Phish-Pharm: A Searchable Database of Pharmacokinetics Data in Aquatic Animals

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Abstract

The growth of the global aquaculture industry has created important issues involving drugs for farmed aquatic species, including approval of new drugs and surveillance for illegal drug residues in farmed seafood. In order to protect human and animal health, FDA evaluates the safety and effectiveness of new veterinary drugs for aquatic species, determines safe drug tolerance levels in seafood, and monitors for drug residues in human and animal food. These activities require FDA scientists to evaluate drug pharmacokinetics (PK), the movement of a drug in the body, and drug pharmacodynamics, how the drug affects the body or target organism. Readily accessible information on these parameters in aquacultured species is therefore needed by FDA as well as researchers and veterinarians outside the agency.

To address this need, the FDA's Center for Veterinary Medicine (CVM), Office of Research has developed, and regularly updates, a database called Phish-Pharm detailing physiological and physical parameters for a variety of aquatic species. Users search for information using eight fields: drug/chemical, drug class, common name, genus and species, route of administration, sample analyzed, author's names, and water type. Additional data fields include metabolites, depletion time, elimination half-life (t ½), water temperature, average animal weight, dosage, protein binding, clearance, volume of distribution in a central compartment (Vc), or volume of distribution at steady state (Vd), a comments section, and additional fields listing citation, authors, title, method of analysis, and internet links. This publicly available database contains information from over 600 publications and 175 aquatic species for a variety of drugs. A 2021 update is forthcoming and will include new articles, an improved graphic user interface, additional search fields, and a missing article submission button for users to suggest articles. The most recent published version is available at: www.fda.gov/AnimalVeterinary/ScienceResearch/ToolsResources/Phish-Pharm/default.htm

Introduction

Regulating drug use in aquaculture is challenging due to the diversity of farmed species, farming environments, and animal life-stages where pharmaceutical compounds are used. While there is a growing amount of new literature, the information regarding pharmacokinetic parameters and depletion of drug residues in farmed aquatic species is still relatively incomplete, especially when compared to commonly farmed terrestrial species. Therefore, the FDA Phish-Pharm database was developed to consolidate available literature. The first version of the FDA Phish-Pharm literature database was released in 2005 and the current version online was released in 2014. A new update is currently underway and is expected to be released in 2021.

The FDA literature Phish-Pharm database is available as a free to download Microsoft Access database. The database provides limited PK data so users can quickly evaluate papers for relevant information. Aquatic species represented in the database include commonly farmed finfish species (e.g., trout, salmon, catfish, tilapia), commonly farmed invertebrate species such as marine shrimp and crabs, less commonly farmed species such as crocodiles and turtles, and species studied for other academic purposes (e.g., zebrafish, fathead minnow).

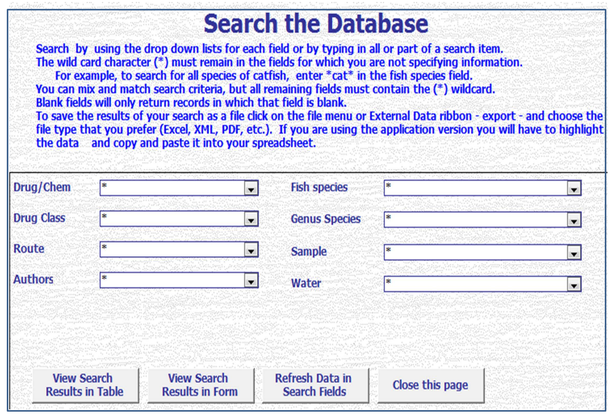

Figure 1. Searchable database where criteria can be selected.

Using the Database

Scientific literature is mined for pharmacokinetic research and articles currently not included in the database.

Sortable fields of information:

1. Articles
   a. author(s)
   b. year of publication
   c. citation and web links to abstracts (if available)

2. Experimental animals and holding conditions
   a. species common name
   b. species scientific name
   c. average water temperature(s)
   d. average animal weight
   e. type of sample analyzed

3. Drug/chemical and pharmacokinetic parameters
   a. drug name
   b. drug class
   c. dosage
   e. route of administration
   f. method of analysis
   g. protein binding
   h. clearance
   i. volume of distribution in a central compartment (Vc) or volume of distribution at steady-state (Vd)
   j. drug depletion half-lives (t1/2 β)

