Reregistration Eligibility Decision Exposure and Risk Assessment on Lower Risk Pesticide Chemicals Sabadilla Alkaloids

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Sabadilla Alkaloids

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Background:

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was amended in 1988 to accelerate the reregistration of products with active ingredients registered prior to November 1, 1984. The amended Act calls for the development and submission of data to support the reregistration of an active ingredient, as well as a review of all submitted data by the U.S. Environmental Protection Agency (referred to as EPA or the Agency). Reregistration involves a thorough review of the scientific database underlying a pesticide's registration. The purpose of the Agency's review is to reassess the potential hazards arising from the currently registered uses of the pesticide; to determine the need for additional data on health and environmental effects; and to determine whether or not the pesticide meets the "no unreasonable adverse effects" criteria of FIFRA.

On August 3, 1996, the Food Quality Protection Act (FQPA) was signed into law. This Act amends FIFRA to require tolerance reassessment during reregistration. It also requires that by 2006, EPA must review all tolerances in effect on the day before the date of the enactment. FQPA also amends the Federal Food, Drug, and Cosmetic Act (FFDCA) to require a safety finding in tolerance reassessment based on factors including an assessment of cumulative effects of chemicals with a common mechanism of toxicity.

This document represents the Lower Risk Pesticide Chemical Focus Group's (LRPCFG) Reregistration Eligibility Decision (RED) and the reassessment of the exemption from the requirement of a tolerance for residues on sabadilla alkaloids. This assessment summarizes available information on the use, physical/chemical properties, toxicological effects, exposure profile, occupational exposure and reentry, dietary assessment, environmental fate and ecotoxicity, and ecological risk assessments for sabadilla alkaloids. In compiling this RED and performing this tolerance reassessment, EPA has utilized reviews previously performed by U.S. EPA and the California Department of Pesticide Regulation (CDPR). EPA established an exemption from the requirement for a tolerance for residues of sabadilla alkaloids when used as an active ingredient in products applied to growing crops, in accordance with good agricultural practice. The Agency has considered any new data generated after the tolerance exemption was issued, new Agency guidance or other federal regulations, as well as previously available information in this assessment.

I. Executive Summary:

Sabadilla alkaloids are insecticides used for the control of thrips on citrus, avocados, and mangos. The available toxicity information was collected on sabadilla alkaloids, and an endpoint was selected for assessing short-term exposures for occupational handlers and for post-application exposures, as well as dietary exposures. An oral, toxicological, no observed adverse effects level (NOAEL) endpoint of 11 mg/kg/day for the alkaloids (derived from a NOEL of 250 mg/kg/day on seed) was selected to assess the short-term dermal and inhalation handler exposures, post-application dermal exposures, and dietary exposures. The dermal and inhalation doses were conservatively estimated from the equivalent oral dose using a 100% absorption factor. An uncertainty factor of 100 (10 for interspecies extrapolation and 10 for intraspecies variation) was used for this assessment, and therefore, the Margin of Exposure (MOE) of concern is 100 for the occupational handler and post-application exposures.

Sabadilla alkaloids are formulated as a wettable powder for use as an insecticide on citrus, avocados, and mangos, and mixed with water and applied with either aerial or ground equipment. The exposure scenarios chosen for this risk assessment were based on the anticipated use patterns from the current label for the sabadilla alkaloids end-use product. In addition, the application rates were determined based on

information provided on the currently registered product label. For the agricultural crop scenarios, the only short-term dermal MOE less than 100 was the baseline attire scenario for the Mixing/Loading Wettable Powders for Aerial Applications. However, with the addition of personal protective equipment (PPE), specifically, chemical-resistant gloves, this scenario also reached an MOE of greater than 100. All of the inhalation MOEs were greater than 100.

In order to assess occupational post-application exposure, transfer coefficients were used to numerically represent the post-application exposures an individual would receive. The approach used to reduce post-application risks is referred to as the Restricted Entry Interval (REI). The REI is a time period following a pesticide application during which entry into the treated area is restricted. The REIs calculated for the varying levels of exposure to sabadilla alkaloids are all less than 24 hours. The product label states that worker entry into treated areas is restricted for 24 hours after application and that early entry to treated areas requires the use of PPE. Therefore, post-application exposure to workers is minimal.

Sabadilla alkaloid acute and chronic dietary exposure assessments were conducted using the Dietary Exposure Evaluation Model. The assessments show that the sabadilla alkaloids are 38% of the aPAD and 8% of the cPADfor the most sensitive age group (children 1-2 years old), and less than 13% of the aPAD and 3% of the cPAD for the general U.S. population. In addition, the estimated drinking water concentrations (EDWCs) were calculated by utilizing models. The estimated drinking water concentrations are very low for the various sabadilla alkaloids, ranging between 1.62 and 1.80 ppb for the annual peak concentrations, and 0.05 and 0.10 ppb for the annual mean concentrations for surface waters, and 0.00072 ppb (0.72 parts per trillion) for groundwater.

Very little measured data are available on the physical and chemical properties or the environmental fate of sabadilla alkaloids. The major route of dissipation and degradation appears to be photolysis, because biodegradation and hydrolysis occur at considerably slower rates. Volatilization from soil and water is probably not important, due to the expected low vapor pressures. While no measured data are available on soil mobility, the physical and chemical properties of sabadilla alkaloids indicate likely low mobility in soil.

Available and estimated data on toxicity and exposure indicate that sabadilla alkaloids present minimal risks to small mammals on an acute basis. Risk assessments suggest risk concerns for endangered species (mammals) at the maximum application rates, but at the typical application rates, with shorter estimated half-lives, and longer intervals between applications, the endangered species risks were only slightly elevated, and only for small mammals (15 grams) feeding on short grass. Risks to terrestrial plants cannot be quantified due to a lack of phytotoxicity data. Similarly, no data were available to quantify the acute or chronic risks to birds, but the available acute ecotoxicity data for fish do not suggest a substantial potential for adverse effects, and QSAR estimates on the alkaloids indicate no chronic toxicity concerns for fish and green algae, and no acute concerns for daphnia. Furthermore, there is only a small volume of end-use product used on an annual basis, on a limited number of minor use crops, in a limited geographical area, further suggesting that the ecological risks would not be expected to be very wide-spread. Note also, with respect to endangered species, this is a screening level and/or qualitative assessment, and does not constitute any findings under the Endangered Species Act.

II. Use Information:

Sabadilla alkaloids are insecticides used for the control of citrus thrips and other species of thrips. The alkaloids are obtained as an extract from the ground seeds from the sabadilla plant, with the primary insecticidal component being veratrine (CAS No. 8051-02-3), consisting of a complex mixture, with the two primary alkaloids being cevadine (crystalline veratrine) and veratridine (amorphous veratrine), according to the Merck Index.

