Pesticides

Refer lecturer for course updated notes.

Students are oblidged to follow the courses for evaluation process and presented notes are preliminary drafts for the whole evaluation process.

Definition

- Pesticides are chemical compounds that are used to kill pests, including insects, rodents, fungi and unwanted plants (weeds).
- Pesticides are used in public health to kill vectors of disease, such as mosquitoes, and in agriculture, to kill pests that damage crops.
- By their nature, pesticides are potentially toxic to other organisms, including humans, and need to be used safely and disposed of properly.

History

- Since the prehistoric period, mankind has fought against the pests that cause damage to themselves, animals and plants and play a role in transporting epidemic diseases.

- In the early 1940s, many organic compounds with arsenic, sulfur, copper, mercury, fluoride and calcium were used to combat these pests.

- After these years, the period of synthetic and contemporary pesticides began and in 1942 DDT and similar organic chlorinated compounds were used, and after the 2nd World War, organic phosphorus compounds were used as herbicides and insecticides.

History

- Since the 1970s, 30,000 kinds of new compounds have been produced for use as pesticides, and 10,000 of these are used for the same purpose in developed countries.
- From the 1970s onwards, the toxic damages of these pesticide species have been understood for humans and compounds such as carbamate group compounds, pyrethroids, which are less harmful examples of pesticides, have been used.
- It is not known how pesticides, which have a very important place in the war against pests, will cause problems in the future despite their more effective and targeted use.

Use Of Pesticides – Types Of Product

Pesticides used in different settings:
- Agricultural
- Veterinary
- Domestic
- Institutional

Formulations: liquid, gel, paste, chalk, powder, granules, pellets, baits...

Concentrations: from 2% to 80% of active ingredient

Containers: glass, plastic or metal flasks, bottles, drums, traps, plastic bags or paper bags....

Activity	Use
Agriculture	Control of multiple crop pests in any stage
Public health	Control of disease vectors such as malaria, dengue, Chagas disease, onchocerciasis, plague, yellow fever, filariasis, trypanosomiasis, schistosomiasis, leishmaniasis and typhus. Control of pests (rodents) and eradication of plantations whose final product is a prohibited drug
Livestock and domestic care aniales	In the disinfection of sheep and pets like dogs and cats
Treatment of structure	Treatment of public and private buildings, offices, hospitals, hotels, cinemas, theaters, restaurants, schools, supermarkets, department stores, sports facilities, food warehouses and the rail industry and sea and air
Maintenance of green areas	Treatment of parks, gardens, playgrounds, golf courses, highways, railways, platforms, towers, high voltage lines and poles
Maintenance of water reserves	Treatment of large reserves of water, natural or artificial, dams, reservoirs, dams, reservoirs, ponds psicolas, canals, ponds and pools
Industries	In the manufacture of refrigerators, electrical equipment, paints, resins, adhesives, pastes, waxes, liquid limpiamentales, tents, sails for sailing, sports nets, mats, carpets and tapestries, the timber industry, packaging materials food, cardboard and paper multiple products. In the food industry for the preservation of fresh foods such as meat, pesacados, etc .
Home	Incorporated in products such as cosmetics, shampoos, soaps and insect repellents. They are used in the washing and drying of carpets, household disinfectants and care products for pets and plants, and the use of insecticides

Classification according to affected species

Acaricides	Algicides	Antifeedants
Avicides	Bactericides	Bird repellents
Chemosterilants	Fungicides	Herbicide safeners
Herbicides	Insect attractants	Insect repellents
Insecticides	Mammal repellents	Mating disrupters
Molluscicides	Nematicides	Nitrification inhibitors
Plant activators	Plant growth regulators	Rodenticides
Synergists	Virucides	Miscellaneous

Classification according to toxicity

Table 1. Classification of pesticides according to toxicity, expressed as LD_{50} (mg/kg)

Class	Toxicity	Examples
Class IA	Extremely dangerous	Parathion, Dieldrin
Class IB	Highly dangerous	Eldrin, Dichlorvos
Class II	Moderately hazardous	DDT, Chlordane
Class III	Slightly hazardous	Malathion

Toxicokinetics Varies For Different Types Of Pesticide

Important to consider:

- Routes of Absorption
  - Dermal, ocular, ingestion, inhalation, injection
- Distribution and storage
  - Fat soluble pesticides are stored in adipose tissue
  - Other
- Biotransformation
  - Into inactive or more active metabolites
- Elimination
  - Urinary excretion
  - Biliary / faecal excretion
  - Excretion in milk

ROUTES OF EXPOSURE

Multiple/simultaneous routes of exposure

- Ingestion
  - Breastfeedin
  - Accidentalingestion
  - Residuesinfood
  - Mouthing
- Inhalation
  - Indoorandoutdoorspraying
  - Occupationalexposure
- Dermalabsorption
  - Accidentalcontact
  - Occupationalexposure
  - Residuesonsurfaces
  - Contaminatedclothing
  - Medicaluse:scabies,headlice
- Transplacental

Mechanisms of action

- Prevention of AChE activity → OP and Carbamate compounds
- Ion channels → DDT and analogs, BHC, cyclodien group, pyrethrins
- Nerve receptors → Nicotine-like
- NM substance-like effect → Avermectins
- Metabolism poisons, respiratory poisons → cyanide, carbon monoxide, rotenone, hydrogensulfide, dinitrophenols
- Inhibition of ME activity → Pyrethrin synergists
- Effect on sugar metabolism → Fluoroacetates

Mechanisms of action

- Poisons of amine metabolism → Chlordimeform
- Prevention of chitin synthesis → Diflubenzuron
- Hormone-like effect → Metoprene, phenoxycarb-like
- Protoplasm poisons → Heavy metals and acids
- Physical poisons → heavy metal oils, inert powder
- Effective oxygen group formation → parathion, malathion, paraquat

General treatment

- Dermal exposure -animal should be bathed with a mild detergent and cool water.
- The area should be washed very gently so as not to stimulate the circulation and enhance skin absorption.
- Initial assessment of the animal's respiratory and cardiovascular integrity is important.
- Further treatment involves continuing symptomatic and supportive care.
- Seizures should be controlled with either diazepam (administered to effect at 0.2–2 mg/kg, IV) or methocarbamol (55–220 mg/kg, IV, not exceeding 200 mg/min).
- Phenobarbital or pentobarbital (IV), to effect, can be used if diazepam or methocarbamol are too short-acting.

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Organophosphates

- Esters derived from phosphoric or phosphoric acid.
- Act on the central nervous system by **inhibiting acetyl cholinesterase**, an enzyme that modulates the amount and levels of the neurotransmitter acetylcholine, disrupting the nerve impulse by serine phosphorylation of the hydroxyl group in the active site of the enzyme
- Parasitic infestations in horses, dogs, and pigs- dichlorvos, trichlorfon
- parasites in ruminants - haloxon, naphthalophos, and crufomate

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Organophosphates

- OPs have replaced the banned organochlorine compounds and are a major cause of animal poisoning .
- Certain OP preparations are microencapsulated, and the active compound is released slowly; this increases the duration of activity and reduces toxicity, but the toxic properties are still present.

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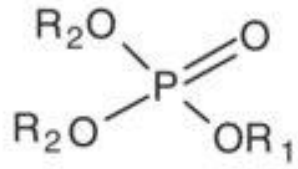
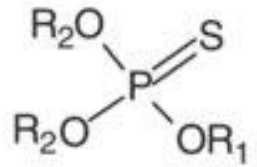
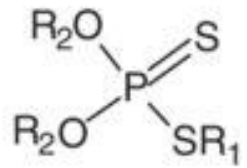
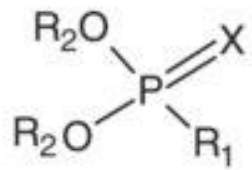
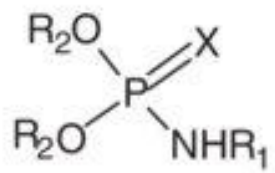
Type	General structure	Pesticides
Phosphates		Chlorfenvinphos Dichlorvos Mevinphos Monocrotophos Tetrachlorvinphos
Thiophosphates		Chlorpyrifos Diazinon EPN Ethyl-Parathion Fenitrothion Fenthion Methyl-Parathion Pirimiphos-methyl Triazophos
Dithiophosphates		Azinphos-methyl Dimethoate Malathion Phorate Terbufos Trichlorfon
Phosphonates		
Phosphoramides		Acephate Fenamiphos Methamidophos

[a]Where R_1 and R_2 are any alkyl groups and X may be S or O.

