Amyl and hexyl cinnamaldehyde: Human health tier II assessment

01 July 2016

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
Octanal, 2-(phenylmethylene)-	101-86-0
Heptanal, 2-(phenylmethylene)-	122-40-7

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

The chemicals in this group are two cinnamyl derivatives, referred to as alkyl-substituted cinnamaldehydes. These chemicals are grouped together because of their close structural relationship and the resulting physico-chemical and toxicological properties. Alpha-amylcinnamaldehyde (CAS No. 122-40-7) and alpha-hexylcinnamaldehyde (CAS No. 101-86-0) are identified as GRAS ('generally regarded as safe') for use as flavouring substances by the United States Food and Drug Administration (US FDA) and World Health Organisation (WHO).

Import, Manufacture and Use

Australian

Alpha-hexyl cinnamaldehyde has reported commercial use in industrial cleaners.No specific Australian use, import, or manufacturing information has been identified for alpha-amylcinnamaldehyde.

International

The following international uses have been identified through the European Union (EU) Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) dossiers; Organisation for Economic Co-operation and Development Screening information data set International Assessment Report (OECD SIAR); Galleria Chemica; the Substances and Preparations in Nordic countries (SPIN) database; the European Commission Cosmetic Ingredients and Substances (CosIng) database; US Personal Care Product Council International Nomenclature of Cosmetic Ingredients (INCI) Dictionary; the US OECD High Production Volume chemical program (HPVIS); the US Environmental Protection Agency's Aggregated Computer Toxicology Resource (ACToR); US National Library of Medicine's Hazardous Substances Data Bank (HSDB); and various international assessments (NTP, 1989; DWECK, 2014).

The chemicals have reported cosmetic uses in:

- perfumes;
- soaps and body wash;
- hair care products;
- antiperspirant spray; and
- tonic and scrubs.

The chemicals have reported domestic uses, including in:

- absorbents and adsorbents;
- cleaning or washing agents;
- paints, lacquers and varnishes; and
- aerosol propellants.

The following non-industrial uses have been identified in:

- pharmaceuticals;
- flavouring agents; and
- pesticides.

Restrictions

Australian

No known restrictions have been identified.

International

In the EU, use of these chemicals in cosmetics is subject to the restrictions described in Annex III of EU Cosmetics Regulation 1223/2009. As such, the presence of the substance must be indicated in the list of ingredients when its concentration exceeds 0.001 % in leave-on products and 0.01 % in rinse-off products (CosIng).

These chemicals are also listed on the following (Galleria Chemica):

- the New Zealand Cosmetic Products Group Standard—Schedule 5, with the same use restrictions as described above for the EU; and
- the International Fragrance Association (IFRA) Standards—Restricted.

Existing Worker Health and Safety Controls

Hazard Classification

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

Exposure Standards

Australian

No specific exposure standards are available.

International

No specific exposure standards are available.

Health Hazard Information

Toxicokinetics

The chemicals in this group are rapidly absorbed from the gastrointestinal tract and are metabolised and excreted primarily in the urine and, to a less extent, in the faeces. Animal and human studies have shown that the cinnamyl derivatives are excreted as polar metabolites within 24 hours of administration (US HPVIS).

The presence of alkyl substituents at the alpha position in the side chain does not affect the main metabolic detoxification pathway and, like cinnamaldehyde, both of the alkyl-substituted cinnamaldehydes undergo beta-oxidation and cleavage to yield the corresponding benzoic acid derivative that is excreted in the urine as a glycine conjugate (US HPVIS). While the metabolism of the chemicals can be inferred from cinnamaldehyde, these chemicals are more lipophilic than the analogue, which affects absorption and distribution.

In toxicokinetics studies in male rats, cinnamaldehyde (CAS No. 104-55-2) was administered intravenously (i.v.) at 5–25 mg/kg bw, or by oral gavage at 50–2000 mg/kg bw. The half-life of the chemical following i.v. administration was found to be 1.7 hours. Blood levels of cinnamaldehyde following oral administration of 500 mg/kg bw were around 1 µg/mL and were maintained during the 24 hours after dosing. Oral bioavailability of cinnamaldehyde was estimated to be less than 20 %. In the blood, cinnamaldehyde was rapidly oxidised into cinnamic acid. The majority of the chemical was excreted as hippuric acid in urine, with a very small fraction as free cinnamic acid or beta glucuronide conjugated cinnamic acid (REACHb).