At present, there is only one registered product containing sabadilla as an active ingredient (EPA Registration Number 39834-1). This product is used for agricultural purposes on citrus, avocados, and mangos. There are no residential uses. The formulation is a wettable powder, with the active ingredient listed on the label as "0.2% sabadilla alkaloids." The label lists both aerial and ground application methods, with the following rates: 10 to 15 lbs (of end-use product) per acre in 10 to 40 gallons of water for aerial applications; and for ground applications, 10 to 15 lbs per acre in 20 to 100 gallons of water, unless 200 gallons of spray are applied per acre, then the maximum rate is 20 lbs per acre. The label also indicates the following, for each of the three crops: "Reapply as needed, usually at a 10-14 day interval. Do not apply at time of harvest." The label does not indicate the maximum number of times per year the product may be applied, nor is information provided by the Biological and Economic Analysis Division (BEAD) in their various Usage and Label Use Data Reports for the maximum number of applications per growing season or per year, but BEAD does indicate that timing of the applications may be made as follows: pre-bloom, bloom, and foliar applications. The EFED Science Assessment utilized 3 applications per year.

BEAD does not provide a recent Quantitative Usage Analysis, but does provide a recent Screening Level Estimate of Agricultural Uses, which lists less than 500 pounds of active ingredient per year applied to each crop (See Appendix A). The EFED Science Assessment references the Pesticide Action Network (PAN, 2004) on-line data, which estimates that 264.3 Gross Pounds per year (based on the amount of active ingredient) are applied in California. Based on its usage pattern, most of the end-use product is probably applied in the State of California.

The exemption from the requirement of a tolerance being reassessed in this document, the respective citation in the Code of Federal Regulations (CFR), and the use pattern as an active ingredient are listed in Table 1.

Table 1. Exemption from the Requirement of a Tolerance Reassessed in this Document

Tolerance Exemption Expression	CAS No.	40 CFR	PC Code	Use Pattern
Sabadilla	8051-02-3	180.905 (a)(8) [a]	002201	Insecticide

a Residues listed in section (a) of 40 CFR 180.905 are exempt from a tolerance when applied to growing crops; section (b) indicates that the pesticides in section (a) are not exempted from the requirement of a tolerance when applied to a crop at the time of or after harvest. The label for the only sabadilla alkaloids end-use product indicates "Do not apply at time of harvest." There are also no post-harvest uses.

III. Physical/Chemical Properties:

The physical and chemical properties of the two primary sabadilla alkaloids, cevadine and veratridine, as well as some of the secondary alkaloids, are provided in Table 2. The Environmental Fate and Effects

Division (EFED) Science Assessment reported that the measured water solubility of the veratrine mixture was 555 mg/L. That assessment also reported that "Very little experimental data are available on the chemical and physical properties of the individual alkaloids. Due to the lack of experimental data, many estimates of properties used for quantifying exposures must be based on quantitative structure activity relationships (QSARs)." The EPIWIN model was utilized. In addition, the EFED Science Assessment reported that "the vapor pressure and Henry's Law constants for the sabadilla alkaloids are negligible." Although the numerical QSAR estimated vapor pressure values not actually reported, the information presented indicates that the potential volatilization from water or from moist soil is very limited, and similarly that the potential for inhalation exposure is minimal.

Table 2. Physical/Chemical Properties for the Primary Sabadilla Alkaloids, Cevadine and Veratridine, as well as for some of the secondary alkaloids

Chemical	CAS No.	Molecular formula	Molecular weight	Melting point	Water Solubility (mg/L)	Dissociation Constant (pKa)	Octanol-Water Partition Coefficient (Log Kow)	Soil Sorption Coefficient (mL/g) (Koc)
Cevadine	62-59-9	$C_{32}H_{49}NO_9$	591.7	205°C [d]	570 [b]	9.2 [c]	0.89 [a]	9.7×10^4 [a]
Veratridine	71-62-5	$C_{23}H_{51}NO_{11}$	673.8	180°C [d]	140 [a]	9.54 [d]	0.68 [a]	2.0×10^5 [a]
Sabadine	124-80-1	$C_{29}H_{47}NO_8$	573.7	285°C [a]	2,232 [a]	9.2 [c]	0.32 [a]	1.8×10^5 [a]
Sabadinine	124-98-1	$C_{27}H_{43}NO_8$	509.6	281°C [a]	1×10^6 [a]	9.2 [c]	-1.20 [a]	6.1×10^4 [a]
Sabadilline	1415-76-5	$C_{34}H_{53}NO_8$	NA	NA	NA	NA	NA	NA

References: a) EPIWIN (2004), b) Gunther et al. (1968), c) SPARC (2004), d) Tomlin (2003), and e) Toxnet (2004).
NA: Not Available.

IV. Hazard Assessment:

Toxicity Data:

Key toxicological data for sabadilla alkaloids are provided in Table 3. These data were obtained from data reviews by CDPR (2001), and two EPA Data Evaluation Records (EPA, 1996, and 2004).

Table 3. Summary of Toxicity Data for Sabadilla Alkaloids

Acute Toxicity					
Test	Species	Route of Administration	Results	Toxicity Category	Reference
Oral LD_{50} (mg/kg-body weight)	Rat	Oral	> 5000 (no deaths)	IV	EPA (1996)
Dermal (mg/kg-body weight)	Rabbit	Dermal	> 2000 (no deaths)	III	
Inhalation (mg/L)	Rat	Inhalation	> 2.10 (no deaths)	IV	EPA (2004)

Test	Species	Route of Administration	Results	Toxicity Category	Reference
Eye Irritation	Rabbit	Eye instillation	some effects on cornea and iris, plus redness of conjunctiva at 1 hour, but non-irritating (clear) at 24 hours and thereafter	IV	EPA (1996)
Dermal Irritation	Rabbit	Applied topically	No irritation observed	IV	
Dermal Sensitization	Guinea pig	Modified Buehler assay	Non-Sensitizing (no dermal response in screening, induction, or challenge phases)		
Subchronic Oral Toxicity					
Oral (mg/kg/day)	Rat	Diet: ground sabadilla seeds admixed with feed: 90 days	NOEL: 250 mg/kg/day LOEL: 500 mg/kg/day Reduced food consumption in high-dose, and reduced body weights in mid- and high-dose males and females. Dose range (nominal): 0, 250, 500, and 1000 mg/kg/day [Sabadilla Seed - Technical grade (Veratran Technical, purity: 4.83% Total Alkaloids)]		CDPR (2001)
Reproductive and Developmental Toxicity					
Oral (mg/kg/day)	Rat	Gavage: gestation days 6-17	Maternal NOEL: 50 mg/kg/day Developmental NOEL: 250 mg/kg/day Maternal LOEL: 250 mg/kg/day (clinical signs) Developmental LOEL: 500 mg/kg/day (reduced mean fetal weights, as well as misaligned and unossified sternebrae) No adverse development effects. Dose range: 0, 50, 250, and 500 mg/kg/day [Veratran D, Technical, assumed 100%]		CDPR (2001)