OP- Diagnosis

- acetylcholinesterase (AChE) activity in blood and brain.
- Brain AChE activity is inhibited >70%, and the enzyme in blood reflects, only in a general way, the levels in nervous tissue.
- <30% inhibition- atropine is indicated
- Muscarinic symptoms: urination, defecation, salivation, myosis, vomiting

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OP poisoning- Treatment

- 1) muscarinic receptor–blocking agents,
- 2) cholinesterase reactivators,
- 3) emetics, cathartics, and adsorbents to decrease further absorption.

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OP poisoning- muscarinic receptor blocking agents

- Atropine sulfate blocks the central and peripheral muscarinic receptor–associated effects of OPs;
- dogs and cats, usually at a dosage of 0.2–2 mg/kg (cats at the lower end of the range), every 3–6 hr or as often as clinical signs indicate.
- horses and pigs, the dosage is 0.1–0.2 mg/kg, IV, repeated every 10 min
- cattle and sheep, the dosage is 0.6–1 mg/kg, one-third given IV, the remainder IM or SC
- Atropinization is adequate when the pupils are dilated, salivation ceases, and the animal appears more alert.
- Animals initially respond well to atropine sulfate; however, the response diminishes after repeated treatments.
- Overtreatment with atropine should be avoided.

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OP poisoning- nicotinic cholinergic effects

- nicotinic cholinergic effects-muscle fasciculations and muscle paralysis
- Diazepam - reduce the incidence of seizures and increased survival of nonhuman primates experimentally.

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OP poisoning-cholinesterase reactivators

- 2-pyridine aldoxime methochloride (2-PAM, pralidoxime chloride).
- 20–50 mg/kg, given as a 5% solution IM or by slow IV (over 5–10 min), repeated at half the dose as needed.
- IV 2-PAM must be given very slowly to avoid musculoskeletal paralysis and respiratory arrest.
- Response to cholinesterase reactivators decreases with time after exposure; therefore, treatment with oximes must be instituted as soon as possible (within 24–48 hr).
- ageing phenomenon-the enzyme/organophosphate complex becomes unresponsive to reactivators (varies with the particular pesticide.

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OP poisoning- removal of poison

- Dermal -washed with detergent and water (about room temperature) but without scrubbing and irritating the skin.
- Emesis- if oral exposure occurred <2 hr previously; emesis is contraindicated if the animal is depressed.
- Oral administration of mineral oil decreases absorption of pesticide from the GI tract.
- Activated charcoal (1–2 g/kg as a water slurry) adsorbs OPs and helps elimination in the feces-recommended in cattle.
- Artificial respiration or administration of oxygen may be required.
- Phenothiazine tranquilizers, barbiturates, and morphine are contraindicated.

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Carbamates

- esters derived from acids or dimethyl N-methyl carbamic acid
- insecticides, herbicides, fungicides and nematicides.
- less persistent than organochlorines and organophosphates
- inhibit acetyl cholinesterase- action is fast and the kinetics of blocking is through the carbamylation of the enzyme by the covalent attachment of electrophilic groups steric carbamoyl sites of the enzyme

Neonicotinoids

- Neonicotinoids are a class of neuro-active insecticides chemically similar to nicotine.
- Act on insects at three different postsynaptic nicotinic receptors found in CNS.
- Wide margin of safety
- Widespread use in veterinary medicine for flea control (tablets, e.g. Capstar®, collars, topical spot on products, etc.).
- TOXIC TO BEEs

Pyrethroids

- Pyrethrins and synthetic pyrethroids are used extensively as insecticides and acaricides for the treatment of a broad range of ectoparasites in large and small animals, as well as in nonmammalian species such as birds, fish, and honeybees.
- extracted from the flowers of *Chrysanthemum cinerariaefolium* and *Chrysanthemum cineum*
- different formulations including spot-on, sprays, ear tags, dips (immersion), soluble powders, and shampoos to control fleas, mite, lice, and ticks between other insect infestations both outside and inside the house

Pyrethroids

- Natural pyrethrins: pyrethrin I and II, cinerin I and II, and jasmolin I and II
- commercial preparations contain 20–25% pyrethrins with the ratio of pyrethrin:cinerin:jasmolin approximating 71:21:7.
- highly photolytic, antioxidants are often added to preparations to stabilize formulations
- MOA- voltage-dependent sodium channel in the nerve membrane is the common target in insects and mammals.