In other toxicokinetics studies in Fischer 344 (F344) rats and CD1 mice, single doses of two or 250 mg/kg bw of trans [^{14}C]-cinnamaldehyde were given to both male and female rats and mice by intraperitoneal (i.p.) administration. A single dose of 250 mg/kg bw of trans [^{14}C]-cinnamaldehyde was administered in male rats and mice by oral gavage. Following i.p. administration, 80 % of the dose of cinnamaldehyde was excreted rapidly in rats and 87 % of the dose was excreted in mice in the first 24 hours. The main urinary metabolite was hippuric acid and other metabolites in smaller amounts were 3-hydroxy-3phenylpropionic acid, benzoic acid, cinnamyl glycine and benzoyl glucuronide in the both rats and mice (REACHb).

Acute Toxicity

Oral

The chemicals in this group have low acute toxicity, based on animal test results following oral exposure. The median lethal doses (LD50s) in rats are reported to be >2000 mg/kg bw.

In an acute oral toxicity study using hexylcinnamaldehyde, 10 male Wistar rats were administered the chemical at doses of 1780, 2670, 4000 or 6000 mg/kg bw. The animals were observed for signs of toxicity at one, six and 24 hours, and each subsequent day after exposure for 14 days. Observed sub-lethal effects included lethargy, depression, anorexia and weight loss. The LD50 was reported to be 3100 mg/kg bw (US HPVIS; REACHb).

In a study using amylcinnamaldehyde, the LD50 was reported as 3730 mg/kg bw in Osborne-Mendel rats. Clinical signs observed following exposure included reduced activity and porphyrin-like deposits around the eyes and nose (US HPVIS).

Dermal

The chemicals have low acute toxicity based on results from animal tests following dermal exposure. The LD50 in rabbits is >2000 mg/kg bw.

In an acute dermal toxicity study, two female rabbits were administered hexylcinnamaldehyde dermally on a clipped area of skin at doses of 1000, 2000 or 3000 mg/kg bw for 24 hours. No mortalities were reported. Moderate erythema and occasional skin sloughing were observed. These clinical signs were reported to be due to poor animal handling technique and were not considered to be treatment-related. The LD50 was reported to be >3000 mg/kg bw (REACHb; US HPVIS).

In an acute dermal toxicity study, four rabbits were administered amylcinnamaldehyde dermally at 2000 mg/kg bw. No evidence of toxicity was seen. The LD50 was reported to be >2000 mg/kg bw (US HPVIS).

Inhalation

Based on the limited available data, these chemicals are expected to have low acute toxicity based on results from animal tests following inhalation exposure.

In an inhalation toxicity study conducted similarly to OECD Test Guideline (TG) 403, five Sprague Dawley (SD) rats were administered hexylcinnamaldehyde as an aerosol in a single four-hour exposure at a nominal concentration of 5 mg/L (mean measured concentration of 2.12 mg/L). Animals were observed for 14 days with no mortalities reported. Clinical signs included enlarged bronchial lymph nodes, multiple grey–green foci on the lungs and mild pulmonary congestion. Only a few animals showed pulmonary oedema. The mean lethal concentration (LC50) was reported to be >2.12 mg/L (US HPVIS).

Corrosion / Irritation

Skin Irritation

Based on the available data from animal studies, the chemicals in this group are irritating to the skin. Due to reported severe erythema and oedema at 24, 48 and 72 hours for hexylcinnamaldehyde, classification is warranted.

In a skin irritation study conducted according to the EU Method B.4 (acute toxicity: dermal irritation/corrosion), male New Zealand White rabbits (three animals/group) were administered 0.5 mL of undiluted hexylcinnamaldehyde by dermal application. The test site was covered with a semi-occlusive dressing for four hours and the animals were observed for 11 days. Severe erythema and oedema were seen at 24, 48 and 72 hours. All reactions were fully reversible with 11 days (REACHb).

