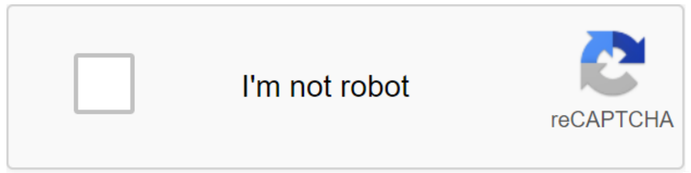

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Antiparasitic drugs mechanism of action pdf

Copyright, Purdue Research Foundation, 1996 BMS 445 Intro Drug Group Slides/Graphics Address () Email Antiparasit Intro. An anti-parasitic review, drugs that kill or inhibit the growth of parasitic organisms, can be divided into the following therapeutic categories: antitenomatodal anti-worm anti-verbal anti-crystal antiphyloid antiphylated insecticide These categories form the main headlines of the drugs to be discussed in this section. Drugs that fall into more than one category will be listed in one that reflects their dominant use. The ideal control of parasites The perfect control of parasites is based on good husband practice. Vaccination control is the second best approach because it leaves no residue in edible products and is potentially effective for animal life. However, since none of them is universally applicable, chemotherapy remains the primary means of combating parasitic infections/infection. Common mechanisms historically anti-parasitic drugs have been almost as toxic as the parasites they were designed to remove. They have triggered a set back that can erase any economic benefits resulting from the removal of parasites. They were difficult to administer. Worst of all, most of them were not very effective. Many relatively non-toxic drugs are now available because widespread screening for active compounds with low host toxicity and intentional design based on biochemical knowledge has been successful. This has led to products that exploit the differences between host and parasite regarding unique enzymes, major enzymes or pharmacological properties. The characteristics of the ideal anti-parasitic following list of characteristics of the ideal antiparasitis can provide a basis for assessing the relative strengths of each of the agents when choosing a drug for clinical use. Effective removal of parasites - they have a wide range of actions. They are active against all stages of parasite development, as well as against tissues and glowing forms. Safe to use - They have a large therapeutic index, do not discolor the body fluids or those who control them. There are no tissue residues and/or short withdrawal times. They do not interact with other drugs or environmental toxins. They are not toxic to young or old animals. Conveniently used they are effective with a single dose of treatment to minimize the cost and stress of handling animals. They have convenient dose forms that are easy to administer. In some cases, this means an oral dose form. In other cases, such as when a large number of cattle are required to be treated individually, injectable forms are oral forms. Because fasting is both a nuisance and requires sometimes difficult pre-work treatment, no fasting is required. Without cleaning is ideal because it reduces the amount of medication, the amount of treatment and and Mess. Short withdrawal times allow for faster marketing and diminished need to keep treated animals specifically defined. Low cost - the drug itself, as formulated should be inexpensive. Also, especially in situations of mass therapy, it should be inexpensive to administer. This includes labor costs and stress (which is the cost) for the animal (s) being treated. Anti-parasitic routes can be given by many routes. The ideal route depends on the number and type of animals that need to be treated and the stability and pharmacokinetics of the drug are administered. Oral administration is the most common --capsules, tablets, and bolus can be given by hand or with a balling gun. A small amount of liquid can be given with a dose of syringe. An irritating solution and a large amount of fluid require the installation of a stomach tube. Individual animals that are large or difficult to handle can be treated verbally with a tube or inserted a gun relatively easily. Long-term therapy and/or treatment of a large number of animals is facilitated by the use of feed additives. Sometimes these supplements are mixed into feed as powders and in other cases drug-soaked resin beads are used. Beads may be less likely to provide long-term contamination of the supply processing and mixing equipment. Mass and continued therapy can also be achieved by mixing drugs into mineral or salt supplements, blocks or mixtures. Finally, drinking water provides a good environment for many drugs to be used in mass therapy. Parental administration is generally not recommended. Parenteral administration includes the risk of processing syringes, needles and the introduction of infectious agents. For example, there was really nothing wrong with the injectable form of ivermectin for horses when it was properly used, but too often it is not. Thus, this form of dose has been withdrawn from the market. Sometimes, when animals are going to be running through the gutter anyway, it is convenient to inject known doses of anti-parasitic intramuscular or subcutaneous. Rarely antiparas