The CDPR review document (2001) also provided information on gene mutation, chromosome effects, and DNA damage. In the mutagenesis study performed to evaluate the mutagenic potential of sabadilla using mouse lymphoma cells, it was reported that ground sabadilla seed did not increase mutation frequency (without activation), but those mouse lymphoma cells plated with rat liver metabolic activation were found to exhibit mutant frequencies approximately two-fold greater than the solvent control. This response is generally regarded as equivocal, as the study authors concluded (MRID 46283307), and is usually confirmed by repeating the assay with metabolic activation. The study investigators also noted that there was no dose-related response in this assay and significant toxicity (growth $\leq$50% of the solvent control) was observed at the 4 highest doses. The study report also indicated a problem with test substance sterility, which was solved by irradiating the test material, yet no information on the effects of radiation on the alkaloid constituents is included. In addition, DSMO was used to suspend the ground seed for testing which raises a question of consistency in dosing *in vitro*.

The CDPR review reported additional findings from the mutagenesis study, specifically, an increase in small colonies compared with solvent controls, "suggesting chromosomal aberrations on chromosome 11 as well as more localized damage," and concluded there was a "possible adverse effect" as a result of exposure of mouse lymphoma cells to the ground sabadilla seeds. It should be noted, however, that the

doses tested did exhibit some cytotoxicity. Furthermore, a micronucleus cytogenetic assay (MRID 46283309) was conducted in mice and reviewed by CDPR. CDPR determined that the results indicated that there was no evidence of induction of micronuclei in the polychromatic erythrocytes of the mice exposed to ground sabadilla seeds, mixed into water and injected into the mice. An Ames test (MRID 46283311) was also submitted, and there was no evidence of mutagenic activity at dose levels up to 5,000 µg/ml with or without metabolic activation.

The Agency considers the negative results in the micronucleus and Ames tests as further evidence that the equivocal results in the mouse lymphoma assay are not a concern. Therefore, the available mutagenicity studies did not indicate that sabadilla alkaloids had a potentially adverse effect on chromosome structure.

Special Considerations for Infants and Children:

The developmental toxicity study reviewed in the CDPR document (2001) examined maternal and development effects in female rats exposed to sabadilla alkaloids during gestation days 6 through 17. Development effects, including an increase in skeletal variations (arches incompletely ossified, sternebrae unossified, and sternebrae misaligned), were observed at 500 mg/kg/day. However, the CDPR DER concluded that these effects were "not a direct effect of sabadilla, but associated with reduced fetal weight." Moreover, the effects in the maternal group were observed at the mid-dose feeding level.
Therefore, considering that at this time, the available data do not indicate any potential sensitivity to infants and children resulting from exposure to sabadilla alkaloids, the additional tenfold FQPA safety factor is deemed unnecessary, and has been removed.

Toxicity Endpoint Selection:

For this assessment of sabadilla alkaloids, short-term (1 to 30 days) occupational handler inhalation and dermal exposure were examined, as well as post-application dermal exposures, and acute and chronic dietary exposures. Inhalation exposures are thought to be negligible in outdoor post-application scenarios due to the infinite dilution expected outdoors and the very low vapor pressure. As such, inhalation post-application exposures are not considered in this assessment.

Since there are no inhalation or dermal toxicological studies available in the existing literature, an oral NOAEL was used to assess short-term dermal and inhalation exposures. The dermal and inhalation doses were conservatively converted to an equivalent oral dose using a 100% absorption factor. The same NOAEL was utilized for post-application dermal exposures and acute and chronic dietary exposures. The oral toxicological endpoint used for sabadilla alkaloids was a NOAEL of 11 mg/kg/day, derived from a NOEL (as identified in the CDPR review) of 250 mg/kg/day from the 90-day feeding study on sabadilla seed containing 4.83% total alkaloids. The 250 mg/kg/day concentration selected as the NOEL in the 90-day study was identified as a nominal dose, with the actual dose being 230 mg/kg/day. Therefore, the NOAEL of 11 mg/kg/day on the alkaloids was calculated as 4.83% of 230 mg/kg/day. This NOEL (250 mg/kg/day) for the seed was based on decreased relative liver weights, elevated serum chemistry (BUN), as well as reduced food consumption and body weights in females at the next highest dose level of 500 mg/kg/day.

The developmental toxicity study, also performed on the sabadilla seed, in the CALEPA document (2001) identified a maternal NOEL of 50 mg/kg/day based on body surface staining, red area around eyes, material around eyes, and increased salivation in the 250 mg/kg/day group. These effects, however, are not

considered "adverse" by the Agency and may be gavage related, therefore 250 mg/kg/day is considered to be the NOAEL based on adverse clinical effects (e.g., ataxia, abnormal gait, decreased activity, and labored breathing) observed at 500 mg/kg/day.

V. Exposure Assessment:

Sabadilla alkaloids are formulated as a wettable powder for use as an insecticide on citrus, avocados, and mangos. The end-use product is applied with either aerial or ground (i.e., airblast) equipment. Table 4 provides the acres treated per day and the maximum application rate for each type of application method. The daily acres treated were defined for each handler scenario (in appropriate units) by determining the amount that can be reasonably treated in a single day (e.g., acres, square feet, cubic feet, or gallons per day). It was assumed that the average occupational workday is 8 hours.

Table 4: Summary of Maximum Application Rates for Sabadilla Alkaloids Agricultural Crop Uses

Crop Type/ Use Site	Application Equipment	Acres Treated Per Day	Maximum Application Rate
Citrus, avocados, mango	aerial	350	0.03 lb ai/acre[a]
	airblast	40	0.04 lb ai/acre[b]

a From product label, 0.2% sabadilla alkaloids as active ingredient; apply 15 pounds of end-use product per acre maximum; assumed percent by weight; therefore, apply 0.03 lb ai/acre.
b From label regarding Ground Application: "Use 10 to 15 lbs. per acre in 20 to 100 gallons of water. If 200 gallons of spray solution are applied per acre increase dose to 20 lbs per acre." Therefore, maximum application rate for ground application is 0.04 lb ai/acre.

It has been determined that there is a potential for exposure to sabadilla alkaloids in occupational scenarios from handling sabadilla alkaloids products during the application process (i.e., mixer/loaders, applicators, and flaggers), and a potential for post-application worker exposure from entering into areas previously treated with sabadilla alkaloids. As a result, risk assessments have been completed for occupational handler scenarios as well as occupational post-application scenarios.

