lethargy, depressed motor activity at very high repeated dermal exposure; ataxia and decreased activity in dams with exposure to the chemical during the premating period in reproductive toxicity studies (OECD, 2002; REACH).

A response of the nasal trigeminal receptors in rats was detected following inhalation exposure to 45 ppm (0.3 mg/L) of the chemical, indicating neurotoxicity (HSDB).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include local effects (skin sensitisation and, at high concentrations, skin irritation).

Public Risk Characterisation

Based on the international uses identified, the chemical may be used in cosmetics and domestic products in Australia as a fragrance ingredient. The general public could be exposed to the chemical when using cosmetics or domestic products in which it is used.

Internationally, there are concentration restrictions on using these chemicals in cosmetics/domestic products (must be indicated in the list of ingredients when the concentration exceeds 0.001 % in leave-on products and 0.01 % in rinse-off products), but there are no restrictions in Australia on their use in cosmetics or domestic products. However, only low hazards are identified for these chemicals and only low concentrations are expected in consumer products (due to their use as fragrance ingredients). While the oxidation products are potentially hazardous (skin sensitisation), these will be present at lower concentrations in consumer products. Consumer products containing these chemicals can oxidise over time; therefore, products that contain relatively high concentrations but used infrequently and have long shelf-lives could contain oxidation products that could pose a sensitisation hazard to sensitive individuals. This oxidation potential in consumer products could be reduced by incorporating an anti-oxidant. The risk to public health is not considered to be unreasonable and further risk management is not considered necessary for public safety.

Occupational Risk Characterisation

During product formulation, dermal exposure might occur, particularly where manual or open processes are used. These could include transfer and blending activities, quality control analysis, and cleaning and maintaining equipment. Worker exposure to these chemicals at lower concentrations could also occur while using formulated products containing these chemicals. The level and route of exposure will vary depending on the method of application and work practices employed.

Given the critical health effects, the chemicals could pose an unreasonable risk to workers unless adequate control measures to minimise dermal exposure are implemented. The chemicals should be appropriately classified and labelled to ensure that a person conducting a business or undertaking (PCBU) at a workplace (such as an employer) has adequate information to determine the appropriate controls.

NICNAS Recommendation

Assessment of the chemicals is considered to be sufficient, provided that the recommended amendment to the classification is adopted, and labelling and all other requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.

Regulatory Control

Public Health

Products containing the chemicals should be labelled in accordance with state and territory legislation (SUSMP, 2014).

Work Health and Safety

The chemicals are recommended for classification and labelling under the current approved criteria and adopted GHS as below. This assessment does not consider classification of physical and environmental hazards.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Irritation / Corrosivity	Irritating to skin (Xi; R38)	Causes skin irritation - Cat. 2 (H315)
Sensitisation	May cause sensitisation by skin contact (Xi; R43)	May cause an allergic skin reaction - Cat. 1 (H317)

[a] Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)].

[b] Globally Harmonized System of Classification and Labelling of Chemicals (GHS) United Nations, 2009. Third Edition.

[*] Existing Hazard Classification. No change recommended to this classification

Advice for consumers

Products containing the chemicals should be used according to the instructions on the label.

Advice for industry

Control measures

Control measures to minimise the risk from dermal exposure to the chemicals should be implemented in accordance with the hierarchy of controls. Approaches to minimise risk include substitution, isolation and engineering controls. Measures required to eliminate, or minimise risk arising from storing, handling and using a hazardous chemical depend on the physical form and the manner in which the chemicals are used. Examples of control measures which could minimise the risk include, but are not limited to:

- health monitoring for any worker who is at risk of exposure to the chemicals, if valid techniques are available to monitor the effect on the worker's health;
- minimising manual processes and work tasks through automating processes;

- work procedures that minimise splashes and spills;
- regularly cleaning equipment and work areas; and
- using protective equipment that is designed, constructed, and operated to ensure that the worker does not come into contact with the chemicals.

Guidance on managing risks from hazardous chemicals are provided in the *Managing risks of hazardous chemicals in the workplace—Code of practice* available on the Safe Work Australia website.

Personal protective equipment should not solely be relied upon to control risk and should only be used when all other reasonably practicable control measures do not eliminate or sufficiently minimise risk. Guidance in selecting personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

Obligations under workplace health and safety legislation

Information in this report should be taken into account to help meet obligations under workplace health and safety legislation as adopted by the relevant state or territory. This includes, but is not limited to:

- ensuring that hazardous chemicals are correctly classified and labelled;
- ensuring that (material) safety data sheets ((M)SDS) containing accurate information about the hazards (relating to both health hazards and physicochemical (physical) hazards) of the chemicals are prepared; and
- managing risks arising from storing, handling and using a hazardous chemical.