are administered intravenously or intra-trachically. Current administration has many advantages It is relatively easy to spray large numbers of animals for ectoparasites. Especially when spraying a large number of range animals with very strong sprays, there is stress. Those who do spraying should be careful to minimize the polluting spray itself drifting in the wind or reflected off the animals. Low pressure handsprays and/or aerosols are effectively used on single animals. The dips are less comfortable in some ways that sprays, but are very effective in getting anti-parasitic on all parts of the animal. For a small number of animals, this can very wasteful, because enough drugs should be ready to immerse the whole animal. Fillings and spot-ons are comfortable and easier to manage than injectable, but animals that will be processed individually. There is concern that these highly concentrated dose forms, formulated to penetrate the skin, can be dangerous for those who inject the drug. HELP Ching Chang Wang. The basic principles of anti-parasitic chemotherapy, Ch. 55 in basic and clinical pharmacology, 2nd r., ed B.G. Katsung. Lange Medical Publications, Los Altos, California, 1984. 611-621. Mansour, tag E. 1979. Chemotherapy of parasitic worms: new biochemical strategies. Science 205 (3):462-469. GREAT REVIEW. Avermectins Am J Vet Res 44(11):2186-2187, 1983. J Neurohim 34:351-358, 1980. The main classes of common antinematotals include the following with

outstanding examples in brackets: avermectins (ivermectin), benzimidazole (mebendazole, fenbendazole), pyrimidine (pyrantel, morantel), organophosphates (dichlorvos, trichlorfon, kumafos) and imidazotiazo(Avermectins The first member of the antelmintic macrolides that would be commercially available was ivermectin. Dose molds are now available for many species. Some samples of trade names: Eqvalan, Heartgard 30, and Ivomec. Moxidectin is a macrolide that is available in other countries and could soon be sold in the US (Lynn'95). IVERMECTIN Structure Spectrum Ivermectin has one of the widest clinical anti-paris spectrum known. It includes gastrointestinal parasites such as ascarins, adult large strongyles, adult/stage 4 larvae of small strongyles, pinworms, large stomach worms, hair worms, and immature stages of stomach bots. It is also effective against parasites that end up in the skin or lungs. For example, the immature form of onhocer, which causes summer dermatitis in horses, is removed as pulmonary worms. Several parasites that live in or on the skin also suffer, such as cattle larvae, lice and ticks. Some stages of some blood-transmitted filatis, such as immature dirofilyarium imitations, are removed. The mechanism of action of Ivermectin causes tonic paralysis of peripheral musculature in nematodes and ectoparasites (ticks, ticks, insects). This is a potentiates release and action GABA. In vertebrates, such neurons and receptors are found in the central nervous system, where ivermectin reaches low concentrations. Ivermectins are ineffective in costodas and trematodes, perhaps because they lack GABA-mediated control of peripheral musculature. Although well absorbed from the gastrointestinal tract, they cross the gemoentzaric barrier badly. They are eliminated mainly in feces in animals. There is little evidence from human research. Adverse effects of ivermectins are relatively safe for species that have an approved dose form; horse, dog, cattle and pigs. They have no known teratogenic effect in these There is evidence of significant teratogenicity in mice, rats and rabbits, the species most commonly used for docionic testing. (Brown '96) In high doses, ivermectins can Signs of CNS, including lethargy, ataxia, midriasis, tremor and death. Adverse effects in horses, an injectable form that is no longer available may present signs of what could be seen with an overdose (Louisiana Study). These signs include swelling of the eyelids, fever, increased speed and depth of breathing, disorientation, signs of colic, extreme depression, and death within minutes. Death occurred in 1 horse out of 3,316 treated. DOGS, ESPECIALLY COLLIES (Boraski, 1984) have been stated to have a special sensitivity to ivermectin. Some collie strains developed severe adverse reactions with the condition of ivermectin at a dose of 100 micrograms/kg; A 16 x label dose is now recommended. At a dose of 6 micrograms/kg (approved dose) the drug is well tolerated in collies and other dog breeds (Lynn'95, p266). A single dose of PO 2 mg/kg and a dose of PO 0.5 mg/kg q1d for 14 weeks is well tolerated by dogs. Doses of more than 20 mg/kg given to laboratory dogs cause midriasis, depression, tremor, ataxia, coma and death. No teratogenic effects, where observed after giving pregnant females repeated PO dose 0.5 mg/kg. (Note: Some of these doses in this paragraph previously were mistaken because they were listed as mg/kg instead of mcg/kg. The author apologizes for this error.) There is now a special formula pill, HEARTGARD 30 (Merck) for use