New York State Integrated Pest Management Program | Cornell Cooperative Extension

Corn Oil Profile

Active Ingredient Eligible for Minimum Risk Pesticide Use

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Label Display Name: Corn oil

Active Components: Corn oil

CAS Registry #: 8001-30-7

U.S. EPA PC Code: 800034

CA DPR Chem Code: 3626

Other Names: Maize oil; lipomul; Zea mays oil

Other Codes: EINECS 232-281-2

Summary: Corn oil is a common food ingredient produced from corn, and as such, has few safety concerns. While not widely used as an active pesticide ingredient, its primary pesticidal use is as a suffocating oil of insects and for post-harvest treatment of cereals and beans. Corn oil may also be used as an adjuvant or inert ingredient with other active ingredients.

Pesticidal Uses: Insecticide, acaricide, fungicide, avicide.

Formulations and Combinations: Various other oils, emulsifiers.

Basic Manufacturers: ADM, Cargill, ConAgra, Ingredion (formerly Corn Products International); Tate & Lyle.

Safety Overview: Corn oil is a commonly consumed food with a long history of safe use in pesticides. It was found to be an equivocal carcinogen in rats.

Background

Most corn oil is produced by the wet milling of corn (*Zea mays*) (Merck 2015). The wet milling process begins by soaking shelled and clean corn kernels in a 0.1-0.2% solution of sulfur dioxide, where it is steeped for 24 to 48 hours (Corn Refiners Association 2006). A number of enzymes may be used in the aqueous solution to increase yield (Moreau 2005). The kernels are then heated and a solvent such as hexane is applied to extract the oil. Some of the corn is still dry milled through an expeller press, with lower levels of free fatty acids and higher tocopherols (Moreau 2005). The oil is then further refined through various filtration, steaming, degumming, dewaxing, deodorizing and bleaching treatments depending on the intended end use (Moreau 2005). Corn has a relatively low yield compared with other oilseeds, with about 3-5% recoverable oil in a corn kernel (Thomas 2000).

The primary use for corn oil is as a cooking oil and to manufacture margarine (Merck 2015). It is also used in cosmetics, pharmaceuticals, and in paint (Hasenhuettl 2000; Andersen et al. 2011). Non-food uses make up a negligible portion of total corn oil consumption in the U.S. (Corn Refiners Association 2006).

Corn silk produces an essential oil high in flavonoids, such as maysin (Andersen et al. 2011). Unless otherwise mentioned, this profile reviews information for the oil extracted from the corn kernel and not oils extracted from corn silk or from any other parts of the corn plant.

Chemical and Physical Properties

The physical and chemical properties of corn oil appear in Table 1.

Table 1

Physical and Chemical Properties of Corn Oil

Property	Characteristic/Value	Source
Molecular Formula:	N/A	
Molecular Weight:	N/A	
Percent Composition:	Glycerides of fatty acids: 95-99%; unsaponifiable fraction: 1-3%; phospholipids: 0-2%	(Merck 2015)
Physical state at 25°C / 1 Atm.	Liquid	(Merck 2015)
Color	Yellow	(Merck 2015)
Odor	Characteristic corn	(Merck 2015)
Density/Specific Gravity	0.916-0.921 at 25°C	(Merck 2015)
Melting (solidification) point	Solidifies at −18 to −10 °C	(Merck 2015)
Boiling (smoke) point	230 to 238° C	(Moreau 2005)
Solubility	Slightly soluble in alcohol	(Merck 2015)
Vapor pressure	3.18×10^{-11}	(EPI 2012)
pH	N/A	
Octonol/Water (K_{ow}) coefficient	1.86	(EPI 2012)
Viscosity	η = 70 mPa·s at 20°C	(Hasenhuettl 2000)
Miscibility	Miscible in chloroform, ether, benzene, petroleum ether, solvent hexane	(Merck 2015)