Pyrethroids

- type I
  - Allethrin, phenothrin and permethrin
  - neurotoxic both for mammals and insects
  - strongly excitant effect on the nervous system
- type II; the addition of the alpha-cyano group to the 3-phenoxybenzyl alcohol group - increased the insecticidal potency
  - deltamethrin, fenvalerate, cyfluthrin, cyhalothrin, and lambda-cyhalothrin
  - exerting their action on higher brain centers and interfering with the transmission of nerve impulses, act on the sodium channel of the axonal membrane; they induce a long-lasting prolongation of the membrane during excitation, leading to prolonged trains of impulses.
  - Reversible effects


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Pyrethroids

- Synthetic pyrethroids
- persists longer than that of natural pyrethrins
- allethrin, cyfluthrin, cyhalothrin, cypermethrin, deltamethrin, fenvalerate, flumethrin, fluvalinate, tau-fluvalinate, and permethrin
- lipophilic compounds
- generally of low acute oral toxicity to mammals but are very toxic to aquatic organisms
- neurotoxic.


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Pyrethroids Toxicity

- type I pyrethroids- T syndrome (characterized by tremor)
  hyperexcitation, ataxia, convulsion, paralysis and repetitive nerve firing
- type II pyrethroids- CS syndrome (characterized by choreoathetosis and salivation) induced by compounds

  hypersensitivity, profuse salivation, choreoathetosis, tremor, and paralysis

  no repetitive nerve firing in sensory nerves

Some cause- intermediate TS-syndrome

Pyrethroids

- Diagnosis of pyrethrin/pyrethroid poisoning is based on clinical signs, history of exposure, and determination of insecticide residue in body tissues and fluids.
- These insecticides do not produce characteristic pathologic lesions.
- symptomatic and supportive treatment
- Induction of emesis may be contraindicated.
- Activated charcoal at 2–8 g/kg may be administered, followed by a saline cathartic (magnesium or sodium sulfate [10% solution] at 0.5 mg/kg).
- Vegetable oils and fats, which promote the intestinal absorption of pyrethrum, should be avoided.


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Pharmacologically active substance	Formulation	Animal species	Indications	Doses
Alpha-cypermethrin	Topically (spray, pour-on)	Bovine, ovine	Ectoparasites (ticks, fleas, lice, blowflies)	150 mg/animal
	Spray	Poultry	Ectoparasites	8–10 mg/bird
Cyfluthrin (8 enantiomers)	Topically (pour-on)	Bovine, caprine	Ectoparasites (horn fleas, horse flies)	100 mg/animal catt
Cyhalothrin(contains two pairs of *cis*-isomers A and B (ratio 60/40)	Topically (pour-on, spray, dip tanks)	Bovine, pigs, and sheep (including dairy animals)	Ectoparasites (horn and face flies)	*Pour-on*: 0.2 mg/ca 0.1 mg/sheep or pig
				Sprays (up to 250 mg/animal/tre
				Dip tanks (up to 50 g/100 L of water

Cypermethrin (contains a mixture of 4-*cis* and 4-*trans*-isomers) (isomer ratio 40:60)	Topically	Cattle, sheep, goats, pigs, chickens including laying birds and lactating cattle, sheep, and goats	Ectoparasites (ticks, fleas, lice, blowflies)	
		Salmonidae	Treatment and control of parasites such as sea lice in *Salmonidae*	Seawater cage at a c 5 µg/L of seawater f period of 1 h
Deltamethrin (90% *cis*-isomer)	Topically (dip, spray, pour-on)	Cattle, sheep, chickens	Ectoparasites (flies, including tsetse flies)	*Cattle*: 0.25–1.5 mg as a single applicati as repeated applicat (every 3–6 weeks)
				Sheep: 0.94–4.5 mg as a single applicati repeated 10 or 21 da
				Chicken: 0.08 mg/k
	Bath	Fin fish (Atlantic salmon, rainbow trout)	Ectoparasites treat sea lice (*Lepeophtheirus*	Bath dose 2 µg/L fo 30 min in a closed container or 2 µg/L