in preventing wormworms so there is no longer any reason for the form of the dose prepared for the form of other types of. However, since it emphasizes the basic principle of therapy, the following anecdote is worth reading. AN IVERMECTIN STORY - Below is an excerpt from a letter written by a practitioner. (Schulze 1984) . . . Recently at the suggestion of a sales representative, I gave an injection of Eqvalan heavily parasitic puppy dogs of a large mixed breed (not Collie). Approximately 0.15 cm was given deep intramuscularly (gastromemius). Otherwise, the animal appeared in good health at the presentation. Within an hour, the agitated customer returned from the seriously ill animals. It exhibited almost every conceivable sign, from prostration, ptialism, opisthotonos, nystagmus, thrashing and paddling, ristener stiffness, coma and death for another 15 minutes. It was like browsing every page of veterinary toxicology text flashing before my eyes. Forget THE LD-50s! this confused vet gave his first and last injection of ivermectin to a dog. Needless to say, I am hesitant to continue my 0.2% andvermectin oral heartworm control regimen in the same way. A certain morality can be extracted from this anecdote. First, be extremely careful when using new drugs in other types than those for which they have been specifically approved. Second, the route of administration and the formulation of the dose do matter and often species. Many studies have shown that although ivermectin ivermectin Not approved for use in cats, one-time doses of PO 0.024 mg/kg are effective against Ancylostoma braziliense and Ancylostoma tubaeforme. A dose of 0.3 mg/kg is required for toxocara cati. Doses of 0.024 mg/kg have been shown to be effective in preventing dirophilia imite adults from appearing in infected cats when given 30 to 45 days after an artificial infection. Thus, this drug and dose should be satisfactory as a heart worm prevention when given q1mo (Lynn'95). The benefits of ivermectin include its wide range of action, its effectiveness against many immature forms, and its lack of cross-resistance with other major antelminite groups, such as benzimidazole and cho destinisterase inhibitors. Many dose forms are currently available including injectable for pigs and cattle; oral paste for horses; and an oral pill for dogs. The dog tablet is designed to prevent heartworm and is given only once a month. Collie have a reputation for being particularly sensitive to the effects of ivermectin, but oral dose forms can be used in them in recommended doses. The drawbacks of the deficiencies seem to be few, but the drug is very expensive. In addition, it is still new enough that its true warts may not have been appreciated. MOXIDECTIN (CYDECTIN) Moxidectin is a new macrolide that is used in South America. Its commercial introduction to the United States is under consideration (Lynn'95). It is effective against a wide range of parasites. IM for horses: Gasterophilus bowel, Parascaris equorum, Strongylus vulgaris, Strongylus edentatus, Oxyuris equi, Habronema muscae. PO for cattle: 99% effect on adults and 4th stage Ostertagia ostertagi, Cooperia spp., Nematodirus helvetianus. Adult Trihostrengillus ... LONG LIST). PO for sheep PO for dogs: D. immitis and nematode (Ancylostoma caninum and Uncinaria stenocephala), Toxacara canis and Toxascaris leonina. Benziidazole Eight benzimidizolams are available for clinical use including: thiabendazole, mebendazole, fenbendazole, cambendazole, oxybendazole, flibendazole, oxfendazole and albendazole. In addition, there are pro-benzimiidazoly. These are prodrugs that give benzimiidazoly after biotransformation. Febantel is an example. It gives febendazole and oxphendazole after injection (Armour 1983). Less soluble derivatives, such as albendazole, fenbandzole and oxfendazole, appear to be more effective due to the increased exposure provided by prolonged dissolution in the intestines. For others especially, re-administration at small dose intervals appears to increase their effectiveness due to increased exposure (Armour 1983). The armor states that because the scar that acts as a slow place to release these drugs into the lower tract, they are more effective in luminants than other species. Representatives, such as mebendazole, have poor bioavailability, bioavailability, Minimal. In fact, they may be one of the reasons for their low toxicity. Others, such as thiabendazole, are quickly absorbed and eliminated in urine. The spectrum of benzimiidazole has such a wide range of actions that it is useless to list it. Some tapeworms and bots are resistant. There is also a difference between members to which is more effective, for example, against tapeworms or suckers than others. Mebendazole has good activity against many tapeworms. Albendazole has an activity against suckers like Fasciola hepatica. Structure -- The mechanism of action Of the Benzimidazole Mechanism is not clearly demarcated and may differ from one group member to another. Interference with