UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

DATE: January 27, 2006

ACTION MEMORANDUM

SUBJECT: Inert Reassessment – Camphor

FROM: Pauline Wagner, Chief Pauline Wagner 1/27/06
Inert Ingredient Assessment Branch

TO: Lois A. Rossi, Director
Registration Division

I. FQPA REASSESSMENT ACTION

Action: Reassessment of one inert ingredient exemption from the requirement of a tolerance. Current exemption is to be maintained.

Chemical: Camphor
CFR: 40 CFR 180.920 formerly 40 CFR § 180.1001(d)
CAS #: 76-22-2

Table 1. Tolerance Exemptions Expression

40 CFR	Inert Ingredient	Limits	Uses (Pesticidal)	CAS Reg. No. and Name
180.920	Camphor	Not more than 5% weight to weight (w/w) of pesticide formulations.	Deodorant, melting point adjustment	76-22-2 Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-

Use Summary: Camphor is used as a topical liniment, preservative in pharmaceuticals and cosmetics, moth repellant, and plasticizer for esters, as well as in lacquers & varnishes, explosives, embalming fluid, and the manufacture of plastics and cymene.

Camphor is cleared by the US FDA under 21 CFR 175.105 for indirect food additive usage as a component of adhesives, and under 21 CFR 172.515 as a synthetic flavoring substance and adjuvant. Camphor is used as a deodorant and/or melting point adjustment in pesticide formulations at not more than 5% weight to weight of the formulation.

II. MANAGEMENT CONCURRENCE

I concur with the reassessment of the one exemption from the requirement of a tolerance for the inert ingredient camphor (CAS Reg. No. 76-22-2). I consider the one exemption established in 40 CFR § 180.920 [formerly 40 CFR 180.1001(d)] to be reassessed for purposes of FFDCA's section 408(q) as of the date of my signature, below. A Federal Register Notice regarding this tolerance exemption reassessment decision will be published in the near future.

Lois A. Rossi

Lois A. Rossi, Director
Registration Division

Date: 2/10/06

CC: Debbie Edwards, SRRD
Joe Nevola, SRRD

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MEMORANDUM

SUBJECT: Reassessment of the One Exemption from the Requirement of a Tolerance for Camphor (CAS Reg. No. 76-22-2)

FROM: R. Tracy Ward R Tracy Ward
Inert Ingredient Assessment Branch
Registration Division (7505C)

TO: Pauline Wagner, Branch Chief
Inert Ingredient Assessment Branch
Registration Division (7505C)

Background

Attached is the science assessment for camphor. This assessment summarizes available information on the use, physical/chemical properties, toxicological effects, exposure profile, environmental fate, and ecotoxicity of camphor. The purpose of this document is to reassess the existing exemption from the requirement of a tolerance for residues of camphor as required under the Food Quality Protection Act (FQPA).

Executive Summary

This document evaluates camphor (CAS Reg. No. 76-22-2), an inert ingredient used as a deodorant (to mask the odor of other chemicals) and/or as a melting point adjuster (to increase or lower the melting point of a formulation) in pesticide formulations. One exemption from the requirement of a tolerance exists for camphor under 40 CFR 180.920 when applied to growing crops only at not more than 5% weight to weight (w/w) of pesticide formulations. This assessment utilizes data and information available from the Hazardous Substances Database (HSDB) and ChemIDPlus (databases of the National Institutes of Health), the National Toxicological Program database (NTP), the International Programme on Chemical Safety (IPCS), and the

Registry of Toxic Effects of Chemical Substances (RTECS) database of the National Institute of Occupational Safety and Health.

Camphor appears to have moderate acute oral toxicity, with an LD_{50} of 1310 mg/kg in mice. It demonstrated moderate to high toxicity in acute inhalation studies (450 mg/m^3 (72 ppm) in mice and 500 mg/m^3 (80 ppm) in rats). In subchronic studies, inhaled camphor resulted in emphysema in mice at 210 mg/m^3 (33 ppm) and rabbits at 33 mg/m^3 (5 ppm). In 13-week subchronic dermal studies, camphor had NOAELs of 1000 mg/kg bw/day in mice and 250 mg/kg bw/day in rats. IPCS reported negative results in carcinogenicity tests for camphor. In addition, camphor was negative for genotoxicity in a microsome mutagenesis test, and a peripheral blood micronucleus assay. Reproductive toxicity studies were not available for camphor, however, in developmental toxicity studies, camphor demonstrated no fetal toxicity (with NOAELs ≥800 mg/kg bw/day in rats) at dose levels that resulted in maternal toxicity.