In another skin irritation study conducted according to the EU Method B.4, hexylcinnamaldehyde (0.5 mL) was applied to rabbit skin. One hour after the removal of the patch, the test site was assessed for any reaction to the treatment. Assessments were done again at 24, 48, 72 and 68 hours. The chemical was reported as irritating to skin (REACHb).

Eye Irritation

Based on the limited data available, the chemicals in this group could cause slight eye irritation.

In an eye irritation study conducted according to the EU Method B.5, 0.1 mL of undiluted hexylcinnamaldehyde was instilled in the conjunctival sac of the left eye of three male New Zealand White rabbits. Observations were made for seven days. Slight conjunctival redness was observed and was reversed in two days. The chemical was not considered to be an eye irritant (REACH).

Sensitisation

Skin Sensitisation

The chemical in this group are considered to be potential skin sensitisers, based on experimental data for hexylcinnamaldehyde and weight of evidence information for amylcinnamaldehyde. Hexylcinnamaldehyde is commonly used as a positive control in skin sensitisation studies.

In a local lymph node assay (LLNA) conducted according to OECD TG 429, hexylcinnamaldehyde was tested in female CBA/Ca mice (five/group) at 1.5, 10 or 50 % w/v. The chemical was administered epicutaneously on both the ears for three days. All animals were injected intravenously with radiolabelled thymidine to label proliferating cells. Clinical signs observed included rough hair coat, hyperirritability, hair loss and irritation to the ears. The animals were euthanised and cell suspensions were prepared five hours post-injection. An EC3 (estimated concentration needed to produce a three-fold increase in lymphocyte proliferation) of 6.6–11.5 % was determined. The chemical was reported to be a contact sensitiser in this assay (US HPVIS).

In a skin sensitisation study, hexylcinnamaldehyde was tested on Hartley-derived guinea pigs (10 animals/sex/dose) at a 20 % concentration in acetone, once per week for three consecutive weeks. A challenge dose of 2.5 % of the chemical in acetone was applied two weeks later. Seventy percent of the animals tested gave a positive response. The chemical was a skin sensitiser in guinea pigs in this study (US HPVIS).

Based on the available information from various tests (LLNA, guinea pig maximisation test (GRMT), HRIPT tests and structural analysis), amylcinnamaldehyde is considered to be an extremely weak skin sensitiser (Api et al, 2015).

Other studies

In a phototoxicity study in Himalayan guinea pigs, a solution (0.025 mL) of 1 %, 3 % or 10 % hexylcinnamaldehyde in ethanol was applied to the flanks of guinea pigs over a 2 cm^2 area. Dimethyl sulfoxide (DMSO) (2 %) was added to each application to enhance the skin penetration of the chemical. The application site was irradiated with UVA 20 J/cm^2, 30 minutes after the application. The two highest concentrations resulted in a phototoxic reaction under exposure to UVA and the 1 % concentration was not phototoxic (REACHb).

Observation in humans

The human data for hexylcinnamaldehyde do not indicate sensitisation.

In a repeated insult patch test, hexylcinnamaldehyde (20 %) in 3:1 ethanol:diethylphthalate (0.3 ml) was applied to the back of 138 male and female human volunteers. The patches were removed 24 hours after application, during the induction phase. A challenge patch was applied to the sites and scored at 24, 48 and 72 hours after the application during the rest phase. Mild erythema with moderate oedema was seen in one volunteer at 48 and 72 hours. The reaction subsided at 96 hours. The chemical did not induce allergic contact dermatitis in 99 % of the test population (REACHb).

In a phototoxicity study, a 0.025 mL solution of 10 % hexylcinnamaldehyde in 1:1 ethanol/acetone was applied to six 2 cm^2 sites on the back of six human volunteers. The application site was irradiated with UVA at 1.0, 2.5, 10 or 20 J/cm^2, 30 minutes following application. Observations were made at four, 24, 48 and 72 hours post-application. No phototoxicity was seen after the exposure to the highest UVA dose (REACHb).

Repeated Dose Toxicity

Oral

Based on the available data, repeated oral exposures to the chemicals are not considered to cause serious damage to health.