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Flumethrin	Topically (pour-on, as a plunge dip)	Bovine, ovine	For control of ticks, lice, mites, and scab	*Pour-on*: 2 mg/kg b
				Plunge dip: 1 L proc 900 L of water
		Honeybees	Diagnosis and treatment varroatosis in honeybees (3.6 mg are hung in beehives)	*Strips*: 4 strips/hive mature colonies anc strips/hive for imm colonies
Permethrin (isomer ratios of *cis:trans*: 80:20, 40:60, or 25:75)	Spray (including udder spray), powders, pour-on, ear tag	Cattle, pigs, sheep, goats, poultry	Ectoparasites (horn and face fleas, mites, ticks, and lice)	4 mg/kg bw for catt
				≈6 mg/kg bw for pi sheep, and poultry
Tau-fluvalinate (contains two of four isomers of racemic mixture, fluvalinate)	Topically treatment	Honeybees	Parasitic mite *Varroa jacobsoni*	Polymer matrix stri in weight containin 800 mg tau-fluvalir suspended midway 8 weeks

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D-Limonene

- oil extracted from citrus rind.
- Control of fleas on cats and for other insect pests.
- Adult fleas and eggs appear to be most sensitive to D-limonene, which is more effective if combined with the synergist piperonyl butoxide.
- At recommended dosages, the solution containing D-limonene appears to be safe, but increasing the concentration 5–10 fold in sprays or dips increases the severity of toxic signs,
  - hypersalivation, muscle tremors, ataxia, and mild to severe hypothermia.
- The inclusion of piperonyl butoxide in the formulation potentiates the toxicity in cats.
- Allergies have also been reported in people in contact with D-limonene, and it appears to increase dermal absorption of some chemicals.
- When orally administered to dogs, D-limonene causes vomiting (median effective dose 1.6 mL/kg). No antidote is available.

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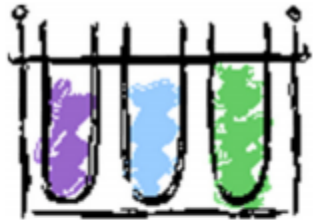
- Avermectins; in insects and mammals, neurons lead to the release of GABA from the nerve endings; thus, they inhibit the stimulation-effect sequence in nerve cells.

- Insect growth regulators: Juvenile hormone anologues - delay the development of parasitic larvae and thus cause them not to mature. Larvae grow and die as a result of slowly developing paralysis.
- Inhibition of Chitin Synthesis - They are effective by inhibiting the activity of certain proteases (such as chemotrypsin) that activate chitin synthatase.

Biopesticides:

- Pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals.
  1. **Microbial pesticides** consist of a microorganism (e.g. a bacterium, fungus, virus or protozoan) as the active ingredient. For example, there are fungi that control certain weeds, and kill specific insects.
  2. **Plant-Incorporated-Protectants (PIPs)** are pesticidal substances that plants produce from genetic material that has been added to the plant.
  3. **Biochemical pesticides** are naturally occurring substances that control pests by non-toxic mechanisms (e.g. insect sex pheromones that interfere with mating, and various scented plant extracts that attract insect pests to traps).