Camphor is expected to quickly volatilize into the ambient air where it is expected to rapidly photodegrade. Dietary (food and drinking water) exposures of concern are unlikely with camphor because of its physical/chemical properties, and the small amount (not more than 5%) that can be used in pesticide formulations. Regarding exposure to camphor from residential-use pesticide products, the potential for dermal exposure will be reduced because of the chemical's volatile properties, and while inhalation exposure is possible, exposures of concern are not expected due to the small amount used in formulations. In addition, inhalation exposure is expected to be limited by the deterrent effects of camphor's strong odor.

Taking into consideration all available information on camphor, there is a reasonable certainty that no harm to any population subgroup will result from aggregate exposure when considering dietary exposure (including crops, meats, and fish) and all other non-occupational sources of pesticide exposure for which there is reliable information. Therefore, it is recommended that the one exemption from the requirement of a tolerance established for residues of camphor when used as a deodorant or melting point adjustment at not more than 5% weight to weight (w/w) of pesticide formulations applied to growing crops only under 40 CFR 180.920 can be considered reassessed as safe under section 408(q) of the FFDCA.

Introduction

This report evaluates the inert ingredient camphor, which has one exemption from the requirement of a tolerance with a limitation of not more than 5% weight to weight in pesticide formulations applied to growing crops only under 40 CFR 180.920.

Camphor is actually a racemic mixture of d- and l-camphor isomers. The d-isomer of this cyclic ketone is produced naturally by the camphor tree, *Cinnamonanum camphora* (Chatterjie and Alexander 1986, as cited in NTP 1992a). DL-camphor, can be obtained from steam distillation of parts of the camphor tree; however, it is usually produced synthetically, primarily from α-pinene (a hydrocarbon derived from turpentine)

via camphene, to bornyl acetate, followed by saponification and oxidation (HSDB 2004). Over 75% of the camphor sold in the United States is produced synthetically (Windholz 1983, as cited in NTP 1992a) and, unlike naturally occurring camphor, manufactured camphor is generally sold as the racemic mixture (Windholz 1983; Chatterjie and Alexander 1986, as cited in NTP 1992a). Other names for camphor include: (±)-Camphor; dl-Camphor; Gum camphor; Spirit of camphor; root bark oil; 1,7,7-trimethylbicyclo [2.2.1]-2-heptanone; 1,7,7-Trimethylnorcamphor; norcamphor, 1,7,7-trimethyl-; and 2-Bornanone (ChemIDplus 2004).

Camphor is used in the manufacture of plastics; as a plasticizer for cellulose esters and ethers; in lacquers and varnishes; in explosives; in pyrotechnics; in embalming fluid; in the manufacture of cymene; in camphorated parachlorophenol and flexible collodion; in moth repellants and in cosmetics (HSDB and ChemIDplus 2004). It is commonly found in over the counter preparations such as spirits of camphor, Campho-Phenique, and other topical liniments that are used to relieve minor aches and pains, chest congestion and stuffy noses, and the pain caused by cold sores (Phelan 1976, as cited in NTP 1992a). Camphor is cleared by the US Food and Drug Administration (US FDA) for direct (21 CFR 172.515) and indirect (21 CFR 175.105) food additive uses. It is also used as an inert ingredient limited to not more than 5% weight to weight of pesticide formulations (40 CFR 180.920).

II. Use Information

A. Pesticide Uses

Camphor is used as a deodorant and/or melting point adjustment in pesticide formulations at not more than 5% weight to weight of the formulation.

Table 1. Tolerance Exemptions Being Reassessed in this Document

40 CFR [1/]	Tolerances Exemption Expression	Limits	Uses (Pesticidal)	CAS Reg. No. and Name
180.920	Camphor	Not more than 5% weight to weight (w/w) of pesticide formulations.	Deodorant, melting point adjustment	76-22-2 Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-

1. Residues listed in 40 CFR §180.920 are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops only.

B. Other Uses

Camphor is also used as a topical liniment, preservative in pharmaceuticals and cosmetics, moth repellant, and plasticizer for esters, as well as in lacquers & varnishes, explosives, embalming fluid, and the manufacture of plastics and cymene.