The exposure scenarios chosen for this risk assessment were based on the anticipated use patterns and the current label for the sabadilla alkaloids product (see Table 5). In addition, the application rate was estimated based on information provided on the product label. The average body weight of an adult (70 kg) was assumed. The oral NOAEL of 11 mg/kg/day was used for the short-term exposure estimates. An uncertainty factor of 100 (10 for interspecies extrapolation and 10 for intraspecies variation) was used for this assessment and, therefore, the MOE of concern is 100 for the occupational exposure risk assessment.

The occupational handler exposure assessments were completed considering different levels of personal protective equipment (PPE). A tiered approach was used, with the lowest tier represented by the baseline attire exposure scenario (i.e., long-sleeve shirt, long pants, shoes, and socks), followed by increasing levels of personal protective equipment or PPE (e.g., gloves, double-layer body protection, and respirators) and engineering controls (e.g., enclosed cabs and closed mixing/loading systems). Because there were no chemical-specific worker exposure data for sabadilla alkaloids, occupational handler exposure estimates were based on surrogate data from the Pesticide Handlers Exposure Database (PHED).

Based on the expected usage pattern, only short-term exposure assessments were completed, with short-

term defined as exposures of from 1 to 30 days. For the agricultural crop scenarios, the only short-term dermal MOE less than 100 was 20, for the Mixing/Loading Wettable Powders for Aerial Applications with the baseline attire scenario (see Table 5). However, with the addition of minimal PPE, specifically using chemical-resistant gloves with single layer of clothing, this scenario reached an MOE of greater than 100. All of the inhalation MOEs were greater than 100 at the baseline attire scenario (See Table 6).

In order to assess occupational post-application exposure, the amount of transferable residues a worker could be exposed to was examined. Since there are no chemical-specific data for the sabadilla alkaloids, conservative values for the transfer coefficients were used to numerically represent the post-application exposures an individual would receive. The amounts of pesticide that can rub off on the skin are measured using techniques that specifically determine the amount of residues on treated leaves or other surfaces (i.e., transferable residues), rather than the total residues contained both on the surface and absorbed into treated leaves. The result yields an estimated transfer coefficient that is used to numerically represent the post-application exposures that an individual would receive. Transfer coefficients are related to specific worker activities, which are related to specific crops, for sabadilla alkaloids, citrus, avocados, and mangoes. To cultivate, grow, and maintain these crops, a variety of cultural practices are required. These practices are varied and typically involve light to heavy contact, with immature plants as well as with more mature plants. Transfer coefficient values are selected to represent this range of exposures and are placed in 1 of 5 generic categories: very low exposure, low exposure, medium exposure, high exposure, and very high exposure.

In order to define the amount of transferable residues to which individuals can be exposed, all of the various post-application agricultural crop scenarios were evaluated using the assumption that 20 percent of the application rate is initially available as a dislodgeable foliar residue and 10 percent of that residue dissipates daily. The approach used to reduce post-application risks is referred to as the Restricted Entry Interval (REI). The REI is a time period following a pesticide application during which entry into the treated area is restricted. The REIs calculated for the varying levels of exposure to sabadilla alkaloids are all less than 24 hours and indicate that there is little risk to workers exposed following application. In addition the current label for the one end-use product does list an REI of 24 hours.

Table 5. Short-Term Dermal Occupational Handler Risks

Exposure Scenario	Application Rate[a] (lb ai/acre)	Area Treated Daily[b] (acres)	Unit Exposures				Baseline Attire[c] MOE[g]	PPE MOE[g]		Engineering Control[e] MOE[g]
			Baseline (mg/lb ai)	PPE (mg/lb ai)		Engineering Controls (mg/lb ai)		Single Layer plus Gloves[d]	Double Layer plus Gloves	
				Single Layer plus Gloves	Double Layer plus gloves					
Mixer/Loader										
Mixing/ Loading Wettable Powders for Aerial Applications	0.03	350	3.7	0.17	N/A	N/A	**20**	370	N/A	N/A
Mixing/ Loading Wettable Powders for Airblast Applications	0.04	40	3.7	N/A	N/A	N/A	130	N/A	N/A	N/A
Applicator										
Applying Liquid Sprays via Aerial Equipment	0.03	350	No Data	No Data	No Data	0.005	No Data	No Data	No Data	15,158
Applying Liquid Sprays via Airblast Equipment	0.04	40	0.36	N/A	N/A	N/A	1,283	N/A	N/A	N/A
Flagger										
Flagging for Liquid Sprays via Aerial Equipment	0.03	350	0.011	No Data	N/A	N/A	6,647	No Data	N/A	N/A

a Application rates are the maximum application rates determined from the EPA registered label for sabadilla alkaloids (see Table 4).
b Amount handled per day values are estimates of acres treated daily.
c Baseline attire is long-sleeve shirt, long pants, shoes and socks, and no gloves.
d PPE-single layer plus gloves is baseline attire plus chemical-resistant gloves.
e Engineering Controls: Closed mixing/loading system, enclosed cab, or enclosed cockpit.
g Dermal MOE = NOEL (11 mg/kg/day) / dermal daily dose (mg/kg/day), where dermal dose = daily unit exposure (mg/lb ai) x application rate x amount handled per day / body weight (70 kg adult).

Table 6. Short-Term Inhalation Occupational Handler Risks

Exposure Scenario	Application Rate[a] (lb ai/acre)	Area Treated Daily[b] (acres)	Unit Exposures			Baseline Attire[c] MOE[f]	PPE MOE[f]	Engineering Control[e] MOE[f]
			Baseline (µg/lb ai)	PPE - 80% Respirator (µg/lb ai)	Engineering Controls (µg/lb ai)		80% Respirator[d]	
Mixer/Loader								
Mixing/Loading Wettable Powders for Aerial Applications	0.03	350	43	N/A	N/A	1,750	N/A	N/A
Mixing/Loading Wettable Powders for Airblast Applications	0.04	40	43	N/A	N/A	11,194	N/A	N/A
Applicator								
Applying Liquid Sprays via Aerial Equipment	0.03	350	No Data	No Data	0.068	No Data	No Data	1,072,720
Applying Liquid Sprays via Airblast Equipment	0.04	40	4.5	N/A	N/A	107,272	N/A	N/A
Flagger								
Flagging for Liquid Sprays via Aerial Equipment	0.03	350	0.35	N/A	N/A	209,880	N/A	N/A

a Application rates are the maximum application rates determined from the EPA registered label for sabadilla alkaloids (see Table 4).
b Amount handled per day values are estimates of acres treated daily.
c Baseline attire is no respirator.
d PPE-80% Respirator is a quarter-face dust/mist respirator (that provides an 80% protection factor).
e Engineering Controls are closed mixing/loading systems, enclosed cab, or enclosed cockpit.
f Inhalation MOE = NOEL (11 mg/kg/day) / inhalation daily dose (mg/kg/day), where inhalation dose = daily unit exposure (µg/lb ai) x application rate x amount handled per day x conversion factor (1mg/1,000 µg) / body weight (70 kg adult).