Property	Characteristic/Value	Source
Flammability	Flash point: 254°C	(Sigma-Aldrich 2015)
Storage stability	On prolonged exposure to air it thickens and becomes rancid	(Merck 2015)
Corrosion characteristics	Not found	
Air half life	0.276 hrs	(EPI 2012)
Soil half life	2,880 hrs	(EPI 2012)
Water half life	1,440 hrs	(EPI 2012)
Persistence	2,860 hrs	(EPI 2012)

The oil is composed of the glycerides of the following fatty acids: myristic 0.1-1.7%, palmitic 8-12%, stearic 2.5-4.5%, hexadecenoic 0.2-1.6%, oleic 19-49%, and linoleic 34-62% (Merck 2015). The unsaponifiable fraction ranges between 1-3%, which is relatively high compared with other commercial vegetable oils. The unsaponifiable portion includes phytosterols such as γ-tocopherol making up 0.58-1.05% of crude kernel oil followed by α-tocopherol at 0.07-0.25% (Moreau 2005). The rest is mostly isomeric sitosterols and waxes such as myricyl and ceryl alcohols. Ferulic acid is an antioxidant in corn oil that esterifies with ß-sitosterol (Hasenhuettl 2000). Crude corn oil may contain up to 2% phospholipids in the form of lecithin and inositol esters.

Human Health Information

No data was found on corn oil in the EPA's Pesticide Active Ingredient database (US EPA Office of Pesticides and Toxic Substances 2016). Corn oil was not included in EPA's final work plan for flower and vegetable oils (McDavit 2010). No EPA documents explicitly waiving data requirements were found.

Acute Toxicity

The acute toxicity of corn oil appears in Table 2.

Table 2

Acute Toxicity of Corn Oil

Study	Results	Source
Acute oral toxicity	>90 g/kg	(Sigma-Aldrich 2015)
Acute dermal toxicity	Not found	
Acute inhalation	Not found	
Acute eye irritation	Rabbit: Slight irritation clearing in 24 hours.	(Andersen et al. 2011)
Acute dermal irritation	Mild irritant	(Sigma-Aldrich 2015)
Skin sensitization	No instances of allergic reaction or sensitization on 27 adult volunteers after 48 and 72 hours	(Andersen et al. 2011)

Corn oil is highly digestible, either metabolized as energy, stored as energy in adipose fat, or passing through the body with less than 5% remaining in male rats after 24 hours (HSDB 2015).

Sub-chronic Toxicity

The sub-chronic toxicity of corn oil appears in Table 3.

Table 3

Sub-chronic Toxicity of Corn Oil

Study	Results	Source
Repeated Dose 28-day Oral Toxicity Study in Rodents	Not found	
90 day oral toxicity in rodents	Rats: No signs of toxicity at highest doses	(Andersen et al. 2011)
90 day oral toxicity in non-rodents	Not found	
90 Day dermal toxicity	Not found	
90 Day inhalation toxicity	Not found	
Reproduction/development toxicity screening test	No adverse effects observed	(HSDB 2015)
Combined repeated dose toxicity with reproduction/development toxicity screening test	No effect	(HSDB 2015)
Prenatal developmental toxicity study	Not found	
Reproduction and fertility effects	No adverse effects observed	(HSDB 2015)

Occupational exposure may result in inhalation (HSDB 2015). Because corn oil is one of the most commonly used carriers used in conducting toxicology experiments, its contributions to toxicity have been studied extensively to see if it causes any confounding effects. Rats treated with corn oil gavages over a two year period had greater body weights on average and an increased survival rate compared to a no treatment control (National Toxicology Program 1994). Another study found that female rats fed 10 ml/kg corn oil and an animal protein diet developed a greater incident of kidney lesions and fat buildup than the control, which received no additional corn oil (Sato et al. 2000).

Chronic Toxicity

The chronic toxicity of corn oil appears in Table 4.

Table 4

Chronic Toxicity of Corn Oil

Study	Results	Source
Chronic toxicity	Ames: Weakly mutagenic	(HSDB 2015)
Carcinogenicity	Equivocal carcinogen	(HSDB 2015)
Combined chronic toxicity & carcinogenicity	Not found	

Corn oil is not identified as a carcinogen by the International Agency for Research on Cancer (IARC 2014, World Health Organization 2014); is not on the California Proposition 65 list of known carcinogens (Cal-EPA 2017); and does not appear on the Toxics Release Inventory (TRI) Basis of OSHA Carcinogens (US EPA 2015).