Camphor is cleared by the US FDA under 21 CFR 175.105 for indirect food additive usage as a component of adhesives (see http://frwebgate.access.gpo.gov/cgi-bin/get-cfr.cgi?TITLE=21&PART=175&SECTION=105&YEAR=2000&TYPE=TEXT).

D-camphor is cleared by the US FDA under 21 CFR 172.515 for use as a synthetic flavoring substance and adjuvant (see http://frwebgate.access.gpo.gov/cgi-bin/get-cfr.cgi?TITLE=21&PART=172&SECTION=515&YEAR=1999&TYPE=TEXT):

"Synthetic flavoring substances and adjuvants may be safely used in food in accordance with the following conditions:

(a) They are used in the minimum quantity required to produce their intended effect, and otherwise in accordance with all the principles of good manufacturing practice.

(b) They consist of one or more of the following, used alone or in combination with flavoring substances and adjuvants generally recognized as safe in food, prior-sanctioned for such use, or regulated by an appropriate section in this part."

III. Physical and Chemical Properties

Table 2. Physical and Chemical Properties of Camphor (Measured=M or Estimated=E)

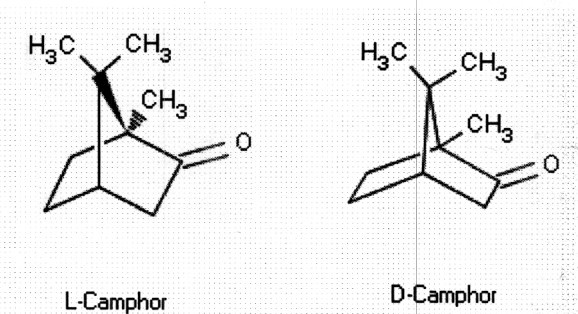
Parameter	Value	Source
Structure	 L-Camphor D-Camphor	ChemIDplus 2004
Common Names	Camphor; (±)-Camphor; Bornane, 2-oxo-; 1,7,7-Trimethylbicyclo(2.2.1)heptan-2-one; DL-Camphor	ChemIDplus 2004
CAS Reg. No.	76-22-2	
Physical State	Colorless or white crystals, granules, or crystalline masses; penetrating aromatic odor.	HSDB 2005

Table 2. Physical and Chemical Properties of Camphor (Measured=M or Estimated=E)		
Parameter	**Value**	**Source**
Molecular Weight	152.24	ChemIDplus 2004
Water Solubility	1600 mg/L at 25º C (M), soluble	ChemIDplus 2004
Melting Point	180ºC (M)	ChemIDplus 2004
Henry's Law Constant	8.1×10^{-5} atm-m^3/mole at 25º C (E)	ChemIDplus 2004
Vapor Pressure	0.65 mm Hg @ 25ºC (M)	ChemIDplus 2004
Octanol/Water Partition Coefficient	Log P = 2.38 (M)	ChemIDplus 2004
Organic Carbon Partition Coefficient	K_{OC} = 106	EPISuite™ 2000

IV. Hazard Assessment

A. Hazard Profile

This assessment utilizes data and information available from the HSDB and ChemIDPlus databases, NTP, IPCS, and RTECS. Camphor appears to have low to moderate acute oral toxicity and moderate to high inhalation toxicity. In subchronic studies, inhaled camphor resulted in emphysema in mice. In subchronic dermal studies, camphor had NOAELs of 1000 mg/kg bw/day in mice and 250 mg/kg bw/day in rats. IPCS reported negative results in carcinogenicity tests for camphor. In addition, camphor was negative for genotoxicity in a microsome mutagenesis test, and a peripheral blood micronucleus assay. In developmental toxicity studies, camphor demonstrated no fetal toxicity (with NOAELs ≥800 mg/kg bw/day rats) at dose levels that resulted in maternal toxicity.

B. Toxicological Data

Acute toxicity:

A summary of acute oral and inhalation toxicity data for camphor is provided in Table 3. Camphor appears to have low to moderate acute oral toxicity, with an LD_{50} of 1310 mg/kg in mice, and LD_{Lo}s of 1800 and 2000 mg/kg in guinea pigs and rabbits, respectively. The lethal dose in dogs was reported to be between 9 and 14 grams, with effects including preliminary stimulation, with subsequent paralysis, of the central nervous system, followed by death due to asphyxia. According to the ACGIH (2001 as cited in HSDB 2004), camphor causes convulsions by stimulating the cerebral cortex cells and causes congestion and edematous changes in the gastrointestinal tract, kidneys and brain.