Examples of Graphs Generated Using the Database

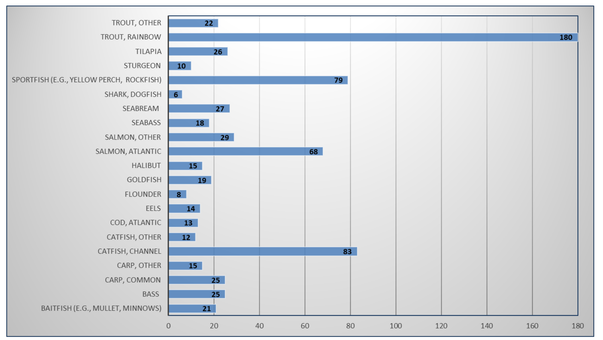

Figure 2. The number of articles in the database sorted for select fish species

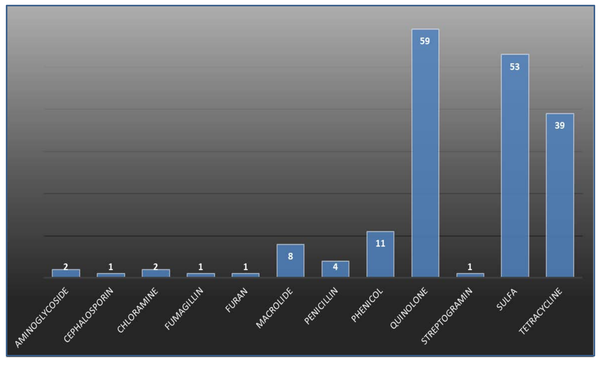

Figure 3. Database results filtered for number of articles on different antibiotic drug classes studied in salmonids

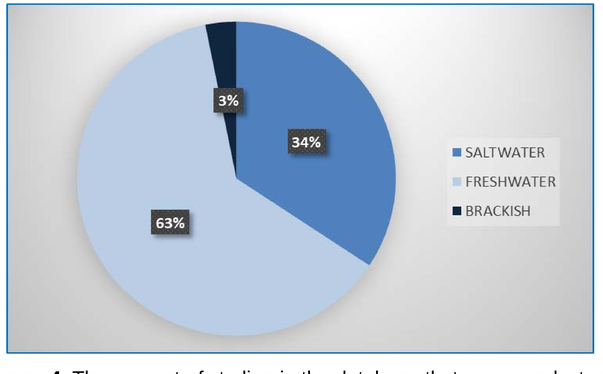

Figure 4. The percent of studies in the database that were conducted in saltwater (n=219), freshwater (n=399), or brackish water (n=20)

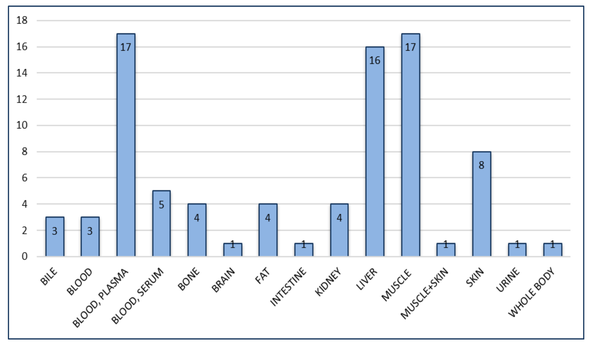

Figure 5. Number of quinolone drug class entries by sample type in Atlantic salmon in 34 unique articles in database

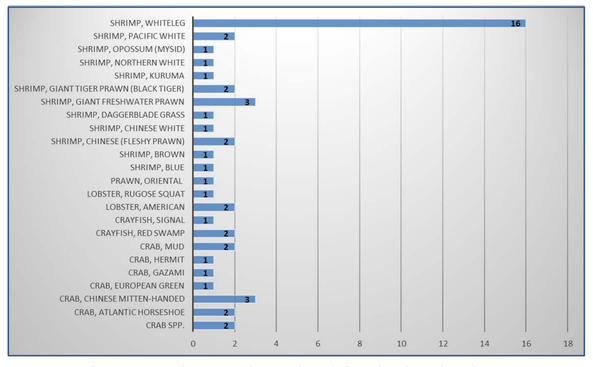

Figure 6. The number of articles in the database sorted for crustaceans

Discussion

The growth of global aquaculture highlights important issues surrounding availability of drugs for farmed aquatic species. To aid FDA scientists and other scientists in academia, private industry, and other government agencies in searching drug PK in aquatic animals, we developed a database detailing PK parameters for a variety of aquatic species and drugs with information from over 600 publications and 175 species.

Because there is a lack of robust pharmacokinetic information, the FDA Phish-Pharm literature database is a useful tool for government, academia, and private organizations involved in aquatic drug research by consolidating published literature on drug metabolism and depletion. The database summarizes certain physiological and physical parameters that can be used by FDA scientists as supplemental information when evaluating safety and effectiveness of new veterinary drugs for aquatic species, determining safe drug tolerance levels in seafood, and monitoring for drug residues in human and animal food for known drugs in new aquatic species or different life-stages.