

Format for submitting pursuant to Article 8 of the Stockholm Convention the information specified in Annex E of the Convention

Introductory information	
Name of the submitting Party/observer	Mexico
Contact details (name, telephone, e-mail) of the submitting Party/observer	DGGIMAR / SEMARNAT
Chemical name (as used by the POPS Review Committee (POPRC))	Gamma isomer of Hexachlorocyclohexane Formula: C ₆ H ₆ Cl ₆ CAS number: 58-89-9
Date of submission	

(a) Sources, including as appropriate (provide summary information and relevant references)																																														
(i) Production data:	At present, no lindane is produced in Mexico. Past production of the mixture of isomers (i.e. technical HCH) has not been proved but remains a possibility. Source: http://www.ine.gob.mx/dgicurg/download/Proyectos-2003/EL_LINDANO_EN_MEXICO.pdf																																													
Quantity Location																																														
Other	<p>Import/Export data:</p> <p>The following table shows the data provided by the Secretariat of Economy with respect to the quantities recorded and origin of lindane imported by Mexico between 1999 and 2001. The Secretariat of Economy was asked to provide the quantities of lindane imported during the years 2002 and 2003 in order to update the information, but this was not received as of the preparation of this report.</p> <p>Lindane imports reported by the Secretariat of Economy, 1999-2001 (tons)</p> <table border="1"> <thead> <tr> <th>Country of origin</th> <th>1999</th> <th>2000</th> <th>2001</th> <th>TOTAL</th> </tr> </thead> <tbody> <tr> <td>Belgium</td> <td>1.0</td> <td>0</td> <td>0</td> <td>1.0</td> </tr> <tr> <td>Spain</td> <td>2.0</td> <td>0</td> <td>1.0</td> <td>3.0</td> </tr> <tr> <td>France</td> <td>15.05</td> <td>11.5</td> <td>0</td> <td>26.55</td> </tr> <tr> <td>India</td> <td>0</td> <td>6.0</td> <td>8.0</td> <td>14.0</td> </tr> <tr> <td>Great Britain</td> <td>0</td> <td>0.5</td> <td>1.0</td> <td>1.5</td> </tr> <tr> <td>Romania</td> <td>4.0</td> <td>9.0</td> <td>4.0</td> <td>17.0</td> </tr> <tr> <td>China</td> <td>2.0</td> <td>0</td> <td>0</td> <td>2.0</td> </tr> <tr> <td>TOTAL</td> <td>24.05</td> <td>27.0</td> <td>14.0</td> <td>65.05</td> </tr> </tbody> </table> <p>Source: http://www.ine.gob.mx/dgicurg/download/Proyectos-2003/EL_LINDANO_EN_MEXICO.pdf</p>	Country of origin	1999	2000	2001	TOTAL	Belgium	1.0	0	0	1.0	Spain	2.0	0	1.0	3.0	France	15.05	11.5	0	26.55	India	0	6.0	8.0	14.0	Great Britain	0	0.5	1.0	1.5	Romania	4.0	9.0	4.0	17.0	China	2.0	0	0	2.0	TOTAL	24.05	27.0	14.0	65.05
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(ii) Uses	Uses of lindane in Mexico.				
	Source: CICOPLAFEST Official Catalog 2001. COFEPRIS				
	Agricultural use	Urban use	Animal husbandry use	Industrial use	Pharmaceutical use
	Application on ornamental plant foliage Planting seed treatment (oats, barley, maize, sorghum, wheat)	Exclusively for public health campaigns	Mite and lice control for cattle, horses, sheep and goats, and other insect control (including spiders and scorpions in stockbreeding facilities).	For use only by pesticide formulating plants	Lindane is authorized in Mexico for the treatment of pediculosis (lice) and scabies
(iii) Releases:					
	Discharges Losses Emissions Other				

(b) Hazard assessment for endpoints of concern, including consideration of toxicological interactions involving multiple chemicals (provide summary information and relevant references)