In an oral repeated dose toxicity study, groups of male and female Carworth SD-derived (CFE) rats (15 animals/sex/dose) were administered amylcinnamaldehyde in the diet for 14 weeks at dose levels of 0, 80, 400 or 4000 ppm (males: 0, 6.1, 29.9 or 287.3 mg/kg bw/day and females: 0, 6.7, 34.9 or 320.3 mg/kg bw/day). No significant differences in the body weights or food and water consumption were seen. Haematological examination showed no significant differences from the control values. Increases in the relative liver and kidney weights of the rats fed the diet containing the highest dose of 4000 ppm were seen, but there were no associated histopathological changes. The lowest observed adverse effect level (LOAEL) was 287.3 (males) and 320.3 (females) mg/kg bw/day based on increased relative liver and kidney weights. The no observed adverse effect levels (NOAEL) were 29.9 (males) and 34.5 (females) mg/kg bw/day (HSDB; US HPVIS).

In a repeated dose toxicity study, Food and Drug Research Laboratories (FDRL) rats (15 animals/sex/dose) were administered amylcinnamaldehyde at 2 % (approximately 2000 mg/kg bw/day) diluted in cotton-seed oil in their diet for 12 weeks. Haematological and blood chemistry examination showed no treatment-related effects. The NOAEL was approximately 2000 mg/kg bw/day (HSDB; US HPVIS).

Dermal

Based on the available data, repeated dermal exposure to the chemicals in this group at high doses can cause systemic and local effects. The lowest LOAEL was reported to be 125 mg/kg bw/day based on changes in the liver and local effects on the skin.

In a 90-day repeated dose toxicity study, male SD rats (10 animals/sex/dose) received a dermal application of hexylcinnamaldehyde at 125, 250, 500 or 1000 mg/kg bw/day on the shaved dorsal skin. Dose-dependent dermal irritation characterised by erythema, cracking, dryness and sloughing was observed. Five males and three females at 1000 mg/kg bw/day died before the 90-day study ended. Chronic necrotising dermatitis with acanthosis, hyperkeratosis and sebaceous gland hyperplasia and focal gastric ulceration was reported at the 1000 mg/kg bw/day dose. Liver histopathological effects reported were vacuolisation and single-cell degeneration. Splenic lymphoid deletion and fibrosis were seen at the 1000 mg/kg bw/day dose. Dose-dependent increases in the myeloid/erythroid and decreases in the cell/fat ratios were reported. Inconsistent changes in haematological parameters such as haemoglobin, haematocrit, erythrocyte count and serum alanine aminotransferase (ALT) were reported in females with consistent elevation in white blood cell counts. Males showed reduced lymphocyte counts and reduced serum glucose, while increased blood urea nitrogen (BUN) levels were seen in both males and females. An LOAEL of 125 mg/kg bw/day was reported and an NOAEL was not established (REACHb; US HPVIS).

In a 28-day repeated dose dermal toxicity study in male SD rats, hexylcinnamaldehyde was applied daily percutaneously to the shaved dorsal skin at doses of 150, 375, 750, 1500 or 3000 mg/kg bw/day (two animals/dose). All doses caused erythema and eschar formation with cracking and dryness, and all doses, except the 375 mg/kg bw/day dose, caused hyperirritability. Haematological examination of animals at the two highest doses showed depressed clotting times and blood cell counts. Increases in blood chemistry parameters–BUN, serum alkaline phosphatase, asparate aminotransferase (AST) and ALT, and a decrease in glucose were seen at 375 mg/kg bw/day. Thickening of the skin and erythema of the dermis and epidermis, body emaciation, congested lungs, gastrointestinal tract irritation, decreases in absolute and relative thymus and spleen weights were also observed at doses of 375 mg/kg bw/day and higher. The LOAEL was reported to be 150 mg/kg bw/day based on the local dermal irritation effects such as erythema, eschar formation, dermatitis and hyperkeratosis. An NOAEL was not established, although an NOAEL of 150 mg/kg bw/day for systemic effects can be derived (US HPVIS).

Inhalation

No data are available.

Genotoxicity

Based on the weight of evidence from the available in vitro and in vivo genotoxicity studies, the chemicals in this group are not considered to be genotoxic.