microtoubal function and inhibition of helminth-specific mitochondrial fumarate system were described. Thiabendazole can have both actions. Mebendazole can only be associated with tubulin. Inhibition of fumarate reductase will prevent the parasite from producing energy. Linking to tubulin can worsen many processes. Cytoplasmic microtubules disappear in tegumentary and intestinal cells. Secret processes, such as from the Golgi machine and the release of acetylcholine, are broken. Cell glucose absorption is reduced. The micro-bubble function can be common to all of these processes. These processes do not change significantly in host cells, although the mechanism of selectivity may be a differential binding with the subunities of tubulin, this is not proven for all benzimidazoles. Adverse effects of teratogenic effects were shown for albendazole, cambendazole, oxphendazole and parbendazole. If these drugs should be used early in pregnancy, it should be for good reason and in the lowest recommended doses. Acute toxicity is extremely difficult to produce with these drugs and LD50s is almost impossible to identify for drugs such as thiabendazole and fenbendazole. They are considered safe up to 20 to 30 times the recommended dose. The earliest sign of toxicity observed in horses with mebendazole is a slight diarrhea. Cambendazole produces a peculiar reaction that led to it being removed from the market in some countries. (U.S.) Benefits of benzimidazoles include their goodness, safety and wide range. Disadvantages include increasing the resistance of parasites to this group of drugs. There is also considerable cross-resistance among the membership. Febentel Febentel Rintal is a pro-benzimiidazole that gives both fenbendazole and oxfendazole. Its range includes Strongyles, Oxyurids, and Ascarids horses. There are no known contraindications, but several types of cyathostomes are reported to be resistant. The dose should be increased to 50 mg/kg from the normally used 6 mg/kg to eliminate Strongyloides Westery from the foals. The drug has a large strength in both young and old horses, stallions, stallions, pregnant mares. It can be given with trichlorfon to control the bots. It is available as a paste and as a pendant. The Pyrimidine derivatives of Pirantel and Morantel are members of this group. The basis of the difference between them and the various forms of dose in which they are available is solubility in the gut. Oxantel belongs to the same group and is used in the human body for trichuriasis. Pyrantel is available as a pamot and tartrate derivative. Combantrin is a pamoate pamoate. Banmint, Nemex, Strongid-T and Strongid-P are examples of pyran tartat. Pirantel tartrate is quickly absorbed from the intestines. The pamoate pamoate is poorly absorbed. The salts of the pyrant are stable in solid form, but not in the solution. Because they decompose, they should be used quickly after opening. Morantel is available as a tart. Rumantel, Nemantel and Strongid are examples of moran tartrate. The mechanism of action of parasites shows spastic paralysis and, apparently, can not maintain its position. Paralysis is caused by nicotine action in the neuromuscular junction of parasites, i.e. these drugs depolarize neuromuscular blocking agents. Depolarization leads to an increase in contraction of parasitic muscles. Note that piperazine causes hypnosis, which will reduce the frequency of spikes and contractions. Thus, piperazine and pyrantel are expected to be antagonistic. Pirantel can also cause a complete neuromuscular blockage in animals if the dose is high enough. In recommended doses it is not dangerous. The Morantel spectrum is used in cattle for Haemonchus, Ostertagia, Trichostrongylus, Kuperia, Nematodirus, and Oesophagostomum. Pirantel is used in dogs, horses and pigs, for ascarids, nematodes and shining. Adverse effects No side effects were described by Theodorids, 1985. However, if the doses are increased, you would expect signs of neuromuscular blockage or other signs of nicotine action. For example, in humans, oral doses can cause transient, mild gastrointestinal signs. The antidotes to the moranel are dairy cows for which the '95 check is not approved.' The pyrantel should not be mixed with rations containing bentonite. (Bentonite is a soft, porous clay made of volcanic ash.) Precautions / comments Withdrawal time are: morantel in cattle, 14 days; pigs, 24 hours. Do not use pyrantel, morantel and levamisol together. Pyrantel is mutually antagonistic with piperazine on membrane potential, but can be used with organophosphates and some other anti-parasitic and antimicrobials. Pyrantel can be used in the presence of dirophilia imitations. It can also be used during pregnancy, breast-feeding, laundering, and men used Breeding. The benefits of Morantel are effective against adult gastrointestinal bovine parasites. Pirantel is not toxic and has a short withdrawal time of pigs. It is the only APPROVED antelminite antelminitis continuous feeding kills newly hatched