(c) Environmental fate (provide summary information and relevant references)	
Chemical/physical properties	
Persistence	
How are chemical/physical properties and persistence linked to environmental transport, transfer within and between environmental compartments, degradation and transformation to other chemicals?	<p>Isomerization</p> <p>Walker, K., Vallero D.A. and Lewis R.G.. Factors Influencing the Distribution of Lindane and Other Hexachlorocyclohexanes in the Environment. ENVIRONMENTAL SCIENCE & TECHNOLOGY VOL. 33, NO. 24, 1999, 4373-4378</p> <p>This review examines the potential for <i>gamma</i>-hexachlorocyclohexane (HCH) to be transformed into other isomers of HCH. HCH residues are among the most widely distributed and frequently detected organochlorine contaminants in the environment. The potential environmental and human health risks associated with these residues have prompted Canada, the United States, and Mexico to consider the development of a North American Regional Action Plan (NARAP) to assess and mitigate HCH pollution. More information on the propensity of <i>gamma</i>-HCH to transform into other isomers is essential to the development of an effective regional management program. The high relative concentrations of <i>alpha</i>-HCH in the Arctic suggest that <i>gamma</i>-HCH may be transformed into other isomers in the environment. Laboratory studies show that significant photoisomerization of <i>gamma</i>-HCH to <i>alpha</i>-HCH is possible. However, field studies do not find evidence for significant isomerization of <i>gamma</i>-HCH, and recent environmental samples suggest that <i>alpha</i>-HCH residues are declining as the use of technical HCH has ended in most parts of the world. Alternative explanations for the patterns of isomer contamination are discussed.</p>
Bio-concentration or bio-accumulation factor, based on measured values (unless monitoring data are judged to meet this need)	<p>H.J. Geyer I, I. Scheuneti , R. Briiggemann , D. Langer, F. Korte, A. Kettrup, M. Mansour, C.E.W. Steinberg, N. Nyholm, and D.C.G. Muir. Half-lives and bioconcentration of lindane (<i>gamma</i>-hch) in different fish species and relationship with their lipid content Chemosphere, Vol. 35, Nos 1/2. pp. 343-351, 1997</p> <p>In this investigation it is demonstrated that the half-lives of the insecticide lindane (<i>gamma</i>-HCH) in mussels and different fish species are dependent on their lipid content. It is found that the bioconcentration factors on a wet weight basis (BCF_w) of <i>gamma</i>-HCH in different aquatic organisms such as mussels, <i>Daphnia</i>, and fishes range from 43 to 4240. It is further demonstrated that the bioconcentration factors on a wet weight basis are positively correlated with the lipid content (%). The mean bioconcentration factor on a lipid basis (BCF_l) of <i>gamma</i>-HCH is 11,000. This BCF_l value is in satisfactory agreement with the log K_{ow} value of lindane (4.10).</p>

(d) Monitoring data (provide summary information and relevant references)

Empty box for monitoring data.

(e) Exposure in local areas (provide summary information and relevant references)

- general

PEER REVIEWED ARTICLES

Pardío V.T., Waliszewski K.N., Landín L.A. and Bautista R.G., Organochlorine pesticide residues in cow's milk from a tropical region in Mexico. Food Additives and Contamination. Vol. 20: 259-269. 2003.

Cattle, particularly dairy cattle, may be exposed to lindane through their feed, inhalation during application, or absorption through skin, and the lindane may later be transferred and secreted in milk. A team of researchers has carried on successive studies in the state of Veracruz to determine the presence and levels of lindane and other organochlorine pesticides in cow's milk and butter, summarized below.

In the study performed between May and December of 2000, duplicate samples were collected from a group of 240 cows at three dairy farms located in Medellín, Paso San Juan and Tlalixcoyan, Veracruz, at which the presence of alpha (CAS No. 314-84-6), beta (CAS No. 319-86-7) and gamma HCH (CAS No. 58-89-9)—among other things—was found. The quantity of milk fat was determined to calculate the pesticide load therein.