A review of the epidemiological literature noted that there is a correlation between fat consumption and breast cancer (Welsch 1995). Epidemiological studies indicate that relatively high levels of consumption of corn oil is correlated with breast cancer, similar to what is found with other fats and oils and high fat diets in general (HSDB 2015). Rats treated with corn oil gavages over a two year period had slightly higher rates of pancreatic lesions than the no treatment control (National Toxicology Program 1994). For this reason, it is classified as an equivocal carcinogen in the Hazardous Substances Database (HSDB 2015).

Human Health Incidents

No human health incidents involving corn oil were reported to the National Pesticide Information Center between April 1, 1996 and March 30, 2016 (NPIC 2016).

Environmental Effects Information

No environmental assessment data was found on corn oil in the EPA's Pesticide Active Ingredient database (US EPA Office of Pesticides and Toxic Substances 2016).

Effects on Non-target Organisms

No leaching, photodegradation or biodegradability data for corn oil were found.

Corn oil was determined to be the least toxic of different vehicles screened for embryonic mortality in chickens (*Gallus domesticus*) (Ameenuddin and Sunde 1984). Other solvents used were acetone, cottonseed oil, ethanol, ethylene glycol, and propylene glycol. Levels of 0.05-0.15 ml of corn oil were considered acceptable for injection into eggs. Cottonseed oil and propylene glycol had inferior embryos at those doses, while acetone, ethylene glycol, and ethanol reduced hatchability. In order to confirm its appropriate use as a commonly used carrier, vehicle, or excipient for substances screened for avian toxicity, corn oil was tested and determined to be non-toxic to chickens—used as surrogates for wildlife bird species—when used at low volumes (DeWitt et al. 2005). High volumes of 1.0 µl/g egg were considered toxic.

Environmental Fate, Ecological Exposure, and Environmental Expression

Corn oil is readily biodegradable (HSDB 2015). Exposure to sunlight causes rancidity (HSDB 2015).

Environmental Incidents

No incidents involving corn oil were reported to the National Pesticide Information Center between April 1, 1996 and March 30, 2016 (NPIC 2016).

Efficacy

Insecticidal Activity

Corn oil is used as a suffocating oil, and has a mode of action similar to cottonseed and soybean oils. The oil adheres to the surface of insects interfering with respiration, effectively suffocating them (Hesler and Plapp 1986). More specifically, vegetable oils block the target insects' spiracles in adults, and prevent gas exchange with the egg membrane (Weinzierl 2000).

Stored wheat (*Triticum aestivum*) treated with food grade corn oil at a rate of 10 ml/kg resulted in 97% mortality of the granary weevil (*Sitophilus granarius*) in one day, compared with a no treatment control

(Qi and Burkholder 1981). In the same study, cottonseed and soybean oils were more effective at preventing oviposition and viable progeny over a 60-day period.

Nuisance bird species may be controlled by having their eggs addled by oiling. When tested on ring-billed gull eggs (*Larus delawarensis*), corn oil achieved a 99% failure to hatch rate, making it superior to white mineral oil (Pochop et al. 1998). Corn oil was selected for the study because no pesticides were registered for egg addling and the researchers acknowledged food grade corn oil was exempt from registration.

Standards and Regulations

EPA Requirements

Corn oil is exempt from the requirement of a food tolerance as a commonly consumed food commodity and as an edible fat or oil [40 CFR 180.950(c)].

FDA Requirements

Corn oil is considered a commonly consumed food ingredient [21 CFR 101].

Other Regulatory Requirements

Corn oil is allowed by the USDA's National Organic Program (NOP) [7 CFR 205].

The National Institute of Occupational Safety and Health (NIOSH) recommends a maximum inhalation exposure limit of 10 mg / m3 (Sigma-Aldrich 2015).

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