In vitro studies

In a bacterial assay conducted according to OECD TG 471, *Salmonella typhimurium* strains TA98, TA100, TA1535, TA1537 and TA1538 were exposed to hexylcinnamaldehyde at concentrations up to 3600 µg/plate. No mutagenic activity was observed in any of the strains tested (HSDB; REACHb; US HPVIS).

In other two separate bacterial assays, amylcinnamaldehyde in concentrations up to 3600 µg/plate was tested in *S. typhimurium* TA97 and TA102 in the first assay, and TA98, TA100, TA1535, TA1537 and TA1538 for the second assay. No mutagenicity was observed (HSDB; US HPVIS).

In vivo studies

In a chromosomal aberration test conducted according to OECD TG 474 with minor deviations, hexylcinnamaldehyde was tested in male and female Naval Medical Research Institute (NMRI) mice at doses of 0, 324, 540 or 756 mg/kg bw. The chemical was neither clastogenic nor aneugenic (HSDB; REACHb; US HPVIS).

In another chromosomal aberration test, amylcinnamaldehyde was tested in male and female NMRI mice at 0, 405, 809 or 1213 mg/kg bw. The chemical did not induce micronuclei in this assay (US HPVIS).

Carcinogenicity

No data are available.

Reproductive and Developmental Toxicity

Based on the available data, the chemicals in this group are not expected to cause reproductive or developmental toxicity.

In a one-generation study conducted similarly to OECD TG 421, Crj: CD (SD) rats (eight animals/sex/dose) were fed hexylcinnamaldehyde in corn oil at 12.5, 25, 50 or 1000 mg/kg bw. The males received the treatment for 14 days before cohabitation, through mating for a maximum of seven days and were euthanised on the day 47 of treatment. Female rats were treated two weeks before cohabitation, through mating and were euthanised on day 45 of treatment. The first group of offspring (FI) generation pups were euthanised on fifth day of lactation. No treatment related clinical observations or gross lesions were seen in the parent (P) generation of either sex. Body weights and feed consumption were unaffected in male rats. In treated P generation female rats, the body weights or body weight gains and the feed consumption were not affected by the treatment during the pre-cohabitation and the gestation periods. A significant decrease in maternal body weight in the 1000 mg/kg bw/day dose group was reported during the lactation period and was considered as the maximum tolerated dose (MTD). No treatment-related effect was seen on oestrous cycling, mating and fertility at any tested dose. No treatment-related clinical or necropsy effects were seen in the F1 generation pups and no developmental effects were observed. The NOAEL for maternal and developmental toxicity was ≥1000 mg/kg bw/day (REACHb).

In a 90-day repeated dose study using hexylcinnamaldehyde in SD rats (see **Repeated dose toxicity** section), the treatment resulted in no significant effect on the weight or histology of reproductive organs in either sex at any tested dose (US HPVIS).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include skin sensitisation. The chemicals can also cause skin irritation.

Public Risk Characterisation

Although the uses in cosmetic and domestic products in Australia are not known, the chemicals are reported to have widespread use in cosmetic and domestic products overseas which are potentially available for use in Australia (US HHPD and CIUCUS). The EU and New Zealand have restrictions on the use of the chemicals in cosmetics (see **International Restrictions** section). Currently, there are no restrictions in Australia on using these chemicals in cosmetic products. In the absence of any

regulatory controls, the characterised critical local health effects have the potential to pose an unreasonable risk under the identified uses. The risk could be mitigated by implementing concentration limits and restricting uses to limit dermal exposure.

Occupational Risk Characterisation

During product formulation, dermal exposure may 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 the chemicals at lower concentrations could also occur while using formulated products containing the chemicals. The level and route of exposure will vary depending on the method of application and work practices employed.

Given the critical systemic local 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.

The data available support an amendment to the hazard classification in the HSIS (Safe Work Australia) (refer to **Recommendation** section).

NICNAS Recommendation

Further risk management is required. Sufficient information is available to recommend that risks to public health and safety from the potential use of the chemical in cosmetics and/or domestic products be managed through changes to poisons scheduling, and risks for workplace health and safety be managed through changes to classification and labelling.