Safety reference values



- Acute Reference Dose (ARfD) / Acceptable Daily Intake (ADI)
- Established by the Joint Food and Agriculture Organization (FAO) and World Health Organizatio (WHO) Meeting on Pesticide Residues (JMPR)
- Based on available toxicological data
- Expressed on a body-weight basis
- Used to assess the risk of acute and chronic adverse effects, respectively

Acute Pesticide Toxindromes

PESTICIDE	ACUTE SYMPTOMS	DIAGNOSIS	TREA TMENT
Chlorophenoxy compounds (e.g. 2,4-D)	Nausea, vomiting, acidosis, myalgia fever, myopathy, neuropathy	Detectable in urine and blood	Decontamination and Urine alkalinization
Bipyridyl compounds paraquat	Vomiting Corrosive lesions Hepatotoxicity Acute tubular necrosis Pulmonary fibrosis	Dithionite test in urine	Decontamination Avoid O2 haemoperfusion Possibly: corticosteroids and cyclophosphamide
Anticoagulant rodenticide Warfarin Brodifacoum Diphacinone	Haemorrhage (from vit. K antagonism)	Elevated prothrombin time (PT)	

Low-level Chronic Exposure

Growing body of epidemiologic and animal data and research studies suggests a link between long-term exposure and:

- Abnormal growth and development
- Impaired neurobehavioral development / functions
- Cancer
- Increased susceptibility to infections

Preconceptional Prenatal Exposure

Pesticide exposure before or during pregnancy has been associated with increased risk of:

- Infertility
- Perinatal death
- Spontaneous abortion
- Premature birth
- Fetal growth retardation
- Congenital malformations
- Early childhood cancer

Prenatal Exposure And Neurodevelopmental Effects

Exposure during brain growth has subtle and permanent effects on:

- Brainstructureandfunction
- Neuronalandaxonaldifferentiation
- Serotoninergicsystem
- Synaptogenesis
- Programmingofsynapticfunction

Pesticides And Childhood Cancer

Some studies have found an association between postnatal pesticide exposure and an increased risk of paediatric cancer

- Brain tumours
- Acute lymphocytic leukaemia
- Non-Hodgkin lymphoma

Prenatal Exposure And Childhood Cancer

- Maternal exposure to pesticide has been associated with paediatric cancer – acute lymphocytic leukaemia

- Association with parental occupational exposure

    - Leukaemia
    - Brain cancer
    - Hodgkin and non-Hodgkin lymphomas
    - Kidney cancer

Residue

Pharmacologically active substance(s)	Marker residue	Animal species	MRLs	Target tissues	Other provision
Alpha-cypermethrin	Cypermethrin (sum of isomers)	Bovine, ovine	20 µg/kg	Muscle	For milk MRL furthe provisions i Commissio Directive 98/82/EC are to be observed
			200 µg/kg	Fat	
			20 µg/kg	Liver	
			20 µg/kg	Kidney	
			20 µg/kg	Milk	
Cyfluthrin	Cyfluthrin (sum of isomers)	Bovine, caprine	10 µg/kg	Muscle	For milk further provisions i Council Directive 94/29/EC are to be observed
			50 µg/kg	Fat	
			10 µg/kg	Liver	
			10 µg/kg	Kidney	
			20 µg/kg	Milk	
Cyhalothrin	Cyhalothrin (sum of isomers)	Bovine	500 µg/kg	Fat	For milk further provisions i Council Directive 94/29/EC are to be observed
			50 µg/kg	Kidney	
			50 µg/kg	Milk	

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Cypermethrin	Cypermethrin (sum of isomers)	All ruminants	20 µg/kg	Muscle	For milk further provisions i Commissio Directive 98/82/EC are to be observed
			200 µg/kg	Fat	
			20 µg/kg	Liver	
			20 µg/kg	Kidney	
			20 µg/kg	Milk	
		Salmonidae	50 µg/kg	Muscle and skin in natural proportions	
Deltamethrin	Deltamethrin	All ruminants	10 µg/kg	Muscle	No entry
			50 µg/kg	Fat	
			10 µg/kg	Liver	
			10 µg/kg	Kidney	
			20 µg/kg	Milk	
		Fin fish	10 µg/kg	Muscle and skin in natural proportions	

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Flumethrin	Flumethrin (sum of trans-Z-isomers)	Bovine	10 µg/kg	Muscle	No entry
			150 µg/kg	Fat	
			20 µg/kg	Liver	
			10 µg/kg	Kidney	
			30 µg/kg	Milk	
		Ovine	10 µg/kg	Muscle	Not for use in animals from which milk is produced fo human consumptic
			150 µg/kg	Fat	
			20 µg/kg	Liver	
			10 µg/kg	Kidney	
	Not applicable	Bees	No MRL required	Not applicable	No entry
Permethrin	Permethrin (sum of isomers)	Bovine	50 µg/kg	Muscle	For milk further provisions i Commissio Directive 98/82/EC are to be observed
			500 µg/kg	Fat	
			50 µg/kg	Liver	
			50 µg/kg	Kidney	
			50 µg/kg	Milk	
Tau-fluvalinate	Not applicable	Bees	No MRL required	Not applicable	No entry