VI. Dietary (Food) Exposure:

Acute and chronic dietary exposure assessments were conducted for sabadilla alkaloids using the Dietary Exposure Evaluation Model software with the Food Commodity Intake Database (DEEM-FCID™, Version 2.03), which incorporates consumption data from US Department of Agriculture (USDA) Continuing Surveys of Food Intakes by Individuals (CSFII), 1994-1996 and 1998. The 1994-96 and 1998 data are based on the reported consumption of more than 20,000 individuals over two non-consecutive survey days. Foods "as consumed" (e.g., apple pie) are linked to EPA-defined food commodities (e.g. apples, peeled fruit - cooked; fresh or not otherwise specified (N/S); baked; or wheat flour - cooked; fresh or N/S, baked) using publicly available recipe translation files developed jointly by USDA/Agricultural Research Service and EPA. For the chronic exposure assessment, consumption data are averaged for the entire U.S. population and within population subgroups, but for the acute exposure assessment are retained as individual consumption events. Based on analysis of the 1994-96 and 1998 CSFII consumption data, which took into account dietary patterns and survey respondents, the Agency concluded that it is most appropriate to report risk for the following population subgroups: the general U.S. population, all infants (<1 year old), children 1-2 years old, children 3-5, children 6-12, youth 13-19, adults 20-49, females 13-49, and adults 50+ years old.

For chronic dietary exposure assessment, an estimate of the residue level in each food or food-form (e.g., orange or orange juice) on the food commodity residue list is multiplied by the average daily consumption estimate for that food/food form. The resulting residue consumption estimate for each food/food form is summed with the residue consumption estimates for all other food/food forms on the commodity residue list to arrive at the total average estimated exposure. The exposure is expressed in mg/kg body weight/day, and as a percent of the acute and chronic Population Adjusted Dose (cPAD). The value for the PAD was taken as equal to the Reference Dose (RfD) of 0.11 mg/kg/day, derived from the oral NOAEL of 11 mg/kg/day from the 90-day feeding study in the rat, with a Safety Factor of 100 applied to determine the RfD. This exposure estimation procedure for dietary exposures is performed for each population subgroup.

For acute exposure assessments, one-day food consumption data are used on an individual basis. The reported consumption amounts of each food item can be multiplied by a residue point estimate and summed to obtain a total daily pesticide exposure for a deterministic exposure assessment, or "matched" in multiple random pairings with residue values and then summed in a probabilistic assessment. The resulting distribution of exposures is expressed as a percentage of the acute PAD (aPAD) on both a user (i.e., those who reported eating relevant commodities/food forms) and a per-capita (i.e., those who reported eating the relevant commodities as well as those who did not) basis.

Since there were no available residue data for the sabadilla alkaloids in the respective food commodities, in conducting this assessment, the Agency has utilized a screening model, the inert screening level assessment, to estimate the residue levels and applied them to citrus, avocados, and mangoes. The screening level assessment uses the following criteria in selecting and assigning residue values:

- A group of 57 of the most "significant" active ingredients were considered. These active ingredients included substances in the insecticide (20) , fungicide (17), and herbicide class (20), and were selected based on a overall ranking scheme that included the following components:
    - Overall Use–Based on 1999 data for active ingredient use (in lbs/yr). (All herbicides at >5 million lbs/yr, and all fungicides and insecticides at > 1 million lbs/yr were included.)
    - Use on crops that are significant contributors to diet. (All active ingredients which had

substantial use on crops that make up the "Top 25 " foods most commonly consumed in the diet of children were included.)
    - Use on specific crops. (Crop-by-crop pesticide use information was evaluated to identify the most frequently used active ingredients.)
    - Actual residue monitoring studies (active ingredients with the highest frequency of detection).
- Tolerances for the 57 active ingredients were examined for each of the representative crops in the Agency's crop group designations [40 CFR 180.41], and for all crops not included in a crop group. Where there were multiple tolerances for a given crop or commodity, the highest tolerance was chosen as the residue level for the model.
- Non-representative crops within each crop group were matched to their most-closely related representative crop.

For these assessments, the screening-level residue estimates were modified in two ways. First, residues were multiplied by four because the screening level assessment assumes application rates of approximately 5 lbs/A and the Veratran D label lists a maximum application rate of 20 lbs/A (20 lbs/A ÷ 5 lbs/A = 4). Second, the residue estimates were multiplied by 0.05 to account for the fact that the sabadilla alkaloids comprise only 0.2% of the Veratran D formulation. This 5% factor is considered to be a conservative adjustment for the percentage of active ingredient in the formulation. The inputs to the dietary exposure model are included in Attachment 1.

The Agency is generally not concerned when exposure estimates are less than 100% of the aPAD or cPAD. As summarized in Table 7, the exposure estimates for the sabadilla alkaloids are about 38% or less than the aPAD, and about 8% or less than the cPAD, for each of the population subgroups.

Table 7. Summary of Dietary Exposure and Risk for Sabadilla Alkaloids

Population Subgroup*	Acute Dietary (95th Percentile)		Chronic Dietary		Cancer	
	Dietary Exposure (mg/kg/day)	% aPAD*	Dietary Exposure (mg/kg/day)	% cPAD*	Dietary Exposure (mg/kg/day)	Risk
General U.S. Population	0.012939	12	0.002540	3	N/A	N/A
All Infants (< 1 year old)	0.003651	4	0.001220	2		
Children 1-2 years old	0.041061	38	0.008229	8		
Children 3-5 years old	0.030861	28	0.006498	6		
Children 6-12 years old	0.019631	18	0.004028	4		
Youth 13-19 years old	0.014617	14	0.002693	3		
Adults 20-49 years old	0.010098	10	0.001804	2		
Adults 50+ years old	0.008154	8	0.001816	2		
Females 13-49 years old	0.011084	10	0.001981	2		

VII. Drinking Water Exposure:

Tier I Estimated Drinking Water Concentrations (EDWCs) for sabadilla alkaloids were calculated by utilizing the FIRST V. 1.0 (surface water) and SCIGROW V. 2.3 (ground water) models for use in the human health risk assessment. For surface waters, the estimated peak concentrations ranged between 1.62

ppb and 1.80 ppb, and the annual average concentrations ranged between 0.05 ppb and 0.10 ppb, depending on the individual alkaloid assessed (Table 8). The estimated ground water concentrations, suitable for both peak and annual average concentrations, are all about 0.0007 ppb (= 0.7 parts per trillion), regardless of the individual alkaloid assessed. These values represent "conservative" (i.e., high-end) estimates of the concentrations of sabadilla alkaloids that could be found in surface and ground water due to the use on citrus, avocados, and mangoes, the crops on the current label. There are no available monitoring data for assessing these EDWCs in either surface waters or ground water.