Your work health and safety regulator should be contacted for information on the work health and safety laws in your jurisdiction.

Information on how to prepare an (M)SDS and how to label containers of hazardous chemicals are provided in relevant codes of practice such as the *Preparation of safety data sheets for hazardous chemicals—Code of practice* and *Labelling of workplace hazardous chemicals—Code of practice*, respectively. These codes of practice are available from the Safe Work Australia website.

A review of the physical hazards of these chemicals has not been undertaken as part of this assessment.

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US National Library of Medicine's Hazardous Substances Data Bank (HSDB). Accessed January 2015 at **http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB**

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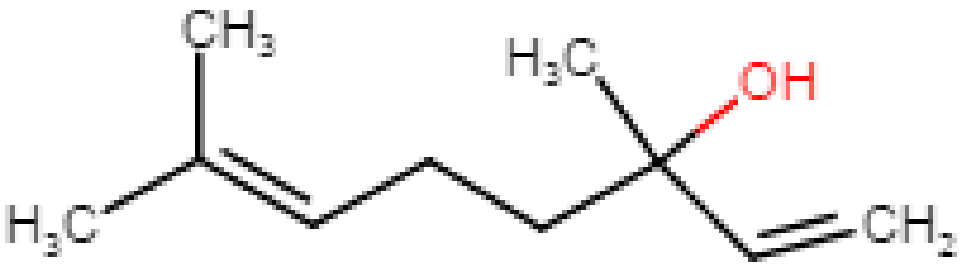
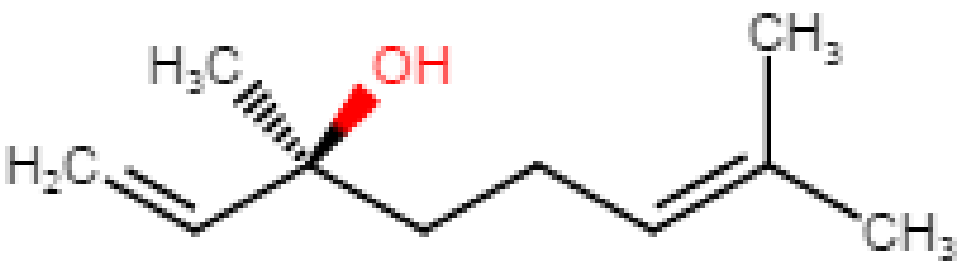
Last Update 21 April 2016

Chemical Identities

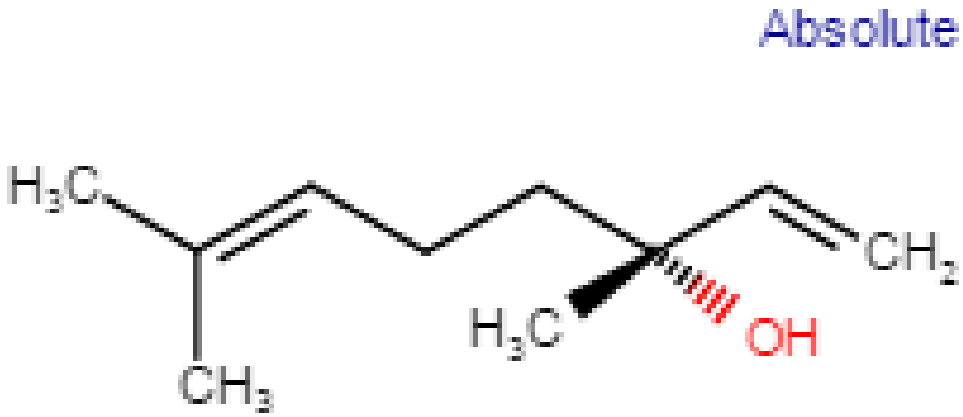
Chemical Name in the Inventory and Synonyms	**1,6-Octadien-3-ol, 3,7-dimethyl-** 1,6-octadien-3-ol, 3,7-dimethyl-, (.+-.)- 3,7-dimethyl-1,6-octadien-3-ol Linalyl alcohol Linalool; dl-linalool
CAS Number	78-70-6
Structural Formula	

	
Molecular Formula	C10H18O
Molecular Weight	154.251

Chemical Name in the Inventory and Synonyms	**1,6-Octadien-3-ol, 3,7-dimethyl-, (S)-** d-Linalool Linalool, (+)- Coriandrol
CAS Number	126-90-9
Structural Formula	

	
Molecular Formula	C10H18O
Molecular Weight	154.251

Chemical Name in the Inventory and Synonyms	**1,6-Octadien-3-ol, 3,7-dimethyl-, (R)-** l-Linalool Linalool, (-)- Licareol
CAS Number	126-91-0
Structural Formula	

	
Molecular Formula	C10H18O
Molecular Weight	154.251

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