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Table 1: Maximum Residue Limits (MRLs) of pesticides (ppm) in meat

	PFA rules	Codex standards	U.S
Pesticide standard	Meat and poultry	Cattle meat	Cattle meat
Aldrin/dieldrin	0.2	0.2	0.3 (fat)
Chlordane	-	0.05	0.3 (fat)
Aldicarb	-	0.10	0.01
Carbaryl	-	0.10	0.10
Chlorpyrifos	0.1	2.0	0.2
Cypermethrin	0.2	0.02	0.05
DDT and its metabolites	7.0 (fat)	5.0 (fat)	5.0 (fat)
Decamethrin/deltamethrin	-	0.03	-
Endosulfan	-	0.10	0.2
Fenvalerate	1.0	1.5	1.5
Heptachlor	0.15	0.2	0.2
Hexachlorobenzene	0.2	0.2	0.5
Lindane	2.0	1.0	7.0
Monocrotofos	0.02	0.02	-
Propoxur	-	0.05	-

Interpretation of MRLs/EMRLs for Foods of Animal Origin (1)

- Part 3 of Schedule 1 - Certain meat or poultry meat

Column 1	Column 2	Column 3	Column 4	Column 5
Item	Pesticide	Residue definition	Description of food	Maximum residue limit (MRL) (mg/kg)
63.39	Chlorpyrifos	Chlorpyrifos	Cattle meat (Fat)	1
63.40	Chlorpyrifos	Chlorpyrifos	Goat meat	0.05
63.41	Chlorpyrifos	Chlorpyrifos	Horse meat	0.25

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Interpretation of MRLs/EMRLs for Foods of Animal Origin (2)

- Part 3 of Schedule 1 - Certain meat or poultry meat
  - Where "(Fat)" forms part of the description of a food (i.e., meat from mammals other than marine mammals or poultry meat) as set out in Column 4 of either Part 1 or Part 2 of the Schedule 1 to the Regulation, the corresponding MRL/EMRL in Column 5 applies only to the fat of the food (i.e., expressed on a fat basis)

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Interpretation of MRLs/EMRLs for Foods of Animal Origin (3)

- Part 3 of Schedule 1 - Certain milk products

Column 1		cfs.gov.hk/english/whatsnew/whatsnew_fstr/files/TM_Feb_2014_Intro_of_Regulation_e.pdf 4		Column 5
Item	Pesticide	Residue definition	Description of food	Maximum residue limit (MRL) (mg/kg)
136.12	Fenpropathrin	Fenpropathrin	Pig fat	1
136.13	Fenpropathrin	Fenpropathrin	Sheep fat	1
136.14	Fenpropathrin	Fenpropathrin	Cattle milk (F)	0.1
136.15	Fenpropathrin	Fenpropathrin	Cattle meat (Fat)	0.5

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Interpretation of MRLs/EMRLs for Foods of Animal Origin (4)

- Part 3 of Schedule 1 - Certain milk products
  - the pesticide residue is fat soluble and the corresponding MRLs for milk products shall be applied as explained below:
    a) For a "milk product" with a fat content less than 2%, the MRL applicable is half that specified for "milk". For example, the MRL of fenpropathrin in skimmed milk (<2% fat) will be "0.1mg/kg (MRL for milk specified in Column 5) divided by 2", i.e., 0.05mg/kg
    b) For a "milk product" with a fat content of 2% or more, the MRL applicable is 25 times that specified for milk, expressed on a fat basis. For example, the MRL of fenpropathrin in butter (a milk product >2% fat) will be "25*0.1mg/kg, expressed on a fat basis", i.e., 2.5mg fenpropathrin residues per kg fat content of butter

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Check for residue levels in animal origin food