Table 8. Estimated Environmental Concentrations (ppb) of Sabadilla Alkaloids in Surface and Groundwater at Three Applications of 0.04 lb/acre with 10-day Intervals.

Scenario	Peak (ppb)	Long-Term Average, Peak (ppb)				
		Annual	4-day	21-day	60-day	90-day
Surface water drinking water (FIRST)[1]	1.62 - 1.80	0.05 - 0.10				
Ambient surface water (GENEEC)[1]	0.38 - 0.58		0.27 - 0.50	0.07 - 0.23	0.03 - 0.09	0.02 - 0.06
Groundwater drinking water (SCI-GROW)	0.0007					

[1] The range of concentrations represent model output for four of the sabadilla alkaloids (cevadine, veratridine, sabadine, sabadinine).

VIII. Aggregate Assessment:

The Food Quality Protection Act amendments to the Federal Food, Drug, and Cosmetic Act [FFDCA, Section 408(b)(2)(A)(ii)] require "that there is a reasonable certainty that no harm will result from aggregate exposure to pesticide chemical residue, including all anticipated dietary exposures and other exposures for which there are reliable information." Aggregate exposure typically includes exposures from food, drinking water, residential uses of a pesticide, and other non-occupational sources of exposure. For an aggregate assessment of sabadilla alkaloids, the only significant exposure routes are oral exposure through food and water consumption, because there are no registered residential uses or other non-occupational sources of exposure.

To determine the maximum contribution allowed from water in the diet, the Agency first looks at how much of the overall allowable risk is contributed by food to determine a "drinking water level of comparison" (DWLOC). The modeled drinking water estimates are then compared to the DWLOC to ensure that they do not exceed this level. Acute and chronic dietary exposure assessments were conducted, and show that sabadilla alkaloids represent a small percent of the PAD, specifically, less than or equal to 38% of the aPAD, and 8% of the cPAD, for all population subgroups. The Agency is generally not concerned when dietary exposure estimates are less than 100% of the PAD. In addition, drinking water concentrations are also very low. Estimated sabadilla alkaloid concentrations in drinking water range between 1.62 and 1.80 ppb for the annual peak concentration, and 0.05 and 0.10 ppb for the annual mean concentration.

Since the dietary contribution is significantly below the PAD and the estimated drinking water exposure levels are minimal, the Agency considers it very unlikely that levels of concern would be reached from the

combination of these two exposure sources. As support for this position, the chronic risk estimates for exposure to food and drinking water sources for the most sensitive population subgroup (children 1-2 years old) and for the general U.S. population have been determined (see Table 1). Considering that the estimated environmental concentrations of sabadilla alkaloids are significantly below the DWLOC for the most sensitive population subgroup, and the low production volume and total amount applied of this chemical, the risks associated with food and drinking water exposures to sabadilla alkaloids are not of concern to the Agency.

Table 9. Summary of Aggregate Risk Estimates for Chronic Food and Water Exposures to Sabadilla Alkaloids

Population Subgroup	Chronic PAD (mg/kg/d)	Food Exposure (mg/kg/d)	Allowable Water Exposure (mg/kg/d)	Annual Peak in Drinking Water (ppb)	Annual Mean in Drinking Water (ppb)	DWLOC (ppb)
Children 1-2 yrs. old	0.11	0.008229	0.101771	1.80	0.10	1020
General U.S. Population	0.11	0.002540	0.10746	1.80	0.10	3760

IX. Risk Characterization:

The assessments of occupational handler and post-application exposures to sabadilla alkaloids indicate that there is very little risk associated with its use as an insecticide on agricultural crops. Only one handler scenario indicated an MOE of <100, an MOE of 20 associated with dermal exposures for mixer/loaders handling wettable powders for aerial applications with baseline attire (assumes no gloves). However, according to the label, applicators and other handlers must wear long-sleeved shirts, long pants, waterproof gloves and shoes plus socks. According to the occupational handler assessment for dermal exposures, if gloves are worn, the MOE will exceed 100, and no longer of concern. Inhalation risks were also found to be low, with all scenarios resulting in MOEs greater than 100. For post-application scenarios, the REIs calculated were all less than 24 hours. The product label states that worker entry into treated areas is restricted for 24 hours after application and that early entry to treated areas requires the use of PPE. Therefore, post-application exposure to workers is not of concern.

X. Environmental Fate/Ecotoxicity/Drinking Water Considerations:

Very little measured data are available on the physical and chemical properties or the environmental fate of sabadilla alkaloids. The major route of dissipation and degradation appears to be photolysis, since hydrolysis is predicted to occur at considerably slower rates (days to years) and the biodegradation data for related chemicals suggest that the sabadilla alkaloids may be slow to degrade in the environment. Volatilization from water is probably not important, since the vapor pressure values and Henry's law constants are reported to be "negligible" in the EFED Science Assessment (although the specific QSAR estimated values were not actually reported). While no experimental data are available on soil mobility, the physical and chemical properties of sabadilla alkaloids suggest low mobility in soil, and that sorption to suspended solids and sediment would be expected to occur if sabadilla alkaloids are released to water.

Concentrations of sabadilla alkaloids in surface water were estimated for the exposures for aquatic

organisms by utilizing the Tier 1 and GENEEC v.2.0 model (see Table 8). Applications of sabadilla alkaloids were modeled at the maximum labeled rate of 0.04 lbs a.i./acre for three applications with two 10-day intervals. Model runs were conducted for four of the sabadilla alkaloids: cevadine, veratridine, sabadine, and sabadinine. Sabadilla alkaloid concentrations in ambient surface water (standard small static water body scenario for aquatic exposure) range between 0.38 - 0.58 ppb, depending on the individual alkaloid (Table 8). The long-term average concentrations decline over time for each alkaloid.

The available information on the toxicity of sabadilla alkaloids, the registered uses and areas in which these compounds are applied, physical-chemical properties, and application methods have been considered in characterizing environmental exposures and ecological risks related to labeled uses. Available studies have been conducted on formulations that contained one or more alkaloids. Data gaps were addressed using quantitative structure activity relationships (QSARs). Available and estimated data on toxicity and exposure indicate that sabadilla alkaloids present minimal risks to fish on an acute basis, based on the estimated exposure concentrations (EECs) for the fish species from GENEEC model (see Table 8).