In mouse inhalation toxicity studies, camphor produced muscle contractions and spasms, with an LD_{Lo} of 400 mg/m^3 (64 ppm), and an inhalation LD_{50} of 450 mg/m^3 (72 ppm). Camphor also produced inhalation toxicity at moderate doses in rats, with an LD_{50} of 500 mg/m^3 (80 ppm).

No acute dermal, dermal sensitization, or eye irritation studies were identified for this assessment.

Parameter	Toxicity value	Comments	Reference
Oral LD_{50} (mouse)	1310 mg/kg	NA	Shika Gakuho 1975, as cited in RTECS 2005
Oral LD_{Lo} (guinea pig)	1800 mg/kg	NA	Smith and Margolis 1954, as cited in NTP 1992a
Oral LD_{Lo} (rabbit)	2000 mg/kg	NA	ibid.
Oral LD_{Lo} (dog)	9000 -14000 mg	Preliminary stimulation, then paralysis of the CNS and asphyxia.	Clark et al 1981, as cited in HSDB 2004
Inhalation LC_{Lo} (3 hr-mouse)	400 mg/m^3 (64 ppm)	Muscle contraction or spasticity	Gigiena i Sanitariya 1957, as cited in RTECS 2005
Inhalation LC_{50} (mouse)	450 mg/m^3 (72 ppm)	Muscle contraction or spasticity; nausea or vomiting	Volkova et al 1998, as cited in RTECS 2005
Inhalation LC_{50} (rat)	500 mg/m^3 (80 ppm)		

Subchronic Toxicity:

In two separate 7-week inhalation studies described briefly in RTECS, mice and rabbits were intermittently subjected to camphor vapors for 3-hour periods of time. Mice experienced emphysema, with an LD_{Lo} of 210 mg/m^3 (34 ppm). Effects in rabbits included emphysema and unspecified changes to the brain and heart at an LD_{Lo} of 33 mg/m^3 (5 ppm).

NTP (1998) reported a 13-week dermal toxicity study in which camphor was applied to the skin of mice (10/sex/dose) at dose levels of 0, 200, 400, 600, 800 and

1000 mg/kg bw/day. There were no deaths, significant weight differences, or clinical findings in the mice. Minimal hyperplasia was seen in the epidermis of all males in the highest dose group (1000 mg/kg bw/day), and in all females in the 800 and 1,000 mg/kg bw/day dose groups. The NOAEL for this two-week subchronic dermal study in mice was determined to be 1000 mg/kg bw/day.

NTP also conducted 13-week (1998) dermal toxicity study in rats at doses of 0, 16, 32, 64, 125 and 250 mg/kg bw/day, with effects similar to the 13-week study in mice. The rat dermal study produced a NOAEL of 250 mg/kg bw/day, with no LOAEL determined.

Table 4. Summary of Subchronic Toxicity Data for Camphor

Parameter	Toxicity Value	Comments	Reference
Subchronic Inhalation LD_{Lo} (mouse-7 weeks, intermittent)	210 mg/m^3/3 hours (33 ppm)	Emphysema	Gigiena i Sanitariya 1957, as cited in RTECS
Subchronic Inhalation LD_{Lo} (rabbit-7 weeks, intermittent)	33 mg/m^3/3 hours (5 ppm)	Unspecified changes in the brain and heart; emphysema	ibid.
Subchronic Dermal (mouse-13 weeks)	NOAEL = 1000 mg/kg bw/day LOAEL = NA	NA	NTP 1998
Subchronic Dermal (rat-13 weeks)	NOAEL = 250 mg/kg bw/day LOAEL = NA	NA	ibid.

Genetic Toxicity:

Gomes-Carneiro et al (1998) performed microsome mutagenesis tests on camphor using four tester strains of *S. typhimurium*, both with and without activation, and with up to cytotoxic concentrations of camphor. No evidence of camphor-induced genotoxicity was found with or without activation.