A. suum larvae in the gut to prevent the appearance of milk stains on the liver of pigs. The disadvantages of Morantel are not too good against the larvae shaped cattle. Pyrantel should not be used in highly weakened animals. It can cause vomiting in sultry animals. Organophosphates The main examples of organophosphates include dichlorovo, trichlorfon and kumafos. TASK Action Mechanism: The dog Is Quicker Release Rates for Short Gastrointestinal ATGARD V Pigs Slow Release Rate for Longer Gastrointestinal Movement Value Resin Protection Drug From Hydrolysis Irreversible Inactivation of Acetylcholinesterase, which leads to excessive cholinergic activity at the relevant sites. It would be expected to reduce plasma cholinease activity to a minimum level, making the host more susceptible to other cholinemic agents and cholinesterase inhibitors. Spectrum organophosphates are effective against bots, ascarids and tapeworms. They are also used locally against insects and arachnids. Adverse side effects are discussed with a special reference to dichlorvos. Those of the other organophosphates will be very similar. The safety margin is very narrow. The drugs are safe about 2 times the recommended dose. Signs of toxicity are characteristic of acetylcholinesterase inhibitors and include evidence of excessive acetylcholine in muscari and nicotine receptors. Early signs include salivation, lacrimation, urination, shortness of breath, and bowel movements that have mnemonic SLUDD. Treatment with atropine and pralydoxim. Organophosphate compounds are very specific to targeted species, especially in flea collars and in resins intended for oral administration. For more information on why a resin formula designed for one species can be toxic or ineffective when it is given to another species, contact Roberson (JBM5th 830-831). The following is a summary of Roberson's material. Dichlorvos is formulated into resin to make a slow release of the dose form. Variations in geometry, size and formulation method (including coating or non-coating), pellets plus a number of dichloro allows the use of different diffusion rates suitable for different host animals. The task, for the dog, has smaller pellets and a faster release speed to accommodate short gastrointestinal tract. For pigs, the Atgard V has large pellets and a moderate release level for a longer tract. Pellets can contain 20% dichlorovo. Moderate release levels can result in a loss of 50-55% while passing through the pig tract within 24 hours. Generally, enough dichlorvos is eliminated in feces to be effective as for fly larvae. The two main difficulties associated with dichlorvo are overcome by pitches. First, they reduce the toxicity of volatile, toxic drugs. Secondly, they protect the drug in the automotive tank from moisture to slow hydrolytic degradation. Degradation. There are important contraindications to the use of dichlorvos. The drug should not be used for several days after the use or exposure of cholinesterase inhibitors. An important source of exposure is the regular use of these agents around the owner's premises. Dichlorovo should not be used at the same time as other antelmintics, tranquilizers, myorelaxants or modified live viruses. Drugs that may also have effects on the central nervous system, skeletal muscles, and/or muscarial receptors can increase dichlorovo toxicity. Presumably, live viral vaccines act as stressors that can exacerbate toxicity. Dichlorvos should not be used in animals with diarrhea or severe constipation or intestinal blockage. Puppies and kittens weighing less than 1 pound and less than 10 days have no good risks. Dogs with heartworms should not be treated. The advantage of dichlorvos is that it is inexpensive and effective against bots. Other organophosphates share these properties. The downside is the low therapeutic index. Levamizole (Imidazothiazole derivatives) Levamizole is a left-rotator form of tetramyzole. Dextro isomer contributes to toxicity but not therapeutic effect, so it has been removed in the on-market drugs. Levamizole restores the immune function mediated by cells in peripheral T-lymphocytes and stimulates phagocytosis in monocytes. the structure of the Levamisol Action Mechanism causes nicotine stimulation of ganglia and CNS in susceptible worms. Parasites seem to be much more sensitive to these effects than the host. Parasites are paralyzed and banished alive. At higher concentrations, levamizole interferes with non-automodal carbohydrate metabolism, where it blocks fumarate reconsider and succinate oxidase. The Levamisol spectrum has a wide range of activities against many intestinal roundworms, pulmonary worms and microfilariae D. immitis. Adverse effects of levamisol are safe, i.e. do not cause serious problems at 5-time recommended dose. Adverse effects of levamisol include signs of CNS and parasympathetic ganglion stimulation. In 2-3 times the recommended dose, cattle lick their lips, salivate, and shake their heads. In higher doses, you can see excitement, tremor, and