Rodenticides

- botanical rodenticides
  - scilliroside
  - strychnine
- carbanilate rodenticides
  - mieshuan
- coumarin rodenticides
  - brodifacoum
  - bromadiolone
- alpha-bromadiolone
  - coumachlor
  - coumafuryl
  - coumatetralyl
  - dicoumarol
  - difenacoum
  - difethialone
  - flocoumafen
  - warfarin
- indandione rodenticides
  - chlorophacinone
  - diphacinone
  - naphthylindane-1,3-diones
  - pindone
  - valone

Rodenticides-cont'ed

- inorganic rodenticides
  - arsenous oxide
  - phosphorus
  - potassium arsenite
  - sodium arsenite
  - thallium sulfate
  - zinc phosphide
- organochlorine rodenticides
  - gamma-HCH
  - HCH
  - lindane
- organofluorine rodenticides
  - fluoroacetamide
  - fluoroacetic acid
  - gliftor
  - sodium fluoroacetate
- organophosphorus rodenticides
  - phosacetim
- pyrimidinamine rodenticides
  - crimidine
- thiourea rodenticides
  - antu
  - promurit
  - thiosemicarbazide
- urea rodenticides
  - pyrinuron
- unclassified rodenticides
  - bromethalin
  - chloralose
  - α-chlorohydrin
  - cholecalciferol
  - curcumenol
  - ergocalciferol
  - flupropadine
  - hydrogen cyanide
  - norbormide
  - Paris green
  - silatrane
  - tetramine

Molluscicides

- allicin
- bromoacetamide
- calcium arsenate
- cloethocarb
- copper sulfate
- fentin
- ferric phosphate
- metaldehyde
- methiocarb
- niclosamide
- Paris green
- pentachlorophenol
- sodium pentachlorophenate
- tazimcarb
- thiacloprid
- thiodicarb
- tralopyril
- tributyltin oxide
- trifenmorph
- trimethacarb

Plant Growth Regulators

- **antiauxins**
  clofibric acid
  2,3,5-triiodobenzoic acid
- **auxins**
  4-CPA
  2,4-D
  2,4-DB
  2,4-DEP
  dichlorprop
  fenoprop
  IAA
  IBA
  naphthaleneacetamide
  α-naphthaleneacetic acids
  1-naphthol
  naphthoxyacetic acids
  potassium naphthenate
  sodium naphthenate
  2,4,5-T
- **cytokinins**
  2iP
  benzyladenine
  4-hydroxyphenethyl alcohol
  kinetin
  zeatin
- **defoliants**
  calcium cyanamide
  dimethipin
  endothal
  ethephon
  merphos
  metoxuron
  pentachlorophenol
  thidiazuron
  tribufos
- **ethylene inhibitors**
  aviglycine
  1-methylcyclopropene
- **ethylene releasers**
  ACC
  etacelasil
  ethephon
  glyoxime
- **frost protectants**
  heptamaloxyloglucan
- **gametocides**
  fenridazon
  maleic hydrazide
- **gibberellins**
  gibberellins
  gibberellic acid

Growth inhibitors

- growth inhibitors
- abscisic acid
- ancymidol
- butralin
- carbaryl
- chlorphonium
- chlorpropham
- dikegulac
- flumetralin
- fluoridamid
- fosamine
- glyphosine
- isopyrimol
- jasmonic acid
- maleic hydrazide
- mepiquat
- piproctanyl
- prohydrojasmon
- propham
- tiaojiean
- 2,3,5-triiodobenzoic acid
- morphactins
- chlorfluren
- chlorflurenol
- dichlorflurenol
- flurenol

growth retardants

- chlormequat
- daminozide
- flurprimidol
- mefluidide
- paclobutrazol
- tetcyclacis
- uniconazole

growth stimulators

- brassinolide
- brassinolide-ethyl
- DCPTA
- forchlorfenuron
- hymexazol
- psoralen
- pyripropanol
- triacontanol

Pesticide Synergists

- bucarpolate
- dietholate
- jiajizengxiaolin
- octachlorodipropyl ether
- piperonyl butoxide
- piperonyl cyclonene
- piprotal
- propyl isome
- sesamex
- sesamolin
- sulfoxide
- tribufos
- zengxiaoan