In an NTP (1999) peripheral blood micronucleus assay, different doses of camphor were applied to the skin of mice (10/sex/dose). After a 24-hour exposure to the camphor, no dose-group of either sex showed a significant increase in micronuclei compared to the control.

***Developmental Toxicity*:**

In an NTP study (1992a), camphor was administered daily by gavage to pregnant rats at doses of 100, 400 and 800 mg/kg bw/day, from gestational day (GD) 6 through 15. There were small, but significant increases in water intake at GD 6 to 9 at the 100 mg/kg bw/day dose level. There were no maternal deaths, but there were small but significant decreases in maternal weight gain (GD 6 through 15) and food intake (GD 6 to 9) at the 400 and 800 mg/kg bw/day dose levels. There was also a small, but significant, dose-dependant increase in absolute and relative maternal liver weights. Maternal hypoactivity/lethargy was observed on GD 6 and 7 at the highest dose level. There were no effects on fetal growth, viability or development at any dose level. The LOAEL for maternal toxicity was ≤100 mg/kg bw/day, based on the increased water intake at 100 mg/kg bw/day. The NOAEL for fetal toxicity was ≥800 mg/kg bw/day, with an undetermined LOAEL.

In an NTP study (1992b), camphor was administered daily by gavage to pregnant rabbits at doses of 50, 200 and 400 mg/kg bw/day, from GD 6 through 19. There were no maternal deaths or significant differences in maternal food intake, gravid uterine and absolute and relative liver weights when compared to controls. Maternal body weights at all dose levels were not significantly different from controls, but maternal body weight gain during gestation decreased significantly with increasing camphor dose levels. No dose of camphor had any affect on fetal growth, viability or morphological development. The NOAEL for both maternal and fetal toxicity was determined to be 400 mg/kg bw/day.

The NTP study results were confirmed in studies by Leuschner (1997, as cited in HSDB). D-Camphor did not cause teratogenicity when administered orally during the fetal period of organogenesis to pregnant rats at doses up to 1000 mg/kg bw/day, and to pregnant rabbits at doses up to 681 mg/kg bw/day. The NOAEL for the rat fetus was >1000 mg/kg bw/day, and for the rabbit fetus >681 mg/kg bw/day.

Carcinogenicity:

In commenting on carcinogenicity, the International Programme on Chemical Safety (IPCS 2003) reported that "carcinogenicity tests have been negative."

C. Metabolism and Pharmacokinetics

Camphor is rapidly oxidized to campherols (2-hydroxycamphor and 3-hydroxy-camphor), and then conjugated in the liver to the glucuronide form (Kresel 1982, as cited in IPCS). Camphor-related metabolites are relatively fat-soluble and may accumulate in fatty tissue.

Campherol conjugated to glucuronic acid is eliminated mainly in the urine as an inactive compound (Kresel 1982, as cited in IPCS). Trace amounts are eliminated by the lungs.

D. Special Consideration for Infants and Children

In developmental studies, camphor had fetal NOAELs at ≥800 mg/kg bw/day in rats and 400 mg/kg bw/day in rabbits. Camphor demonstrated no fetal toxicity in rats at levels of camphor that resulted in maternal toxicity (LOAEL ≤ 100 mg/kg bw/day based on increased water intake at GD 6 to 9) in developmental studies. Based on this information there is no concern, at this time, for increased sensitivity to infants and children to camphor when used as an inert ingredient in pesticide formulations. For the same reason, a safety factor analysis has not been used to assess risk and, therefore, the additional tenfold safety factor for the protection of infants and children is also unnecessary.

V. Environmental Fate Characterization/Drinking Water Considerations

According to the HSDB (2004) profile, camphor may be released to the environment naturally from various plant and tree species. It may also be released to the environment from its production and use as an odorant, flavorant, plasticizer, preservative, and use in cosmetics and pharmaceuticals. Because of its high vapor pressure (0.65 mm Hg at 25ºC), camphor will rapidly vaporize in the ambient air. Vapor-phase camphor will be photochemically degraded in the atmosphere, with a reaction half-life estimated at 1.6 days. Volatilization from moist soil surfaces is expected to be an important fate process based upon an estimated Henry's Law constant of 8.1×10^{-5} atm-m^3/mole. Camphor may volatilize from dry soil surfaces based upon its vapor pressure. Camphor is expected to have moderate mobility in soil, and may adsorb to suspended solids and sediment in water, based on an estimated K_{oc} of 106 (EPISuite™ 2000).