death. The advantage of levamisol is that it has a filling and injectable dose form and affects the licinopole stages found in the tissues. It is also well known for its ability to boost immune function in animals with a certain deficiency. This doesn't seem to boost a fully functional immune system. The disadvantages of levamisol deficiencies include the adverse effects noted above. Butamizole (Imidazothiazole derivatives) Butamizole is associated with levamisol. Supplied in propylene glycol, a benzyl alcohol base for subcutaneous injections. Drugs containing butamizole Styquin. Spectrum Spectrum Spectrum include whipworms and nematodes. Side effects of the drug is free from serious side effects up to 3-time recommended dose. Since dosing is important, it is recommended to use 1.0 ml syringes in the treatment of animals weighing less than 10 pounds. Adverse effects include pain during injections, sterile abscess or gray formation after injection, and transient listlessness. Contradictions Unlike its relative levamisol, there are important contraindications to the use of butamizole, indicating its greater toxicity. Butamizole is not suitable for seriously ill or weakened animals; animals with renal or liver disease; animals treated with bunamidine (Scoloban); and animals with heart worm infection. Bunamidine apparently increases the toxicity of butamisol because there have been reports of deaths when drugs have been used simultaneously. The benefits of butamisole are its effectiveness and, although not without toxicity, it is safer than some of the alternatives. You don't need a fast to use butamisol. This does not appear to have a negative effect on reproduction. It is safe during pregnancy and does not affect male fertilization. Butamizole can also be safely used with phenothiazine tranquilizers (e.g. chlorpromazine) and organophosphate products. The disadvantages of Butamisol cannot be used in weakened animals or animals with renal or liver disease. The range of his activities is limited, mainly involving adult nematodes. Over-The-Counter Anthelmintics Many worms are available in your corner drug or pet store without prespcription. Veterinarians should be generally familiar with these less effective products because many customers will know them well. Typically, these are older drugs that have significant drawbacks compared to new drugs released recently. n-Butyl chloride This drug that is present in many comercial drugs is given orally to dogs and cats after 18-24 hours quickly for ascarids and some effect on nematodes. It should be followed with a cleansing 1 hour after treatment. The animal can be fed within 4-8 hours after treatment. Sometimes the animal may vomit, but otherwise it is relatively safe. Препарат HIGHLY FLAMMABLE. Toluol (!yes!) toluol is present in May commercial preparations. It is flammable, i.e. it burns. It comes in gelatin capsules. The adverse effects of toluene are safe for mammals on an acute basis, but in the long term, re-exposure to any aromatic hydrocarbons is impractical. Overdose produces temporary inconsistencies, muscle tremors, vomiting, and central nervous system depression. Theodorids 1985. Treatment of toxicity caused by toluene involves warm water gavage (flash stomach through the mouth with mineral oil, and oxygen therapy. The use of digestible oils, alcohol and epinephrine as an emergency treatment should be avoided. Toluol will split on on solvent-based. Since mineral oil is not digested or absorbed, this is tantamount to elimination. Assimilated oils, however, will release tol as they are digested, allowing it to be absorbed as well. Using/commentary Toluola is inconvenient to use because it should quickly animal 12 hours before and 4 hours after treatment. Toluol is used to remove ascarids and nematodes of dogs and cats. It has some activity against whips, such as Trichuris vulpis. 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Lynn'95 - P248 - Fenoxycarb - marketed as BASUS for veterinarians to control fleas; LOGIC as FIRE ants control TORUS for cockroaches managing Lynn'95 ON insecticides Federal Environmental Pesticide Control Act 1972 (FEPCA). FePCA is administered by the EPA control of the distribution, sale and use of pesticides in U.S. governments may establish stricter controls. . National Toxic Control Center -- Reinmeier, C.R., Faulkner, C.T., Assadi-Rad, A.M., Burr, J.H., and Patton, S. 1995. Comparing the effectiveness of three prophylactic worms against experimentally induced infections with caninum and toxocar kanis in puppies. JAVMA 206 (11): 1710-1715. Not cited in these notes yet. Just added a link 5/31/95. added to the anti-drug group's anti-drug unit top Gordon L. Coppoc, DVM, Ph.D. Professor of Veterinary Pharmacology Head, Department of Fundamental Medical Sciences, Purdue School of Veterinary Medicine, University of West Lafayette, IN 47907-1246 Tel:317-494-8633Fax: 317-494-0781 Email: coppoc@vet.purdue.edu Last changed 8/8/96 GLC GLC antiparasitic drugs mechanism of action pdf