Estimates of the toxicity to small mammals was assessed based on the available toxicity studies in the rat, from oral feeding studies with sabadilla seed technical, comprised of 4.83% total sabadilla alkaloids. Based on the dosages reported in ppm, the EFED Science Assessment computed the corresponding doses in mg total sabadilla alkaloids (TSA) /kg-bw/day, from the 90-day feeding study, 14-day range-finding study for the developmental study, and the developmental toxicity study. Based on these studies, the lowest LD_{50} to the rat was estimated to be 44 mg TSA/kg-bw/day, from the 14-day range-finding study. Based on the limited data set available, the EFED Science Assessment concluded that the sabadilla alkaloids may present a potential for acute RQ risks to small (15 gram) mammals feeding exclusively on short grass. In addition, there are potential endangered species RQ risks to medium (35 gram) and large (100 gram) mammals feeding exclusively on short grass, on tall grass, and feeding on broadleaf/forage plants and small insects, following applications at the maximum allowable rate and shortest interval. However, when the risk assessments are performed utilizing the typical application rates, longer intervals between applications, and shorter half-lives (based on rapid photodegradation), the results suggest only minimal risks, with the only RQ risk exceedances being for small endangered mammals feeding only on the short grass compared with no endangered species risks for the other 4 types of terrestrial exposure pathways. For this typical use scenario, the small mammals feeding on short grass exhibited an RQ of 0.14, while the endangered species RQ of concern is greater than 0.10, a difference which is considered insignificant. Note also that the EFED Science Assessment stated that the toxicity data "should be used in risk assessment with caution since they are based on a very limited number of data points from a single study with female rats of only one strain." In addition, the end-point selected is based on the total sabadilla alkaloids (TSA), whereas the only end-use product currently registered has a label concentration of 0.2% sabadilla alkaloids, and would be mixed with water prior to being applied to the soils and grasses utilized in the terrestrial risk assessment. Furthermore, there is only a small volume of end-use product used on an annual basis, on a limited number of minor use crops, in a limited geographical area, further suggesting that the ecological risks would not be expected to be very wide-spread. Note also, with respect to endangered species, this is a screening level and/or qualitative assessment, and does not constitute any findings under the Endangered Species Act.

A single 48-hour acute toxicity study with the honey bee suggests that sabadilla alkaloids are relatively non-toxic to nontarget insects at maximum application rates. Risks to terrestrial plants cannot be quantified due to a lack of phytotoxicity data. Similarly, no data were available to quantify the acute or chronic risks to birds, but the available acute ecotoxicity data do not suggest a substantial potential for adverse effects. Furthermore, QSAR estimates on the alkaloids indicate no chronic toxicity concerns for fish and green algae, and no acute concerns for daphnia.

XI. 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." If chemicals are structurally related and all are low toxicity chemicals, then the risks either separately or combined should also be low.

EPA does not have, at this time, available data to determine whether sabadilla alkaloids have a common mechanism of toxicity with other substances. 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 sabadilla alkaloids and any other substances, and sabadilla alkaloids do not appear to produce toxic metabolites produced by other substances.

For the purposes of this tolerance action, therefore, EPA has not assumed that sabadilla alkaloids have a common mechanism of toxicity with other substances. For information regarding the Agency'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/.

XII. Tolerance Reassessment:

The current tolerance exemption for sabadilla is at 40 CFR 180.905(a)(8), and defined as exempt from the requirement of a tolerance when applied to growing crops. This pesticide is not exempt from the requirement of a tolerance when applied to a crop at the time of or after harvest. This RED is deemed to have reassessed this tolerance at 40 CFR 180.905(a)(8) and found it acceptable.

XIII. References:

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Appendix 1. BEAD Screening Level Estimate of Agricultural Uses

Sabadilla Alkaloids

The tables below contain "screening level" usage data for agricultural crops. This information is retrieved from our principal agricultural pesticide usage databases. At the present time data from 1998 to 2002 is being used.

All numbers reported are rounded.
'<500' indicates less than 500 pounds of active ingredient.
'<2.5' indicates less than 2.5 percent of crop is treated.

Maximum percent of crop treated is the highest **observed** percent crop treated during this time period. For some crops there may have been only one or two observations and it is quite possible that if usage information had been available for more years that higher usage might have been observed. This situation is more likely to occur with low acreage crops.

'(CA only)' indicates information was available only for California. California requires reporting of all agricultural pesticide use. Their database may indicate small amounts of usage of a pesticide on crops on which the pesticide is not registered. Possible reasons for this include:
- This use may actually have occurred either as an unregistered use or as an experimental or other use in which the crop was not intended for consumption.
- Data input errors may have occurred and either the crop or the pesticide is incorrect in the database.

Use of the chemical on crops for which only California use is reported may possibly have occurred in other states.

In some cases the percent crop treated column is blank. This is because information on acres grown was not readily available.

Some of the numbers may be based on information that does not cover all 50 states. Therefore, it is possible that if the remaining (usually minor states for the crop) had been included that pounds of active ingredient would be slightly higher.

Arthur Grube 308-8095

Last revised Feb 06, 2004

Screening Level Estimates of Agricultural Uses of sabadilla alkaloids
Sorted Alphabetically

OBS	Crop	Pounds of Active Ingredient	Percent of Crop Treated	
			Avg	Max
1	Avocados	<500	10	20
2	Grapefruit	<500	<1	5
3	Lemons	<500	5	5
4	Limes (CA only)	<500		
5	Mangoes (CA only)	<500		
6	Oranges	<500	<1	<2.5
7	Persimmons (CA only)	<500		
8	Stone Fruit (CA only)	<500		
9	Tangelos (CA only)	<500		
10	Tangerines (CA only)	<500		

All numbers rounded.
'<500' indicates less than 500 pounds of active ingredient.
'<2.5' indicates less than 2.5 percent of crop is treated.
'(CA only)' indicates information was available only for California.
Use of sabadilla alkaloids on this crop may also have occurred in other states.