The estimated volatilization half-life for a model river is 10 hours, and for a model lake is 9 days. Camphor is not expected to hydrolyze, since this compound lacks functional groups that hydrolyze under environmental conditions. Camphor may undergo direct photolysis since it adsorbs light (UV max = 292 nm) in the environmental UV spectrum.

Small amounts of camphor are used in pesticide formulations (not more than 5% weight to weight), and camphor released to the environment is expected to rapidly volatilize from soils or vaporize from water to the air where it is expected to photodegrade rapidly. As a result, camphor is not expected to pose a hazard to the environment or be a concern in drinking water.

VI. Exposure Assessment

The general population may be exposed to camphor via consumption of food in which it is used as a flavorant and adjuvant (as permitted by the USFDA under 21 CFR 172.515); inhalation of ambient and indoor air where camphor-containing consumer products are used; dermal contact with this compound occurs in consumer products containing camphor such as cosmetics and pharmaceuticals. In addition, camphor may be released to the environment naturally from various plant and tree species.

Camphor is expected to quickly volatilize into the ambient air where it is expected to rapidly photodegrade. Dietary (food and drinking water) exposures of concern are unlikely with camphor because of its physical/chemical properties, and the small amount (not more than 5%) that can be used in pesticide formulations. Regarding exposure to camphor from residential-use pesticide products, the potential for dermal exposure will be reduced because of the chemical's volatile properties, and while inhalation exposure is possible, exposures of concern are not expected due to the small amount used in formulations. In addition, inhalation exposure is expected to be limited by the deterrent effects of camphor's strong odor.

Aggregate Exposure

In examining aggregate exposure, the FFDCA section 408 directs EPA to consider available information concerning exposures from the pesticide residue in food and all other nonoccupational exposures, including drinking water from ground water or surface water and exposure through pesticide use in gardens, lawns, or buildings (residential and other indoor uses).

For camphor, a qualitative assessment for all pathways of human exposure (food, drinking water, and residential) is appropriate given the lack of human health concerns associated with exposure to camphor as an inert ingredient in pesticide formulations.

Cumulative Exposure

Section 408(b)(2)(D)(v) of the FFDCA requires that, when considering whether to establish, modify, or revoke a tolerance, the Agency consider "available information" concerning the cumulative effects of a particular pesticide's residues and "other substances that have a common mechanism of toxicity."

Unlike other pesticides for which EPA has followed a cumulative risk approach based on a common mechanism of toxicity, EPA has not made a common mechanism of toxicity finding as to camphor and any other substances, and this material does not appear to produce a toxic metabolite produced by other substances. For the purposes of this tolerance action, therefore, EPA has not assumed that camphor has a common mechanism of toxicity with other substances. For information regarding EPA's efforts to determine which chemicals have a common mechanism of toxicity and to evaluate the cumulative effects of such chemicals, see the policy statements released by EPA's Office of Pesticide Programs concerning common mechanism determinations and procedures for cumulating effects from substances found to have a common mechanism on EPA's website at http://www.epa.gov/pesticides/cumulative.

IX. Human Health Risk Characterization

Camphor appears to have moderate acute oral toxicity, with an LD_{50} of 1310 mg/kg in mice. It demonstrated moderate to high toxicity in acute inhalation studies (450 mg/m^3 (72 ppm) in mice and 500 mg/m^3 (80 ppm) in rats). In subchronic studies,

inhaled camphor resulted in emphysema in mice at 210 mg/m^3 (33 ppm) and rabbits at 33 mg/m^3 (5 ppm). In 13-week subchronic dermal studies, camphor had NOAELs of 1000 mg/kg bw/day in mice and 250 mg/kg bw/day in rats. IPCS reported negative results in carcinogenicity tests for camphor. In addition, camphor was negative for genotoxicity in a microsome mutagenesis test, and a peripheral blood micronucleus assay. Reproductive toxicity studies were not available for camphor, however, in developmental toxicity studies, camphor demonstrated no fetal toxicity (with NOAELs ≥800 mg/kg bw/day in rats) at dose levels that resulted in maternal toxicity.