The frequency of detection of HCH isomers varied between 45% and 48% at Medellín and 100% at Tlalixcoyan. The quantities thereof appear in the next table.

Levels of HCH isomers found in cow's milk in three towns of Veracruz between May and December 2000 (average values in mg/kg⁻¹)

Town	alpha HCH (α-HCH)	beta HCH (β-HCH)	gamma HCH (γ-HCH)
Medellín	0.013 ± 0.005	0.023 ± 0.030	0.049 ± 0.035
Paso San Juan	0.013 ± 0.009	0.017 ± 0.019	0.022 ± 0.035
Tlalixcoyan	0.031 ±	0.069 ±	0.128 ±

	0.033	0.029	0.043
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Source: Pardo V.T., Waliszewski K.N., Landín L.A. and Bautista R.G., Organochlorine pesticide residues in cow's milk from a tropical region in Mexico. Food Additives and Contamination. Vol. 20: 259-269. 2003.

Results of an earlier study undertaken in 1996 in the same area by the same authors, but at different farms, showed the presence of the three isomers in cow's milk at average levels of 0.055, 0.99 and 0.026 mg/kg⁻¹, respectively. The levels of alpha and beta HCH isomers were higher than those found at Tlalixcoyan, but levels of the gamma isomer were five times lower.

The authors complement the study determining dietary exposure to lindane (gamma HCH) by calculating the acceptable daily intake (ADI) specified by the United Nations Food and Agriculture Organization (FAO) and the World Health Organization (WHO), shown in the Table below.

Acceptable daily intake (ADI) and estimated acceptable daily intake (EADI) of gamma HCH in cow's milk in three towns in Veracruz studied between May and December 2002. (µg/kg⁻¹ in body weight/day⁻¹)

ADI (FAO-WHO)	Medellin Children/Adults	Tlalixcoyan Children/Adults	Paso San Juan Children/Adults
8	0.178/0.06*	0.076/0.002	0.066/0.021

* INEGI 2002.

Source: Pardo V.T., Waliszewski K.N., Landín L.A. and Bautista R.G., Organochlorine pesticide residues in cow's milk from a tropical region in Mexico. Food Additives and Contamination. Vol. 20: 259-269. 2003.

This table refers to the average daily dose (ADD) of lindane estimated to be ingested in the three towns of Veracruz, as a function of average daily milk consumption. This study indicates that children have a higher exposure than adults.

Average daily dose (ADD) of lindane in children and adults in three towns in Veracruz between May and December 2000 (µg/day)

Milk consumption	ΣHCH	Medellin (γ-HCH)	Paso San Juan (γ-HCH)	Tlalixcoyan (γ-HCH)
Adult (460 ml)	1.253	0.992	0.396	2.362
Child (800 ml)	2.179	1.725	0.668	4.108

Source: Pardo V.T., Waliszewski K.N., Landín L.A. and Bautista R.G., Organochlorine pesticide residues in cow's milk from a tropical region in Mexico. Food Additives and Contamination. Vol. 20: 259-269. 2003.

Waliszewski S.M., Villalobos Pietrini R., Gómez-Arrollo S. e Infanzón R.M., Persistent organochlorine pesticide levels in cow's milk samples from tropical regions of Mexico. Food Additives and Contamination. Vol. 20:270-275,2003.

Another study similar to the above was performed around the city of Veracruz, analyzing 150 samples of cow's milk in 1998 and 2001, at various farms. In this case, levels of beta HCH were determined as an indicator of the environmental isomerization of gamma HCH, found in 97% and 93% of the samples obtained in each of the aforesaid years, at concentrations of 0.106 and 0.087 mg/kg⁻¹, respectively, exceeding 0.01 mg/kg⁻¹, the Maximum Residue Level (MRL) established by the FAO. The observed ranges were between 0.002 and 0.394 mg/kg⁻¹ in 1998 and between 0.002 and 0.330 mg/kg⁻¹ in 2001, showing that in the period under study concentrations of beta HCH were stable. This may be related to the fact that lindane is still being used to treat ectoparasites in dairy cattle.