Assessment of the chemical is considered to be sufficient provided that risk management recommendations are implemented and all requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.

Regulatory Control

Public Health

Given the risk characteristion, it is recommended that the chemicals should be included in the Poisons Standard (the Standard for the Uniform Scheduling of Medicines and Poisons) with appropriate restrictions on the sale, supply and use of the chemical in domestic and cosmetic products.

Consideration should be given to the following:

- the chemicals are used in a range of cosmetic and domestic products available for sale in Australia;
- the chemicals are potential skin sensitisers with an LLNA derived EC3 of 6.6–11.5 %; and
- overseas restrictions on the use of the chemical in cosmetic products, where the presence of the substance must be indicated in the list of ingredients when its concentration exceeds 0.001 % in leave-on products and 0.01 % in rinse-off products.

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]

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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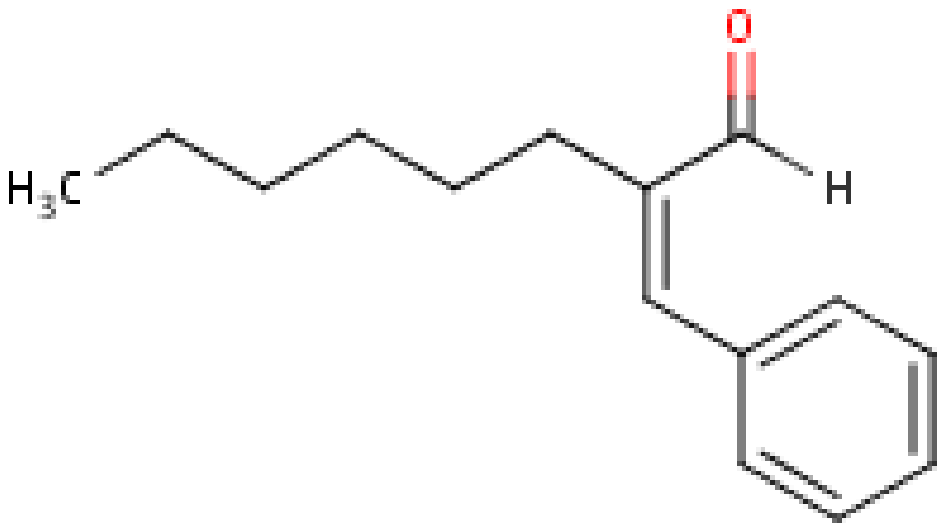
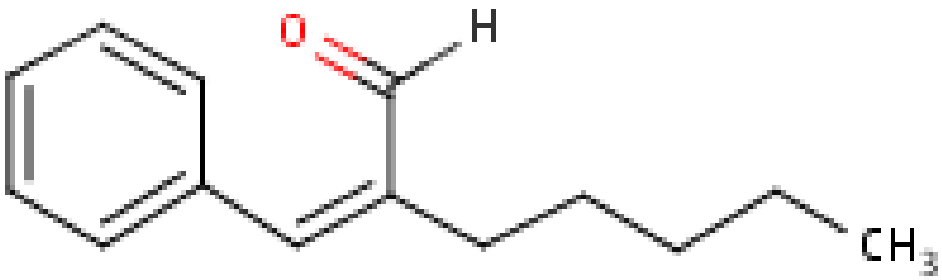
Last Update 01 July 2016

Chemical Identities

Chemical Name in the Inventory and Synonyms	**Octanal, 2-(phenylmethylene)-** .alpha.-hexyl cinnamic aldehyde 2-hexyl-3-phenyl-2-propenal 2-propenal, 2-hexyl-3-phenyl- .alpha.-hexyl cinnamaldehyde, hexylcinnamaldehyde
CAS Number	101-86-0
Structural Formula	
Molecular Formula	C15H20O
Molecular Weight	216.3

Chemical Name in the Inventory and Synonyms	**Heptanal, 2-(phenylmethylene)-** .alpha.-amylcinnamaldehyde amyl cinnamal .alpha.-pentyl cinnamaldehyde, amylcinnamaldehyde
CAS Number	122-40-7
Structural Formula	
Molecular Formula	C14H18O
Molecular Weight	202.2

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