(slua0001.sas sabadilla alkaloids)

Appendix 2. Sabadilla Alkaloids: Acute and Chronic Dietary Exposure Assessments

Appendix 2-1. Dietary Exposure Model Inputs

```
Filename: C:\Documents and Settings\MDOHERTY\My Documents\Chemistry Reviews\DEEM
Runs\Veratran.R98
Chemical: Veratran
RfD(Chronic): .5 mg/kg bw/day  NOEL(Chronic): 50 mg/kg bw/day
RfD(Acute): .5 mg/kg bw/day  NOEL(Acute):  50 mg/kg bw/day
Date created/last modified: 06-22-2004/09:32:21/8          Program ver. 2.03
Comment: Factor 2 of 0.05 is to acknowledge that the active ingredient is only 0.2% of the
formulation.  The 5% factor is a conservative adjustment for the low concentration.
-------------------------------------------------------------------------------
  EPA    Crop                                  Def Res     Adj. Factors  Comment
  Code    Grp  Commodity Name                    (ppm)       #1    #2
-------- ---- -------------------------------  ----------  ------ ------  -------
95000200 O    Avocado                          40.000000   1.000  0.050  10 ppm
          Full comment: 10 ppm screen x 4 (applic. rate factor)
10001060 10   Citrus citron                    20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10001070 10   Citrus hybrids                   20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10001080 10   Citrus, oil                      20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10001800 10   Grapefruit                       20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10001810 10   Grapefruit, juice                20.000000   2.100  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10001970 10   Kumquat                          20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10001990 10   Lemon                            20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10002000 10   Lemon, juice                     20.000000   2.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10002001 10   Lemon, juice-babyfood            20.000000   2.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10002010 10   Lemon, peel                      20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10002060 10   Lime                             20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10002070 10   Lime, juice                      20.000000   2.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10002071 10   Lime, juice-babyfood             20.000000   2.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
95002150 O    Mango                            12.000000   1.000  0.050  3 ppm
          Full comment: 3 ppm screen x 4 (applic. rate factor)
95002151 O    Mango-babyfood                   12.000000   1.800  0.050  3 ppm
          Full comment: 3 ppm x 4; Papaya proc. factor
95002160 O    Mango, dried                     12.000000   1.800  0.050  3 ppm
          Full comment: 3 ppm x 4; Papaya proc. factor
95002170 O    Mango, juice                     12.000000   1.500  0.050  3 ppm
          Full comment: 3 ppm x 4; Papaya proc. factor
95002171 O    Mango, juice-babyfood            12.000000   1.500  0.050  3 ppm
          Full comment: 3 ppm x 4; Papaya proc. factor
10002400 10   Orange                           20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10002410 10   Orange, juice                    20.000000   1.800  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10002411 10   Orange, juice-babyfood           20.000000   1.800  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10002420 10   Orange, peel                     20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10003070 10   Pummelo                          20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10003690 10   Tangerine                        20.000000   1.000  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
10003700 10   Tangerine, juice                 20.000000   2.300  0.050  5 ppm
          Full comment: 5 ppm x 4 (applic. factor
```

Appendix 2-2. Summary of Acute Screening Dietary Exposure and Risk Estimates.

```
U.S. Environmental Protection Agency                                    Ver. 2.02
DEEM-FCID ACUTE Analysis for VERATRAN                                (1994-98 data)
Residue file: Veratran.R98                                Adjustment factor #2 used.
Analysis Date: 07-15-2004/10:52:27    Residue file dated: 07-15-2004/10:39:19/8
NOEL (Acute) =  50.000000 mg/kg body-wt/day
Daily totals for food and foodform consumption used.
Run Comment: "Factor 2 of 0.05 is to acknowledge that the active ingredient is
 only 0.2% of the formulation.  The 5% factor is a conservative adjustment for
the low concentration."
================================================================================

Summary calculations (per capita):
```

95th Percentile			99th Percentile			99.9th Percentile		
Exposure	% aRfD	MOE	Exposure	% aRfD	MOE	Exposure	% aRfD	MOE
U.S. Population:								
0.012939	2.59	3864	0.030117	6.02	1660	0.067880	13.58	736
All infants:								
0.003651	0.73	13693	0.033202	6.64	1505	0.127654	25.53	391
Children 1-2 yrs:								
0.041061	8.21	1217	0.075365	15.07	663	0.136549	27.31	366
Children 3-5 yrs:								
0.030861	6.17	1620	0.056715	11.34	881	0.117429	23.49	425
Children 6-12 yrs:								
0.019631	3.93	2547	0.037060	7.41	1349	0.057776	11.56	865
Youth 13-19 yrs:								
0.014617	2.92	3420	0.029171	5.83	1714	0.049480	9.90	1010
Adults 20-49 yrs:								
0.010098	2.02	4951	0.019624	3.92	2547	0.046589	9.32	1073
Adults 50+ yrs:								
0.008154	1.63	6132	0.014177	2.84	3526	0.027340	5.47	1828
Females 13-49 yrs:								
0.011084	2.22	4510	0.020354	4.07	2456	0.040903	8.18	1222

Appendix 2-3. Summary of Chronic Screening Dietary Exposure and Risk Estimates.

U.S. Environmental Protection Agency Ver. 2.00
DEEM-FCID Chronic analysis for VERATRAN (1994-98 data)
Residue file name: C:\Documents and Settings\MDOHERTY\My Documents\Chemistry Reviews\DEEM Runs\Veratran.R98
Adjustment factor #2 used.
Analysis Date 07-15-2004/12:39:22 Residue file dated: 07-15-2004/10:39:19/8
Reference dose (RfD, Chronic) = .5 mg/kg bw/day
COMMENT 1: Factor 2 of 0.05 is to acknowledge that the active ingredient is only 0.2% of the formulation. The 5% factor is a conservative adjustment for the low concentration.

Total exposure by population subgroup

Population Subgroup	Total Exposure mg/kg body wt/day	Total Exposure Percent of RfD
U.S. Population (total)	0.002540	0.5%
U.S. Population (spring season)	0.002574	0.5%
U.S. Population (summer season)	0.002395	0.5%
U.S. Population (autumn season)	0.002487	0.5%
U.S. Population (winter season)	0.002719	0.5%
Northeast region	0.003378	0.7%
Midwest region	0.002338	0.5%
Southern region	0.002202	0.4%
Western region	0.002543	0.5%
Hispanics	0.003437	0.7%
Non-Hispanic whites	0.002289	0.5%
Non-Hispanic blacks	0.002920	0.6%
Non-Hisp/non-white/non-black	0.003428	0.7%
All infants (< 1 year)	0.001220	0.2%
Nursing infants	0.000442	0.1%
Non-nursing infants	0.001515	0.3%
Children 1-6 yrs	0.006864	1.4%
Children 7-12 yrs	0.003811	0.8%
Females 13-19 (not preg. or nursing)	0.002555	0.5%
Females 20+ (not preg. or nursing)	0.001860	0.4%
Females 13-50 yrs	0.002174	0.4%
Females 13+ (preg./not nursing)	0.002493	0.5%
Females 13+ (nursing)	0.002432	0.5%
Males 13-19 yrs	0.002780	0.6%
Males 20+ yrs	0.001741	0.3%
Seniors 55+	0.001806	0.4%
Children 1-2 yrs	0.008229	1.6%
Children 3-5 yrs	0.006498	1.3%
Children 6-12 yrs	0.004028	0.8%
Youth 13-19 yrs	0.002693	0.5%
Adults 20-49 yrs	0.001804	0.4%
Adults 50+ yrs	0.001816	0.4%
Females 13-49 yrs	0.001981	0.4%