Waliszewski SM, Villalobos-Pietrini R, Gomez-Arroyo S, Infanzon RM. Persistent organochlorine pesticides in Mexican butter. Food Addit Contam. 2003 Apr; 20(4):361-7.

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200 butter samples obtained during 2001 were analyzed to determine several organochlorine pesticides, including beta HCH. In 99% of the samples, beta HCH levels were found at levels near the detection threshold (with a mean of 0.063 mg/kg⁻¹) and less than those found in butter from New Zealand (0.074 mg/kg⁻¹).

Waliszewski S.M., Aguirre A.A., Infanzón R.M. and Siliceo J., Carry-over of persistent organochlorine pesticides through placenta to fetus. Salud Pública de México. Vol. 42: 384-390. 2000.

Samples were taken of maternal adipose tissue, mother's blood and umbilical cord blood from 64 volunteers who underwent caesarean sections between 1997 and 1998. The results obtained (table below) indicate that absorbed organochlorine pesticides cross the placental barrier and balance out between the mother and the fetus.

Comparison of frequency and median in samples of maternal adipose tissue, mother's blood and umbilical cord blood in 64 residents of Veracruz in 1997-1998

HCH isomer	Frequency (%)	Median (mg/kg in fat)
Alpha (α-HCH):		

Adipose	36	0
Blood	14	0
Umbilical cord	14	0.11
Beta (β -HCH):		
Adipose	100	0.16
Blood	72	0.16
Umbilical cord	61	0.01
Gamma (γ -HCH):		
Adipose	63	0
Blood	25	0
Umbilical cord	14	0.12

Source: Waliszewski S.M., Aguirre A.A., Infanzón R.M. and Siliceo J., Carry-over of persistent organochlorine pesticides through placenta to fetus. *Salud Pública de México*. Vol. 42: 384-390. 2000.

To give perspective to the levels of beta HCH found in Veracruz with respect to the levels found in other parts of the world, the authors prepared the next table showing that the levels found in Mexico are not among the highest when compared to the levels found in other countries. However, it does not specify whether the studied population is equivalent to the population studied in Mexico.

Country comparison of levels of beta HCH in human adipose tissue

Country	Levels in human adipose tissue (mg/kg in fat)
Kenya (1992)	0.03
Poland (1994)	0.23
Italy (1995)	0.21
Spain (1995)	1.53
Iran (1995)	0.73
Greenland (1999)	0.11
Mexico (1989, this study)	0.16

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Gonzalez-Farias F, Cisneros Estrada X, Fuentes Ruiz C, Diaz Gonzalez G, Botello AV. Pesticides distribution in sediments of a tropical coastal lagoon adjacent to an irrigation district in northwest Mexico. *Environ Technol.* 2002 Nov;23(11):1247-56

This work presents the content of organochlorine (OCs) pesticides in sediments of both, agricultural drains from the Irrigation District 076, El Carrizo, Sinaloa, and of the adjacent coastal lagoon ecosystem of Agiabampo-Bacorehuis-Jitzamuri, located in northwest Mexico. The presence of alpha-HCH, beta-HCH, lindane, delta-HCH, among other organochlorine pesticides was recorded in the sediment sample. The analysis of the sediments suggests that the principal pesticides input to the coastal ecosystem is mainly through three of the seven agricultural drains, that collect the excess irrigation water and runoff from the district surface. A gradient of pesticide residues in sediments exists from the agricultural drains (52 ng OCs g⁻¹ dry weight) to the Jitzamuri bay (32 ng OCs g⁻¹ dry weight).

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Izquierda: 0.04 cm

<p>- as a result of long-range environmental transport</p> <p>- information regarding bio-availability</p>	
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(f) National and international risk evaluations, assessments or profiles and labelling information and hazard classifications, as available (provide summary information and relevant references)

(g) Status of the chemical under international conventions

A North American Regional Action Plan (NARAP) for lindane is under development between the three North American countries, Canada, United States and Mexico. For more information consult: www.cec.org