Camphor is expected to quickly volatilize into the ambient air where it is expected to rapidly photodegrade. Dietary (food and drinking water) exposures of concern are unlikely with camphor because of its physical/chemical properties, and the small amount (not more than 5%) that can be used in pesticide formulations. Regarding exposure to camphor from residential-use pesticide products, the potential for dermal exposure will be reduced because of the chemical's volatile properties, and while inhalation exposure is possible, exposures of concern are not expected due to the small amount used in formulations. In addition, inhalation exposure is expected to be limited by the deterrent effects of camphor's strong odor.

Taking into consideration all available information on camphor, there is a reasonable certainty that no harm to any population subgroup will result from aggregate exposure when considering dietary exposure (including crops, meats, and fish) and all other non-occupational sources of pesticide exposure for which there is reliable information. Therefore, it is recommended that the one exemption from the requirement of a tolerance established for residues of camphor when used as a deodorant or melting point adjustment at not more than 5% weight to weight (w/w) of pesticide formulations applied to growing crops only under 40 CFR 180.920 can be considered reassessed as safe under section 408(q) of the FFDCA.

X. Ecotoxicity and Ecological Risk Characterization

There were no deaths in sea lamprey (*Petromyzon marinus*) exposed to freshwater with a concentration of 5000 µg/L (5 mg/L) of camphor for 24 hours, but stress behavior was observed. In studies by Verschuren (2001, as cited in HSDB), fathead minnow (*Pimephales promelas*) had an LC_{50} of 110 mg/L in the 96-hour static bioassay, while zebrafish (*Brachydanio rerio*) had an LC_{50} of 35-50 mg/L in a 48 to 96 hour bioassay (conditions unspecified). An estimated bioconcentration factor of 38 suggests the potential for bioconcentration of camphor in aquatic organisms is moderate (HSDB 2004). A small amount of camphor is used as the inert ingredient in pesticide formulations (not more than 5% weight to weight in formulation). Camphor has high volatility/vapor pressure and rapid photodegradation properties. Therefore, the camphor residues that leach from the soil into water are not expected to be at concentrations that would pose a risk concern, especially to nontarget plant and animal species.

References

ChemID Plus. 2004. U.S. National Library of Medicine. National Institutes of Health, Department of Health & Human Services. Last modified: September 9, 2004. <http://chem.sis.nlm.nih.gov/chemidplus/>.

EPI (Estimation Programs Interface) Suite™ version. 3.12 (August 17, 2004). 2000. U.S. Environmental Protection Agency. Office of Pesticide Prgorams and Syracuse Research Corporation. <http://www.epa.gov/opptintr/exposure/docs/EPISuitedl.htm>

Gomes-Carneiro, M.R., I. Felzenszwalb and F.J.R. Paumgartten. 1998. Mutagenicity testing of (±)-camphor, *1,8*-cineole, citral, citronellal, ()-menthol and terpineol with the *Salmonella/* microsome assay. Mutat. Res., Vol. 416, p. 129-136.

HSDB. Hazardous Substance Database. 2004. U.S. National Library of Medicine, National Institutes of Health. Updated: September 9, 2004 <http://toxnet.nlm.nih.gov>.

IPCS. 2003. International Programme on Chemical Safety. Poisons Information Monographs. Camphor (PIM 095). <http://www.inchem.org/documents/pims/pharm/camphor.htm#SectionTitle:7.2%20Toxicity>.

MSDS. 2003. Camphor. Mallinckrodt Baker, Inc. <http://www.jtbaker.com/msds/english.html/c0594.htm>

NTP. 1992a. National Toxicology Program. Final Report on the Developmental Toxicity of *d*-Camphor (CAS No. 464-49-3) in Sprague-Dawley Rats, NTP Study No. TER 91018.

NTP. 1992b. National Toxicology Program. Final Report on the Developmental Toxicity of *d*-Camphor (CAS No. 464-49-3) in New Zealand White (NZW) Rabbits, NTP Study No. TER 91019.

NTP. 1998. National Toxicology Program. Study No. C87003. 13-Week Topical Application. <http://ntp-apps.niehs.nih.gov/ntp_tox/>.

NTP. 1999. National Toxicology Program. Study No. A69097. Peripheral Blood Micronucleus Assay. <http://ntp-apps.niehs.nih.gov/ntp_tox/>.

RTECS. 2005. NIOSH Registry of Toxic Effects of Chemical Substances, <http://www.cdc.gov/niosh/rtecs/ex12b128.html#Z>. Updated November 2004.